

Modeling and Analysis of Interventions Directed by Race and Gender of Students in the Mitigation of School Dropout in Brazil

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Abstract

The present study investigated the extent to which the student-student dimension of the Relational Factors for the Risk of School Dropout Scale [1] was able to track students at higher risk of dropping out of school based on their relationships with each other and how class, race, and gender markers [2] were determinant for risk analysis and prevention over the course of a year. Synthetic data was generated using the Gaussian Copula technique, which estimates new responses based on the correlation between the observed variables in the real dataset, reproducing its relationships. Due to ethical considerations and compliance with Brazilian data protection legislation (LGPD), this study relies on synthetic, anonymized data, however, a nationwide data collection using real-world data is currently being conducted in Brazil. This approach was considered due to the General Law of Data Protection (LGPD). Results reflect that the use of interventions based on Psychology and Critical Pedagogy have an effect on reducing the risk of school dropout as well as promoting well-being [3] in this environment and quality for the teaching and learning process as showed in the state case [4]. In the end, it is proposed to link the measure to its intersectional analyses, which consider racism, sexism and ableism as important tools in the fight against school dropout when we think of a country of continental proportions and as diverse in numerous factors as is the case of Brazil.

Keywords: school dropout, large scale analysis, gender, race, school dropout prevention

1. Introduction

Early school dropout is a multifaceted and persistent challenge, with profound implications not only for individual trajectories, but also for public health, economic development, and social equity [1]. Historically, approaches to mitigate this phenomenon have focused on traditional early warning metrics, such as the ABC typology based on Frequency, Behavior Incidents, and Course Performance [2]. Although useful, these indicators often fail in primary prevention, as they only identify the problem when the student is already in an advanced process of leaving school, ignoring the complex web of structural and contextual factors that motivate school dropout [2].

To overcome these limitations, public policies have been proposed that aim at more systemic perspectives on school dropout. It is in this scenario that the Relational Model (MR) and the Instrument for the Assessment of Risk Factors for School Dropout (IAFREE) stand out, which propose an in-depth analysis of interpersonal dynamics in the school context [1] [2]. IAFREE tracks vulnerabilities through five interrelated dimensions: Student-School, Professional School Students, Family-Student, Student Community, and Student-Student [5]. The model understands that school dropout is not an isolated event or a purely individual failure, but the result of interactional failures and a school environment that often cannot accommodate the diversities and needs of its students [2].

The socioeconomic dimension plays an undeniable role in the failure of students in the educational system, given that the dynamics of contemporary capitalism require more sophisticated analyses. Recent studies have revealed a paradox in Brazilian public schools: from the point of view of "flexible capitalism", the increase in family income may also be associated with a higher risk of dropping out of school [3]. This is because the precarious labor market and the promises of immediate financial gains end up devaluing the school as a significant space for the construction of life projects [3]. In addition, recent educational reforms, such as the New Brazilian Secondary School, are often overtaken



by market logics that deepen educational inequality. By focusing on a disjointed and class-based vocational education, these policies run the risk of acting as tools of a "State Racism", where education functions as an instrument of segregation, condemning young people from the popular classes to underemployment and naturalizing inequalities [4].

1.1 Prejudice in Brasil

It is impossible, therefore, to analyze school dropout in Brazil without an intersectional lens that highlights the markers of race-ethnicity and gender. Racism, as a structural, intrinsic, and multifaceted phenomenon of Brazilian society, directly impacts the subjectivities and trajectories of black students [5]. The school, which should be a welcoming space, often acts as a hostile environment, where discriminatory practices, stigmas and recreational racism (the use of humor to propagate prejudiced violence) are repeated daily [5]. The ideology of whitening and the myth of racial democracy mask this violence, forcing young black people to deal with rejection, invisibility, or stereotyped visibility in teaching materials and social interactions [5].

At the same time, gender inequalities and sexism consolidate significant barriers to school retention and success. Gender relations are socially constructed from belief systems that promote the superiority of normative heterosexuality and hegemonic masculinity [6] [7]. At school, these norms translate into microaggressions, machismo, LGBTQIAPHobia and the imposition of restricted social roles, which negatively affect students' mental health and engagement [6] [8]. Exclusionary language and the naturalization of stereotypes (such as the false idea that women do not belong in the field of exact sciences) limit girls' aspirations and reinforce symbolic violence [7] [8].

For the school to act as a protection institution, it is essential to anchor educational practices and research in references that value listening and the dignity of vulnerable populations. Black Feminist Epistemology, by proposing the valorization of lived experience, orality, the ethics of care and personal responsibility, offers a robust methodological path [9]. This framework teaches us that listening to students, validating their experiences intersected by racist and sexist discrimination, is not only an act of research, but a political gesture of emancipation and pain that avoids revictimization and promotes social justice [9].

1.2 The Current Study

In view of this complex web of vulnerabilities, the present study investigates to what extent the Student-Student dimension of the IAFREE scale can track students at higher risk of dropping out based on their interpersonal relationships. More than mapping interactions, the study seeks to examine how race-ethnicity and gender markers are determinants in risk analysis and in the formulation of prevention strategies over the course of an academic year.

To ensure analytical rigor combined with the ethical commitment to privacy protection, in strict compliance with the General Data Protection Law (LGPD) of Brazil, this work adopted an innovative methodology based on the generation of synthetic data using the Gaussian Copulation technique. This method estimates new responses based on the correlations observed in the real data set, allowing for safe and effective simulation of large-scale interventions.

Through this modeling, the research demonstrates that interventions based on Psychology and Critical Pedagogy have a proven effect on reducing the risk of dropout, promoting the well-being and quality of the teaching-learning process. By linking the measurement of dropout risk to intersectional analyses, we argue that the fight against racism and sexism are not marginal agendas, but rather structural tools indispensable for the definitive mitigation of school dropout in a country of continental proportions and deep inequalities such as Brazil.

2. Method

A quantitative, cross-sectional, descriptive-comparative design was adopted, based on synthetic data modeling. We analyzed patterns of vulnerability to school dropout based on the relational dimensions of the Instrument for the Assessment of Risk Factors for School Dropout – Alternative Version (IAFREE-A), with emphasis on social markers of sex and race-ethnicity. The quantitative design with synthetic data allowed us to examine population patterns of school vulnerability, preserving the correlational structure of the original database and, at the same time, ensuring greater protection of student's privacy.



2.1 Ethics

The generation of synthetic data was adopted as a strategy to mitigate ethical risks, especially in relation to the preservation of privacy, the minimization of the exposure of individual information, and compliance with the General Law for the Protection of Personal Data (LGPD – Law No. 13,709/2018). Thus, no directly identifiable individual data was used in the analyses presented.

2.2 Participants

The database was composed of 10,000 synthetic cases of students, generated to preserve the statistical structure of an original educational base, maintaining patterns of association between variables without exposure of individually identifiable data. For the present analysis, the variables Sex and Race-Ethnicity were considered.

Regarding gender, the total database had 4,898 students classified as male (49.09%), 5,082 as female (50.91%). Considering the inclusion criteria defined for this study, only the cases classified in the binary categories male and female were maintained, resulting in an analytical sample of 9,980 students. The distribution indicates a proportional balance between the two groups, which favors statistical comparisons between males and females, reducing the risk of significant sample asymmetries.

Regarding the Race-Ethnicity variable, the sample presented three categories. The white category gathered 2,079 students (20.83%), the brown category gathered 2,295 students (23.00%) and the black category gathered 5,606 students (56.17%). Therefore, it is observed that category 3 predominates in the racial-ethnic composition of the sample, which already alerts us to the racial profile of public school students in Brazil.

3. Results

The analysis was conducted based on the corrected IAFREE-A scores. According to the calculation manual, all items of the instrument should be inverted, except for items Q5 and Q36, so that higher scores indicate greater vulnerability or greater need for attention to the school trajectory. The results were interpreted based on the five relational dimensions of the instrument, axes of protection and vulnerability related to school permanence, allowing a relational reading of the risk of dropout.

3.1 Gender Analysis

Table 1 shows the mean dimensional scores of the IAFREE-A by gender. In all dimensions, male students had higher averages than female students, indicating greater perceived vulnerability to school dropout.

Table. 1. Mean IAFREE-A 46 dimensional scores by sex

Dimension	Male	Male	Female	Female
	M	SD	M	SD
Student – School	2,70	0,35	2,64	0,35
Student – School Professionals	3,02	0,40	2,99	0,40
Student – Family	2,84	0,41	2,79	0,42
Student – Community	2,89	0,34	2,82	0,35
Student – Student	2,85	0,56	2,67	0,57

The differences between the male and female groups were statistically significant in all dimensions. Considering the large sample size, the interpretation prioritized effect sizes. The greatest difference was observed in the Student-Student dimension ($d = 0.31$), followed by Student-Community ($d = 0.19$), Student-School ($d = 0.16$), Student-Family ($d = 0.13$) and Student-School Professionals ($d = 0.07$).

This pattern suggests that the difference by sex is more relevant in the dimensions linked to school belonging, peer relationships, educational expectations, and school-community integration. The Student-Student dimension is central to the study, as it allows us to trace how interpersonal relationships in everyday school life can act as protective or vulnerable factors for dropout.



Our analysis situates school dropout as a relational phenomenon and not as an individual failure of the student.

Table 2 presents the percentage of students classified as high vulnerability in each dimension, considering the universal normative cut-off points of IAFREE-A.

Table 2. Percentual de vulnerabilidade por sexo

Dimension	Male	Female
Student – School	96,45%	94,59%
Student – School Professionals	51,16%	44,57%
Student – Family	51,18%	38,57%
Student – Community	42,02%	36,97%
Student – Student	90,10%	88,27%

The Student-Community dimension presented the highest percentages of high vulnerability in both sexes: 96.45% among male students and 94.59% among female students. High scores in this dimension indicate that students capture important weaknesses in the relationship between school and community, including low territorial integration, insecurity, conflicts between school and community values, and difficulties in articulating with external protection networks.

The second most critical dimension was Student-School Professionals, with 90.10% of high vulnerability among male students and 88.27% among female students. This result indicates a largely unfavorable perception of the relationships with teachers, management, coordination and other school professionals. High scores in this dimension express difficulties in dialogue, welcoming, institutional collaboration, teacher expectations and pedagogical quality.

The most substantive difference between the sexes appears in the Student-Student dimension. While 51.18% of male students were classified as highly vulnerable, this percentage was 38.57% among female students. This difference suggests that male students in this database have greater fragility in peer relationships, school belonging, social skills and expectations regarding education. From the psychosocial point of view, this finding can be interpreted in the light of processes of socialization of masculinities, interpersonal conflicts, less adherence to care practices, and greater subjective distance from school.

3.2 Racial Analysis

Table 3. Means of the IAFREE-A dimensional scores by race-ethnicity.

Dimension	White	Brown	Black
Student – School	2,67	2,67	2,67
Student – School Professionals	3,00	2,99	3,01
Student – Family	2,82	2,81	2,81
Student – Community	2,84	2,85	2,86
Student – Student	2,75	2,75	2,77

The averages were quite close between the three race-ethnicity categories. The comparative analyses indicated the absence of statistically relevant differences in the dimensions Student-School, Student-School Professionals, Student-Family and Student-Student. In the Student-Community dimension, there was a statistically significant difference, but with practically zero effect size ($\eta^2 = 0.0007$), indicating low practical relevance.

Table 4. Percentage of vulnerability by race-ethnicity

Dimensão	White	Brown	Black
Student – School	47,62%	47,28%	48,09%
Student – School Professionals	89,37%	88,37%	89,42%
Student – Family	40,12%	39,52%	39,17%
Student – Community	94,61%	95,51%	95,83%
Student – Student	44,73%	43,75%	45,18%

The Student-Community dimension showed high vulnerability above 94% in all race-ethnicity categories, with a higher percentage in the Blacks category (95.83%). Suggesting that the

fragility in the articulation between school, community and protection network is a transversal axis of the sample, crossing all racial-ethnic groupings.

The Student-School Professionals dimension also presented extremely high percentages in all categories: 89.37% in the White category, 88.37% in the Brown category and 89.42% in the Black category. Pedagogical and institutional relations constitute a general critical point for school permanence.

The Student-Student dimension presented percentages between 43.75% and 45.18%, with a slight increase in the Blacks category. Although the difference between the categories is small, this dimension remains theoretically important because it is directly connected to school belonging, peer acceptance, subjective recognition, and expectations for the future.

4. Discussion

As seen, vulnerability to school dropout is organized mainly around institutional, community and relational dimensions, and not only around individual characteristics of students. This finding supports the central premise of the IAFREE Relational Model, dropout should be understood as a phenomenon produced in the interaction between everything that makes up the school. We were able to shift the analysis from late indicators, such as attendance and performance, to psychosocial and contextual factors that precede school dismissal.

The Student-Community dimension showed the highest levels of high vulnerability in all groups analyzed by race-ethnicity and sex-gender, suggesting fragility in the articulation between school, territory and protection networks. The school cannot be thought of as an isolated institution, but as part of a broader social ecosystem. When the school does not activate support services, does not establish community partnerships or does not dialogue with the concrete living conditions of students, its protective capacity is reduced. Preventing dropout requires intersectoral actions involving education, social assistance, health, culture, security, family and community.

The Student-School Professionals dimension, with high levels of vulnerability. He pointed to problems perceived in the relationship with teachers, management and other professionals, involving pedagogical quality, institutional communication, teacher expectations and welcoming. Regarding school permanence, the results are relevant because learning does not depend only on formal access to school, but on the quality of pedagogical and institutional interactions that sustain engagement. When students perceive low teacher expectations, unresponsive pedagogical practices or fragile institutional relationships, the school tends to lose its function of recognition and protection.

The sex-gender breakdown showed greater vulnerability among male students in all dimensions, especially in Student-Student, involving interpersonal relationships, social skills, belonging, identification with the school and expectations regarding education. This suggests that students may be more exposed to forms of socialization that hinder the expression of vulnerability, the construction of care bonds and the non-violent mediation of conflicts. Preventive interventions should, therefore, consider masculinities, school life, belonging and life project as central axes, avoiding interpretations that individualize or pathologize boys.

In the cut by race-ethnicity, the dimensional means were close among all regardless of being White, Brown or Black, the high transversal vulnerability should not be interpreted as the absence of racial inequalities. Structural racism, sexism, and other forms of discrimination permeate the Brazilian school experience, affecting recognition, belonging, and permanence. Even when the average differences are small, racialized reading remains necessary, especially in the dimensions related to community, relationships with professionals, and interactions between students.

4.1 Limitations

Although it preserves correlational patterns from the original database and is adequate to protect the privacy of students, the results should not be interpreted as definitive population estimates. The synthetic base allows simulating trends, testing models and guiding interventional hypotheses, but it does not replace analyses with empirical data collected directly in real school contexts.

Another limitation concerns the use of the male-female binary category, which limits the understanding of the experiences of trans, non-binary students and other gender identities. In addition, the race-ethnicity variable was analyzed in three aggregated categories, which may reduce sensitivity to capture specificities among white, brown, black, indigenous, and yellow students. Considering that the theoretical model of the study itself emphasizes racism, sexism and structural inequalities as fundamental dimensions of school dropout.

4.2 Proposals

It is recommended that schools strengthen intersectoral networks with social assistance, health, guardianship council, community collectives, cultural facilities and territorial organizations, since the community dimension presented high vulnerability in all groups analyzed. It is also proposed to invest in critical, anti-racist and anti-sexist teacher training, qualification of pedagogical practices, improvement of institutional communication and creation of protocols to confront discrimination, bullying, racism, sexism and LGBTQIAPNb+phobia.

The results indicate the need for specific actions aimed at school belonging, peer relationships, masculinities, conflict mediation and the construction of positive educational expectations, especially among male students. It is also recommended that IAFREE-A be incorporated as a preventive and non-punitive screening tool, allowing schools to identify relational dimensions of risk before dropout occurs. Its application should be linked to collective intervention plans, qualified student listening, longitudinal monitoring and continuous evaluation of the effects of the actions implemented, avoiding the use of the instrument to label students and prioritizing its function of protecting school trajectories.

5. Final Considerations

School dropout should be understood as a relational, structural, and intersectional phenomenon, produced by the articulation between social inequalities, institutional weaknesses, precarious community bonds, and school experiences marked by recognition or exclusion. In this sense, confronting dropout requires more than monitoring attendance, behavior, and performance: it requires a school capable of listening, welcoming, and transforming the conditions that make students vulnerable. In dialogue with bell hooks, it is understood that education must be a practice of freedom, sustained by care, listening and ethical commitment to historically marginalized subjects. In the same way, in Paulo Freire, school permanence can only be thought of from a critical, dialogical and emancipatory pedagogy, capable of recognizing students as historical subjects and not as objects of intervention.

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