

Racial microaggressions in higher education: perceptions and experiences of STEM students at the Federal University of Alfenas

Microagresiones raciales en la educación superior: percepciones y experiencias de estudiantes de ciencias exactas de la Universidad Federal de Alfenas

Microagressions raciales dans l'enseignement supérieur : perceptions et expériences des étudiants en sciences exactes de l'Université Fédérale de Alfenas

Microagressões raciais no ensino superior: percepções e experiências de estudantes das ciências exatas na Universidade Federal de Alfenas

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Abstract

Racial microaggressions are manifested in interpersonal relationships resulting from structural racism. They can be understood as subtle and nebulous forms of verbal, non-verbal, or visual insult directed at people based on their race, often done automatically or unintentionally by the aggressors, but which negatively impact the lives of those who experience them. In mathematics education research, few works have problematized how Black students in Science, Technology, Engineering, and Mathematics (STEM) programs have experienced racial microaggressions throughout their academic trajectory. In this study, we present the research results in which we sought to fill this gap by identifying students' experiences in STEM programs with racial microaggressions in their university careers. The study included STEM students at the Federal University of Alfenas (n=390). They answered the Scale of Academic, Social, and Survival Experiences in STEM (EASS-STEM). The results indicate that students between the ages of 20 and 30 more clearly identify aspects related to racial microaggressions. Additionally, Black students are those who experience racial microaggressions more intensely, even with scores

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higher than *Pardo* students, who also make up the group of Black students in Brazil. This shows that skin color is directly related to experiences with racism and racial microaggressions faced by students in these programs. The results also demonstrate that, despite overcoming the access barrier, Black affirmative-action students must endure the challenge of surviving academically due to the structural violence they experience during their academic careers.

Keywords: Microaggressions, Racism, STEM programs, Mathematics education.

Resumen

Las microagresiones raciales se manifiestan en las relaciones interpersonales como una de las consecuencias del racismo estructural. Pueden entenderse como formas sutiles y veladas de insulto verbal, no verbal o visual, dirigidas a personas en función de su raza, muchas veces realizadas de forma automática o intencionada por los agresores, pero que repercuten negativamente en la vida de quienes las experimentan. En la investigación en educación matemática, pocos trabajos han problematizado la forma en que estudiantes negros de cursos de ciencias exactas han experimentado prácticas de microagresiones raciales a lo largo de su trayectoria académica. En este trabajo presentamos resultados de una investigación en la que buscamos llenar este vacío identificando las experiencias de estudiantes de cursos de educación superior en el área de ciencias exactas con microagresiones raciales en su carrera universitaria. Participaron en el estudio estudiantes matriculados en cursos de educación superior en el área de Ciencias Exactas de la Universidad Federal de Alfenas (n=390) que respondieron un instrumento denominado Escala de Experiencias Académicas, Sociales y de Supervivencia en Ciencias Exactas (EASS-Exactas). Los resultados indican que los estudiantes entre 20 y 30 años identifican con mayor claridad aspectos relacionados con las microagresiones raciales. Además, los estudiantes autodeclarados negros son los que experimentan con mayor intensidad las microagresiones raciales, incluso con puntajes superiores a los estudiantes auto declarados *pardos*, que también componen el grupo de estudiantes negros en Brasil. Esto demuestra que el color de la piel está directamente relacionado con las experiencias de racismo y microagresiones raciales vividas por los alumnos de estos cursos. Los resultados también muestran que, aun superando la barrera de acceso, los estudiantes de cuota negra y negra continúan enfrentando el desafío de sobrevivir académicamente debido a la violencia estructural que experimentan durante su carrera académica.

Palabras clave: Microagresiones, Racismo, Ciencias exactas, Educación matemática

Résumé

Les microagressions raciales se manifestent dans les relations intersubjectives comme l'une des conséquences du racisme structurel. Elles peuvent être comprises comme des formes subtiles et voilées d'insultes verbales, non verbales ou visuelles, dirigées contre des personnes en raison de leur race, souvent faites automatiquement ou intentionnellement par les agresseurs, mais qui ont un impact négatif sur la vie de ceux qui les subissent. Dans les recherches en didactique des mathématiques, peu de travaux ont problématisé la manière dont les étudiants noirs des filières des sciences exactes ont vécu des pratiques de microagressions raciales tout au long de leur parcours scolaire. Dans ce travail, nous présentons les résultats d'une recherche dans laquelle nous avons cherché à combler cette lacune en identifiant les expériences des étudiants des filières de l'enseignement supérieur dans le domaine des sciences exactes avec des microagressions raciales dans leur parcours universitaire. L'étude a inclus des étudiants inscrits dans des cours d'enseignement supérieur dans le domaine des sciences exactes à l'Université fédérale d'Alfenas (n = 390) qui ont répondu à un instrument appelé l'échelle des expériences académiques, sociales et de survie en sciences exactes (EASS-Exact). Les résultats indiquent que les étudiants âgés de 20 à 30 ans identifient plus clairement les aspects liés aux microagressions raciales. De plus, les étudiants noirs autodéclarés sont ceux qui subissent les microagressions raciales le plus intensément, même avec des scores supérieurs aux étudiants *Pardo*, qui constituent également le groupe des étudiants noirs au Brésil. Cela montre que la couleur de la peau est directement liée aux expériences de racisme et aux microagressions raciales vécues par les étudiants de ces filières. Les résultats montrent également que, même en surmontant la barrière d'accès, les étudiants noirs et les étudiants du quota noir continuent de faire face au défi de survivre académiquement en raison de la violence structurelle qu'ils subissent au cours de leur carrière universitaire.

Mots-clés: Microagressions, Racisme, Sciences exactes, Didactique des mathématiques

Resumo

Microagressões raciais manifestam-se em relações interpessoais como uma das consequências do racismo estrutural. Elas podem ser entendidas como formas veladas de insultos verbais, não verbais ou visuais, direcionadas a pessoas com base em sua raça, feitas de forma intencional ou não pelos agressores, mas que causam um impacto negativo na vida daqueles que as vivenciam. Na pesquisa em educação matemática, poucos trabalhos têm problematizado a forma como estudantes negros e negras de cursos da área das ciências exatas têm vivenciado práticas de microagressões raciais ao longo de sua trajetória acadêmica. Neste artigo, apresentamos os

resultados de uma pesquisa³ em que buscamos preencher essa lacuna ao identificar as experiências de estudantes de cursos superiores da área de ciências exatas com microagressões raciais em seu percurso universitário. Participaram deste estudo estudantes matriculados em cursos superiores da área de ciências exatas da Universidade Federal de Alfenas (n=390) que responderam a um instrumento denominado Escala de Experiências Acadêmicas, Sociais e de Sobrevivência no âmbito das Exatas (EASS-Exatas). Os resultados indicam que estudantes com idade entre 20 e 30 anos identificam com maior clareza aspectos relacionados às microagressões raciais. Além disso, estudantes autodeclarados pretos e pretas são aqueles que vivenciam de forma mais intensa as microagressões raciais, inclusive com *scores* acima dos/das estudantes autodeclarados pardos(as), que também compõem o grupo de estudantes negros no Brasil. Isso evidencia que a cor da pele está diretamente relacionada às experiências com racismo e com microagressões raciais vivenciadas por estudantes destes cursos. Os resultados também evidenciam que, mesmo vencendo a barreira do acesso, estudantes cotistas negros e negras continuam enfrentando o desafio de sobreviver academicamente devido a violência estrutural que vivenciam durante sua trajetória acadêmica.

Palavras-chave: Microagressões, Racismo, Ciências exatas, Educação matemática.

³ This study is an excerpt of a master's degree research (Lopes, 2022). Some results were also presented at the 12th Mathematics Society Education Conference, whose proceedings were published in Lopes and Silva (2023).

Racial microaggressions in higher education: Perceptions and experiences of STEM students at the Federal University of Alfenas

For decades in Brazil, the Black population has been excluded from different sectors of society, including the school context. Specifically in higher education, this marginalization has been even more conspicuous. Since the 2000s, with the demands of social groups and the Black Movement, Brazilian universities began to adopt affirmative action policies aimed mainly at the Black population and other historically discriminated groups (Passos, 2015). Affirmative actions are policies associated with the development of principles aimed at fighting discrimination through the promotion of differentiated norms and criteria so that individuals belonging to specific groups -generally marked by exclusion in the recent past- can access different sectors of society, with an ideal of equity as a backdrop (Silva, 2017).

In 2012, the Brazilian Federal Supreme Court considered the use of affirmative actions in higher education constitutional, which led to the approval of Law No. 12,711, the Quota Law (Brasil, 2012). This law mandates that federal public higher education institutions reserve at least half of the places in selection processes per shift and per course for students who completed high school in public schools, respecting social and racial aspects. After the law sanctioning, several state public universities adopted similar policies. Affirmative actions, such as the Quota Law, have contributed to Black students accessing prestigious programs and traditional Brazilian public institutions, which has changed the racial profile of these universities (Lopes, Silva, & Ferreira, 2021).

In mathematics education, some research has problematized the implications of affirmative action in higher education, especially when related to academic and social factors that interfere with the retention of students who benefit from these policies. For example, Silva and Powell (2016) and Silva and Skovsmose (2019) discuss issues related to race and racism in the university context, exposing questions specifically related to higher education courses in which mathematics is a central subject. Historically, these spaces are built along the lines of whiteness⁴, showing to be elitist and predominantly male, in which Black students only in recent decades have occupied some space. In this sense, such studies research and discuss how students who benefit from affirmative action are affected by racism and issues related to

⁴ Whiteness is not necessarily about skin color, but it is a concept that articulates and materializes the universal white place and subject with the privileges that benefit all members of this collective (Pinheiro, 2023).

material and academic survival in higher education and how this affects the permanence of historically marginalized groups in the university.

In this direction, Lopes and Silva (2022) addressed the impact of affirmative action in the Science, Technology, Engineering, and Mathematics (STEM) programs and discussed promoting racial diversity through the Quota Law in higher education. The results highlight the underoccupancy of vacancies allocated to students benefiting from affirmative action who are self-declared Black, mixed race, and indigenous, becoming more pronounced when associated with the income factor. The study also highlights the importance of the Quota Law for racial diversity at universities, promoting access to higher education for a more significant number of students belonging to historically marginalized groups.

In line with this, Silva (2016) argues that affirmative action requires developing specific educational proposals, pointing out possibilities for engaging mathematics education in entry, retention, and post-education dimensions. It points out that, in STEM programs, social and academic isolation tends to be more intense in the trajectory of Black students when compared to other students. Furthermore, among the factors that go beyond pedagogical issues and influence post-admission are the experiences with racism that such students face in their routine at university, often manifested in the form of racial microaggressions (Santos, 2009; Silva & Powell, 2016). Racial microaggressions are manifested in interpersonal relationships as one of the consequences of structural racism in Brazilian society (Almeida, 2019) and are understood as more or less subtle and veiled forms of verbal, visual, or attitudinal insults, directed at people based on their race, gender, ethnicity, social class, language, religion, among others, made intentionally or unintentionally by the aggressors, but capable of having a profound impact on the lives of those attacked (Silva & Powell, 2016).

Racial microaggressions “express an evolved form of racism, as more aggressive and systemic forms of racism are no longer socially acceptable as in the past” (Silva & Powell, 2016, p. 45). The prefix micro refers to the local context where the attacks occur, generally where they are regulars, for example, their workplace, the supermarket, gym, stores, the classroom, or the university environment. In Brazil, the false discourse of “openness to racial diversity” confers racial microaggressions as an even more perverse characteristic, as political and social agent discourses often try to impose a fictitious idea of the non-existence of racism, especially in interpersonal relationships. The indirect nature of racial microaggressions in

Brazil is generally anchored in racist stances and attitudes, translated into the privileges of whiteness, which white people usually do not see or admit to exist.

In the academic scenario, the negative impact of racial microaggressions on students' lives has led to them abandoning subjects and even dropping out of undergraduate courses, as it affects their sense of belonging to the university (Silva, 2016). Furthermore, it negatively impacts students' academic performance, retention, and progress in higher education programs (Silva & Powell, 2016; Silva Júnior, 2023). Consequently, social and academic integration is affected by constant experiences of racial microaggressions, which can lead to dropout, change of course and university, and, sometimes, definitive withdrawal from higher education (Solórzano, Ceja, & Yosso, 2000).

Notably, in Brazilian Mathematics Education, few studies problematize the impact of racial microaggressions in different learning environments. Therefore, in this work, we present the research results in which we sought to identify students' experiences in the STEM programs concerning their social and academic integration and other factors that interrelate with this integration, such as experiences with racial microaggressions. In this article, we discuss results related to the influence of racial microaggressions in this integration.

Theoretical Framework

According to Bonilla-Silva (2015), racism must be understood, studied, and analyzed from a racialized view of society. For him, although they are social constructions, race is socially real and operates in our daily lives and different situations and spaces. Bonilla-Silva (2015) highlights that after racial stratification is established in a society, races are configured as independent criteria on the vertical social hierarchy, causing social positions of subordination and superordination to be experienced by different groups. This means that after establishing social racialization, social relations and practices based on racial distinctions are developed at all levels of society.

To Bonilla-Silva (2015), then, racism must be understood from the point of view of a racialized society. In other words, racism is a product of projects of social domination, such as colonialism, slavery, and labor migration, among others. Once this social organization emerges in human history, it becomes embedded in society. Bonilla-Silva's (2015) ideas encourage us to overcome simplistic notions about racism and to understand it as a phenomenon beyond the individual and institutional spheres, being a "normal" consequence of how political, economic,

legal, and family systems are constituted (Silva & Skovsmose, 2019). In other words, it allows us to understand racism as a structural element of society (Almeida, 2019).

In Mathematics Education, race and racism are still subjects little explored in academic research and the development of pedagogical practices, especially in the Brazilian scenario. Martin (2013) says that when addressed, race and racism have been used more to reinforce stereotypes about Black people than to problematize their impact on these people's mathematical learning experiences. Martin (2013) points out that research in Mathematics Education has rarely focused on racism in its analyses or even clearly theorized its perverse influence in the contexts of mathematics teaching and learning. Particularly in higher education in STEM, the obstacles Black students endure are even more serious. Apparently, there is a lack of attention regarding the privileges of whiteness in this area, causing racism to gain an even more neutral and invisible status, favoring mathematics to be seen as a racialized space (Battey & Leyva, 2016).

Racial microaggressions, as we have already mentioned, are manifested in interpersonal relationships because of structural racism. They can be divided into *microinsults*, *microinvalidations*, and *microattacks*. Microinsults involve communications that convey rudeness and lack of sensitivity, belittling an individual's racial identity (Sue et al., 2007). Commonly, the aggressor is unaware that he is committing microinsults. In Brazil, this happens because our society has been shaped throughout its history by structural racism. These aggressions include assuming that a Black person in a restaurant is an employee and not a customer or even that a Black student entered the university due to racial quotas, even if this did not actually occur. Thus, microinsults represent an overlap of races in which white superiority over other ethnic-racial groups is assumed.

Microinvalidations highlight intentional or unintentional communications that exclude or nullify an individual's reality based on racial and cultural criteria. An example of a microinvalidation is when we question why a Black person has command of the cultured norms of a language or when a Black person is demanded not to be sensitive to racism, claiming that they must be strong, nullifying the importance of the racial aspect in the individual's experience (Sue et al., 2007).

Microattacks highlight the most explicit aspect of racial microaggressions. It can occur verbally or non-verbally, marked by prejudiced actions carried out intentionally. Examples

include offensive nicknames based on physical characteristics, accusing the person of being a criminal because of their race, and physically attacking the individual because of the color of their skin, among others (Sue et al., 2007).

In Brazilian higher education, microaggressions have led to Black people's exclusion, especially after the increasing number of these groups in universities resulting from the implementation of the Quota Law and other affirmative actions (Silva, 2016). Studies such as Solórzano, Ceja, and Yosso (2000) indicate that racial microaggressions negatively affect the racial climate in universities. These authors highlight that racial microaggressions are present in the academic and social spaces of the three mostly white American universities. In those environments, Black students experienced prejudice, invisibility, and exclusion. Solórzano, Ceja, and Yosso (2000) underscore, among other factors, that such students were questioned about their level of intelligence and, at times, felt that their presence on campus was unwanted and bothered other groups of students.

On the university campus, experiences with racial microaggressions are presented in a nebulous and veiled way but always linked to racial stereotypes. In some cases, some particularities, or limitations, of a small number of students are used as justification to discriminate against Black students. And when these particularities are positive, such as better performance in subjects, those students are considered rare cases of success within the racial group, with a pejorative perception of white students about their colleagues.

Experiences with racial microaggressions are presented in a more explicit and direct way outside the university campus. Black students usually identify situations and protocols to be followed in social events and other environments that are not requested from white students. In this sense, racial stereotypes are an obstacle to remaining at university because they force Black students to deal daily with racial conflicts and microaggressions on and outside the campus. Additionally, bullying and racism affect other factors. In response to the insults, several students abandon their courses or look for other universities with greater Black representation. Besides, when they stay in these environments, racial microaggressions lead to dropping out of subjects, changing courses, and, in several cases, abandoning their religious and personal beliefs (Solórzano, Ceja, & Yosso, 2000).

Lee et al. (2020) highlight the presence of racial microaggressions in the STEM programs. They state that the racial climate on the university campus directly influences the

number of Black and Latin American students at American universities. Moreover, the low number of Black students on university campuses is sometimes wrongly associated with their personal characteristics, intelligence, or mathematical performance. Something similar was found by Silva Júnior e Silva (2023) in the Brazilian context.

As strategies to combat microaggressions and racism in higher education, students often create social and academic “counterspaces”, where they can establish a positive racial climate (Solórzano, Ceja, & Yosso, 2000). These counterspaces usually occur in student organizations and ethnic or religious groups, among other spaces, which may include the collaboration of professors and university employees. In addition to racial issues, counterspaces are safe spaces for students belonging to underrepresented groups and can be aimed at gender issues.

Ong, Smith, and Ko (2018) showed that counterspaces were essential for Black women’s adherence to STEM courses in a US context, as they positively influenced their sense of belonging, fought invisibility and social and academic isolation they experienced. In Brazil, we can cite as examples of counterspaces in the university context the Centers for Afro-Brazilian Studies (Núcleos de Estudos Afro-Brasileiros - NEABs) and the Centers for Afro-Brazilian and Indigenous Studies (Núcleos de Estudos Afro-Brasileiros e Indígenas - NEABIs) existing in many higher education institutions. In these spaces, students often find support they do not feel within their courses and academic departments (Silva, 2016).

Given this scenario, we consider that mathematics education can discuss the implications of racial microaggressions in higher education. The STEM programs, particularly, can be a space in which discussions about racism do not take place. Martin (2013) points out that this area is not exempt from the ideologies present in most social contexts. Furthermore, the hard sciences, an area where mathematics has an important influence, can be considered a racialized space in which the social construction of whiteness is maintained with the existence of “unfair learning opportunities, as well as feelings and experiences of academic delegitimization experienced by historically excluded Black students” (Battey & Leyva, 2016, p. 71, free translation).

Methodology

To understand how racial microaggressions can influence the social and academic integration of students in science courses, we developed a scale to measure academic, social, and survival experiences in STEM programs called *Escala de Experiências Acadêmicas*,

Sociais e de Sobrevivência no âmbito das Exatas – EASS-EXATAS. The EASS-EXATAS⁵ was constructed and refined through previous applications, in which we found favorable evidence of statistical validity. It has 75 objective questions, with a Likert scale as an answer key (1 = strongly disagree and 5 = strongly agree), which meets the precision criteria for statistical data, based on the calculation of a questionnaire quality estimator called Cronbach's alpha (= 0.7). The questions were arranged in six blocks: Preparation, Social integration, Academic Integration, Negative experiences with Mathematics, Sense of Belonging, and Microaggressions. In this text, we discuss the results of the Microaggressions block.

The instrument was applied online during the 2020 academic year. The target audience for the research was students⁶ enrolled in courses in the STEM area at the Federal University of Alfenas (UNIFAL-MG), a century-old institution, located in the south of the state of Minas Gerais. Initially called School of Pharmacy and Dentistry of Alfenas (Escola de Farmácia e Odontologia de Alfenas - EFOA), it became a university in 2005 through the Restructuring and Expansion of Federal Universities (Reestruturação e Expansão das Universidades Federais - REUNI) program, adopting the name Universidade Federal Alfenas. It has an annual enrollment of around 1,500 students, in undergraduate and postgraduate courses in all areas of knowledge.

EASS-EXATAS received 534 replies. As the focus of this research was on undergraduate STEM programs at UNIFAL-MG, respondents from other higher education institutions (77), postgraduate students (33), and students who entered the university without the use of the Unified Selection System (Sistema de Seleção Unificada - SiSU) (10), which is the main form of entry based on the UNIFAL-MG Notice. Furthermore, we disregarded seven students who stated they were not interested in participating in the research and 11 others, who were under 18.

Aiming to inhibit technical problems and incoherent responses, we used items to control responses in all instrument blocks. As a result, we identified that some respondents did not pay attention to these items, excluding six other students. After this adjustment stage, data from 390 students who fully answered the closed questionnaire remained. The final sample corresponded to 74% of the initial sample.

The answers were organized in electronic spreadsheets and subsequently underwent descriptive analyses characterizing the sample based on the aspects studied, in addition to

⁵ The research instrument is found in Appendix B by Lopes (2022).

⁶ Students enrolled in the 17 undergraduate courses in the STEM area of UNIFAL-MG were invited, and all respondents signed an Informed Consent Form (ICF) indicating their agreement or disagreement with participating in the study.

regression and variance analyses. Initially, based on the answers in the six blocks of the instrument, we constructed a matrix containing Spearman correlations to identify possible significant correlations between the variables. Based on moderate and strong correlations (above 0.5), we verified the association between the blocks and the variables. To this end, we analyzed the correlation significance test and the chi-square test (χ^2). These tests determine whether variables are correlated and dependent on each other, respectively.

We performed the correspondence analysis in cases where we identified correlated and dependent variables (Mingoti, 2007). Specifically, the Spearman rank correlation coefficient can estimate linear correlations in categorical variables and cases with no joint normality for two variables. The independence test using the chi-square method verifies whether the observed absolute frequency of the studied variable significantly differs from the expected absolute frequency distribution (Siegel & Castellan Júnior, 2017). We also used the principal components analysis (PCA), a data reduction method, to visualize the association between variables in the same block. It is a multivariate analysis technique that can be used to analyze relationships between a significant number of variables, making it possible to explain such variables based on their inherent dimensions (Ferreira, 2018).

In this study, we chose the PCA over other types of analysis due to the possibility of reducing variable information to a smaller set of statistical variables, maintaining the quality of information for analysis. This analysis was performed for different groups of variables based on the correlation matrix⁷. All analyses in this study were carried out using the R software, version 4.0.4, and we also adopted a significance level of 5%.

Regarding sample characterization, the respondents' average age was 23.7 years (standard deviation = 5.21). There was a predominance of students aged 20 to 24, making up 51.54%. Regarding gender, the sample was composed of 219 female students and 171 male students. Regarding racial self-declaration, we identified 252 white, 103 *Pardo*⁸, 31 Black, and four Asian (4) students. The number of Black and *Pardo* students was lower than that of white students.

Results and Discussion

In the block called Racial Microaggressions, we analyzed the extent to which students from STEM programs at UNIFAL-MG perceived and experienced racial microaggressions in

⁸ In Brazil, Black people is composed by *Pretos* (Black) and *Pardos* (mixed race) people.

their university context. The p-values for the Spearman correlation and chi-square test related to the Racial Microaggressions block are shown in Table 1.

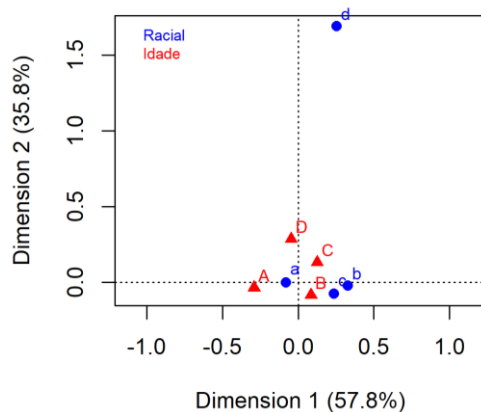
Table 1.

Variables correlated with the Racial Microaggressions block with mathematics and p-values for the Spearman correlation and chi-square test.

Variable	p-value for correlation*	p-value of X ²
Sex	0.5587	0.0939
Age	0.0853	0,0245
Type of Entry (A0 or Quotas)	----	0.9113
Quotas	----	0.7995
Racial Self-Declaration	----	< 0,001

* For categorical variables, we do not calculate the p-value for the correlation.

Based on Table 1, the chi-square test shows insufficient evidence to justify the existence of a dependence between the variables Sex, Type of Entry and Quotas, and the Racial Microaggressions variable. The Entry Type variable refers to how the student entered the university, that is, through Broad Competition (General Competition) or Quotas, according to the Quota Law. The entry quota refers to the affirmative action used for admission, i.e., whether the student used a quota that considers social, racial aspects, or both. Our results thus indicate that the level of experiences related to racial microaggressions does not depend on the students' gender, type of entry or entry quota. The correlation significance test allows us to state that the variables Age and Racial Microaggressions are dependent (p-value = 0.0245), as well as the variables Racial Self-Declaration and Racial Microaggressions (p-value < 0.001). To understand this scenario, we highlight the correspondence analysis between the variables for each case. Initially, we present the correspondence analysis between the variables Racial Microaggressions and Age in Figure 1:



Caption:

- A – Age between 18 and 20 years old.
- B – Age between 20 and 25 years old.
- C – Age between 25 and 30 years old.
- D – Age over 30 years old
- a – Score less than 2.
- b – Score between 2 and 3.
- c – Score between 3 and 4.
- d – Score between 4 and 5.

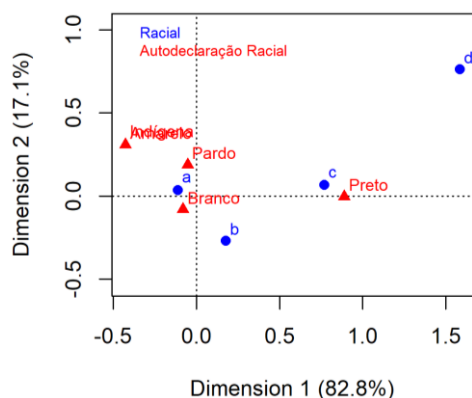
Figure 1.

Correspondence analysis between the variables Racial Microaggressions and Age.

In Figure 1, we realized that students with the ages indicated in the caption (A, B, C and D), in general, are associated mainly with three scores (a, b and c) with racial microaggressions. The score refers to the simple arithmetic average among all items answered by research participants in a given block, in this case, Racial Microaggressions. That score varies from 1 to 5, as the instrument follows the Likert Scale. For example, in the case of the Microaggressions block, if the student has a total score close to 1, means that he or she perceives and experiences less racial microaggressions in higher education. If you present a score close to 5, this student perceives and experiences racial microaggressions more significantly and intensely.

In correspondence analysis, we observe the proximity between variables, i.e., the closer an item in red is to an item in blue, the greater the correspondence between them. We also observed that no students are significantly associated with the d score, as it is far from all other points on the graph. More specifically, younger students (A) and older students (D) are associated with the lowest level of experiences of racial microaggressions (a). Students aged between 20 and 25 years old (B) and 25 to 30 years old (C) are mainly associated with medium levels of experiences with racial microaggressions (b and c). This may be evidence that students between 20 and 30 perceive, witness, or experience microaggressions more intensely than others. One hypothesis for this is that students in this age group are more engaged in issues related to racism and racial microaggressions when compared to adolescent students (recent high school graduates) and older students. It is worth noting that no similar results were found in the literature; i.e., we have not yet identified studies that associate experiences with racial microaggressions with students' age.

We also performed a correspondence analysis between the variables Racial Microaggressions and Racial Self-Declaration, the results of which are highlighted in Figure 2:



Caption:

- a – Score less than 2.
- b – Score between 2 and 3.
- c – Score between 3 and 4.
- d – Score between 4 and 5.

Figure 2.

Correspondence analysis chart between the variables Racial Microaggressions and Racial Self-Declaration.

We can see, from Figure 2, that self-declared Black students are associated with one of the highest levels of experiences with racial microaggressions (c). White, Asian, and *Pardo* students are associated with lower levels of experiences with racial microaggressions. Surprisingly, white students score higher (b) than *Pardo* students. We consider that this may be a sign that white students perceive or have witnessed the existence of veiled racist practices directed at Black colleagues in university spaces.

According to studies by Santos (2009) and Silva and Powell (2016), experiences with implicit racism, manifested in racial microaggressions, can directly affect students' permanence in higher education. The results presented here highlight a scenario in which self-declared Black students are those who most experience racial microaggressions and that self-declared *Pardo* students –even if they belong to the group of Black students– identify and experience fewer microaggressions. This reinforces the fact that, in Brazil, the darker the skin color of a student from STEM programs, the greater their experience with racism in their academic career. According to Santos (2009), this group needs to constantly face explicit and covert situations of racism, in addition to formulating strategies that favor survival in the undergraduate course and at university.

Harris et al. (2018) state that university students exposed to racial microaggressions generally seek to establish support networks with other people, whether formally or informally, and mainly in groups with Black students. In analyzing the responses to the EASS-EXATAS instrument, we identified that several students with higher scores in the Racial Microaggressions block participate in extracurricular activities at the university, such as ethnic-racial organizations, religious organizations, art or dance, athletics, and volunteer work. Self-declared Black and *Pardo* students in this research usually stated that they had already participated in an ethnic-racial, religious organization or volunteer work at UNIFAL-MG. Therefore, we separated self-declared Black and *Pardo* students into two groups based on scores (Group A – score between 0 and 1.5; and Group B – score above 1.5), seeking to identify the relevance of extracurricular activities in their daily lives.

In Group A, with 84 respondents, 65.5% said they did not participate in extracurricular activities. In Group B, with 50 respondents, approximately 46% claimed not to participate in extracurricular activities. This shows that, as the total scores of the Racial Microaggressions

block increase, the greater the participation of Black students in extracurricular activities. This may be a sign that students who experience racial microaggressions more pronouncedly have sought support in these activities, seen by us as counterspaces, as a strategy for academic survival at the institution (Santos, 2009; Silva Júnior, 2023).

The main extracurricular activities in which students engaged are presented in Table 2, which displays the answers of all research participants about the item “I participate in the following extra-class activity(ies) at university”:

Table 2.
Answers to the item “I participate in the following extracurricular activity(ies) at the university.”

Complementary Activities	Quantity
None	212
Volunteer work	71
Athletic	38
Internship in a different area than the one you study	36
Art, music, or dance	33
Junior company	20
Journalism, debate, or drama	18
Religious organization	17
Ethnic-racial organization	7
Academic center	4
PET	3
Internship in the area you study	3
Forums and lectures	1
Other activities	5
Total	468 ⁹

It is worth noting that the gender issue can also influence experience with racial microaggressions. In this study, we did not identify significant differences between the level of experiences with microaggressions experienced by men and women (p -value = 0.0939), but we observed a slight difference between the scores of self-declared Black men (2.11) and self-declared Black women (2.13). Even though it is not a statistically significant difference, we know that the number of self-declared Black women in this area in UNIFAL-MG programs presents a disparity when compared to the number of self-declared white students or even self-declared Black men (Lopes, 2022). In this sense, some studies, such as Martins, Lima, and

⁹ The total exceeds the number of respondents due to the possibility of each student reporting more than one extracurricular activity.

Santos (2020), state that racial and gender microaggressions are correlated with worse levels of mental health and self-esteem in Black women. Therefore, we consider it essential to carry out an in-depth analysis of the low rate of self-declared Black women in STEM programs, as well as how racial microaggressions have influenced the access and permanence of this group in that area.

For the principal component analysis (PCA), we considered all 14 items from the Racial Microaggressions block, shown in Table 3, and the results obtained are shown in Figure 3. As highlighted before, this analysis allows us to visualize the association between variables in the same block (Ferreira, 2018).

Table 3.

Items from the Racial Microaggressions block considered in the principal component analysis.

- Micro1. I was/am insulted or threatened because of my ethnic-racial identity.
- Micro2. I heard/saw colleagues making prejudiced or discriminatory comments towards Black people.
- Micro3. I heard/saw teachers or staff making prejudiced or discriminatory comments towards Black people.
- Micro4. I feel that I am/was excluded from academic activities because of my ethnic-racial identity.
- Micro5. I feel (or have felt) difficulties getting involved in academic activities because of my ethnic-racial identity.
- Micro6. I feel like I am/was not taken seriously during academic activities because of my ethnic-racial identity.
- Micro7. I witnessed EXPLICIT/DIRECT racist attitudes at the university.
- Micro8. I witnessed COVERT / SUBTLE attitudes of racism at the university.
- Micro9. I suffered EXPLICIT/DIRECT racist attitudes at university.
- Micro10. I suffered COVERT/SUBTLE racist attitudes at university.
- Micro11. I feel invisible in the classroom because of my ethnic-racial identity.

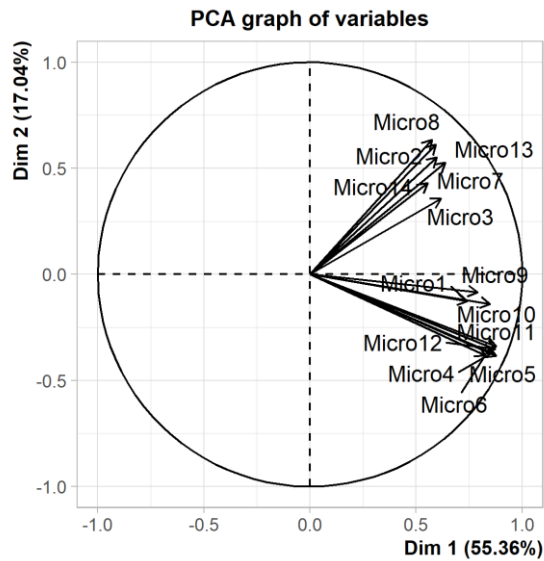


Figure 3.

Graph on principal component analysis of the Racial Microaggressions block.

Dimensions 1 and 2 – x-axis and y-axis, respectively – present, in parentheses, the proportion of the total variation in the data they explained, generally being less than 100%. Based on Figure 3, we observe that dimensions 1 and 2 explain 72.64% of the data. This means that 72.64% was retained, and the remaining 27.36% of the data was discarded by PCA. Furthermore, we identified some situations with racial microaggressions observed and experienced by the respondents. In particular, the Racial Microaggressions block appears consistent, with all items related to each other. In general, we observed that some items are in the 1st quadrant of the graph, while others are in the 4th quadrant. Items that are in the same quadrant are directly related to each other (positively correlated), and inversely related (negatively correlated) to items in the other quadrant. Thus, based on the results, we can associate them with two main groups, in which there is a greater correlation between these items.

We noticed that being insulted or threatened because of one's ethnic-racial identity (Micro1) is positively correlated with several other items, such as feeling excluded from academic activities (Micro4), feeling difficulties getting involved in academic activities (Micro5), feeling not to have been taken seriously during academic activities (Micro6), feeling invisible in the classroom (Micro11) and being ignored in academic environments (Micro12), all due to ethnic-racial identity. Furthermore, the Micro1 item is also positively related to experiencing explicit racist attitudes at university (Micro9) and suffering covert racist attitudes at university (Micro10).

The association of the items presented highlights the negative impact of racial microaggressions on Black students' reality in STEM programs. A direct impact of this association is that racial microaggressions tend to directly affect the sense of belonging and integration of the students who experience them. In this sense, Silva (2016) states that microaggressions can cause victims to abandon courses and drop out of university.

Furthermore, racial microaggressions can be seen as a form of structural violence for students: they mirror, at the university, a racism that is structurally rooted in Brazilian society. For Silva and Skovsmose (2019), Black students have been victims of this violence in higher education, which favors their underrepresentation and exclusion at this level of education. Here, we saw that even overcoming the access barrier, this structural violence persists throughout their academic career, manifesting itself through racial microaggressions. This reinforces that, in addition to the difficulties students find in exact science subjects, in academic terms, these students must manage experiences with racist practices throughout their lives at university (Silva & Powell, 2016).

Another correlation identified by the PCA was that hearing and witnessing colleagues making prejudiced or discriminatory comments towards Black people (Micro2) is positively correlated with other items, such as hearing and witnessing teachers or employees making prejudiced or discriminatory comments towards Black people (Micro3), witnessing explicit racist attitudes at the university (Micro7), witnessing covert racist attitudes at the university (Micro8), witnessing discriminatory or racist jokes at the university (Micro13) and considering that there are many racial/ethnic conflicts on the university campus (Micro14).

The association between the mentioned items reveals that several students perceive the different manifestations of racism present in racial microaggressions in the academic environment. Silva (2016) states that social and educational isolation tends to be more intense in Black students' lives, directly related to items Micro2, Micro3, Micro7, Micro8, Micro13, and Micro14. Moreover, when analyzing these items, we see that they are all linked to issues internal to the university, i.e., problems in academic spaces. In this sense, as mentioned previously, racial microaggressions impact the racial climate of the university campus, whether in academic or social spaces (Solórzano, Ceja, & Yosso, 2000; Silva, 2016; Silva Júnior, 2023). Therefore, the association between such items shows students can identify different forms of prejudice and exclusion linked to racial issues.

When analyzing how microaggressions affect each student individually, we can consider some specific items from the questionnaire, which are presented in Table 4 below:

Table 4.

Items from the Racial Microaggressions block considered individually (The authors, based on a research instrument).

- Micro1. I was/am insulted or threatened because of my ethnic-racial identity.
- Micro4. I feel that I am/was excluded from academic activities because of my ethnic-racial identity.
- Micro6. I feel like I am/was not taken seriously during academic activities because of my ethnic-racial identity.
- Micro9. I suffered EXPLICIT/DIRECT racist attitudes at university.
- Micro12. I was/am ignored in academic environments because of my ethnic-racial

By analyzing the items in Table 4, it is clear that the different experiences related to racial microaggressions in higher education allowed us to identify significant differences between students' scores, being a sign that racial self-declaration and skin color also directly impact the way such students experience attitudes of explicit racism, as well as threats, exclusions, and other insults. When analyzing students' total score concerning racial microaggressions, focusing on the items highlighted in the previous table, we observed that Asian students experienced or witnessed microaggressions at a lower level (1.04), followed by whites (1.25) and *Pardos* (1.28). We note here that, at UNIFAL-MG, the experiences of racism experienced by self-declared *Pardo* students do not present high rates. In the case of self-declared Black students, we identified higher (1.81) scores. Thus, although the group of Black students is composed of self-declared Blacks and *Pardos* in Brazil, there is a significant difference between the level of experiences with microaggressions suffered by these two groups in STEM.

Final Considerations

The results of our study provide evidence that Black students taking STEM programs at UNIFAL-MG, aged between 20 and 30, identify racial microaggressions more clearly. Furthermore, self-declared Black students experience racial microaggressions more intensely in undergraduate STEM programs at UNIFAL-MG, presenting scores above the self-declared *Pardo* students, who also comprise the group of Black students in Brazil. This is evidence that the darker the skin color of a Brazilian student taking STEM programs, the more evident their daily experiences with racial microaggressions are. Regarding the correlations identified, we can note that Black students can identify racial microaggressions more easily and experience the challenge of living with and facing structural violence during their academic careers. And, when we analyze students' perceptions and personal experiences, we notice that self-declared

Black men and women experience racial microaggressions more intensely during higher education, with counterspaces and participation in extra-class activities being important to make them feel as belonging in the course and university. On the other hand, factors such as gender, type of quota, and type of admission did not significantly influence the perception and experience of microaggressions by this group of students at UNIFAL-MG.

Lopes and Silva (2022) present an analysis of the occupancy rate of vacancies allocated to the Quota Law at the Federal University of Alfenas (UNIFAL-MG), from 2014 to 2019. It seems that Black students had the lowest occupancy rates in the vacancies provided for by the Quota Law at this institution and that they would also be those most affected without this affirmative action. In other words, structural violence manifested in the form of racism directly affects their university entry. As we highlighted in this article, those who overcome the access barrier experience the persistence of structural violence during their academic career, which turns up through racial microaggressions, among other forms. This reinforces that, in addition to the difficulties students find in STEM subjects, in academic terms, these students must manage experiences with racist practices throughout their lives at university (Silva & Powell, 2016).

Other studies, such as Queiroz and Santos (2016), Cavalcanti et al. (2019), and Maximo, Gandolfi, and Lopes (2020), highlight that quota students, especially Black men and women, must make stronger individual efforts than their colleagues to enter and remain in higher education. However, these studies also show that such students perform similarly and, at times, better than non-quota students. According to Solórzano, Ceja, and Yosso (2000), racial microaggressions can affect students' academic performance and retention, negatively impacting social and academic integration, which can lead to dropout, retention, or even withdrawal from higher education. In mathematics education, we consider that the discussions presented here can favor the development of new research aimed at better understanding practices for confronting racial microaggressions in the academic sphere, especially in classroom contexts with a predominance of mathematics.

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