



Revista de Administração Pública

ISSN: 0034-7612

ISSN: 1982-3134

Fundação Getúlio Vargas

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Revista de Administração Pública, vol. 53, núm. 3, 2019, Maio-Junho, pp. 542-559  
Fundação Getúlio Vargas

DOI: 10.1590/0034-761220170352

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# The influence of family background on the access to Technical and Vocational Education

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This work investigates the influence of family background variables (father's schooling, mother's schooling, and family income) on the result of a student's application to access a Brazilian institution of technical and vocational education. The research used secondary data carried out 19,226 observations, and formulated a conceptual model with three hypotheses. The results were presented in three stages: I - separation of campuses into clusters; II - analysis of multiple regressions; and, III - analysis of logistic regressions. One of the hypotheses was rejected and two were confirmed, indicating that there is a positive effect of the variables family income and father's schooling, but no statistical significance for the variable mother's schooling.

**Keywords:** human capital; economy; family background; technological education.

## O background familiar e sua influência no acesso ao Ensino Técnico Profissional

Este artigo apresenta uma investigação acerca da influência que as variáveis de *background* familiar (escolaridade do pai, escolaridade da mãe e renda familiar) exercem sobre o desempenho de um estudante, candidato às vagas dos processos de seleção em uma instituição de Ensino Técnico Federal brasileira. A pesquisa consistiu em analisar a influência do *background* familiar, como determinante de desempenho do aluno, no acesso ao Ensino Técnico Profissional brasileiro. Para conduzir essa investigação foram utilizados dados secundários, totalizando 19.226 observações. Buscando alcançar o objetivo proposto, formulou-se um modelo conceitual composto por 3 hipóteses. Os resultados são apresentados em 3 etapas: etapa I – separação dos *campi* em *clusters*; etapa II – análise das regressões múltiplas; e etapa III – análise das regressões logísticas. As hipóteses 1 e 2 foram confirmadas e a Hipótese 3, refutada. Os resultados apresentaram um efeito positivo das variáveis renda familiar e escolaridade do pai, mas sem significância estatística para a variável escolaridade mãe.

**Palavras-chave:** capital humano; economia; *background* familiar; educação tecnológica.

## El trasfondo familiar y sus influencias en el acceso a la Enseñanza Técnica Profesional


Este trabajo presenta una investigación acerca de la influencia que las variables de antecedentes familiares (escolaridad del padre, escolaridad de la madre y renta familiar) ejercen sobre el desempeño de un estudiante candidato a las vacantes de los procesos de selección en una institución de Enseñanza Técnica Federal brasileña. El estudio consiste en analizar la influencia del trasfondo familiar como determinante de desempeño del alumno en el acceso a la Enseñanza Técnica Profesional brasileña. Para conducir esta investigación, se utilizaron datos secundarios totalizando 19.226 observaciones. Buscando alcanzar el objetivo propuesto, se formuló un modelo conceptual compuesto por tres hipótesis. Los resultados se presentaron en tres etapas: etapa I - separación de los *campi* en *clusters*; etapa II - análisis de las regresiones múltiples y etapa III - análisis de las regresiones logísticas. Se han confirmado las hipótesis 1 y 2 y, H3, refutada. Los resultados mostraron un efecto positivo de las variables renta familiar y escolaridad del padre, pero sin significancia estadística para la variable escolaridad materna.

**Palabras clave:** capital humano; economía; antecedentes familiares; educación tecnológica.

DOI: <http://dx.doi.org/10.1590/0034-761220170352x>

Article received on November 10, 2017 and accepted on February 18, 2019.

[Translated version] Note: All quotes in English translated by this article's translator.

ISSN: 1982-3134 

## 1. INTRODUCTION

Success in selection processes is noticeable from factors that Education students call *performance determinants* (Barros, Mendonça, Santos, & Quintaes, 2001; Schiefelbein & Simmons, 1981). These provide elements that may influence a student's performance, bearing in mind past shortcomings. One of the performance determinants mentioned by the literature is based on home background.

The study on home background originates from Coleman (1966), found in his comprehensive educational research with North American students in the 1960s. Prior to this, Schultz (1961) and Becker (1964) had already developed theories that underpinned Coleman's research (1966). More recently the literature has continued with new approaches to this point based on work undertaken by Riani and Rios-Neto (2008), Castelar, Veloso, Ferreira and Soares (2010), Cavalcanti, Guimarães and Sampaio (2010), D. B. Guimarães and Arraes (2010), J. Guimarães and Sampaio (2013), M. K. Miller, Martin and Orr (2014), Mazzonna (2014), Smith, Crosnoe and Chao (2016) and Mendolia and Siminski (2017).

From the studies already performed in Brazil (Castelar et al., 2010; Cavalcanti et al., 2010; D. B. Guimarães & Arraes, 2010; J. Guimarães & Sampaio, 2013; Riani & Rios-Neto, 2008) highly unequal opportunities were found to result from the disparity in Brazilian family structures. It may also be stated that the home background is a determinant factor for the intergenerational success of an individual (Schneider & Coleman, 2018).

Given the context herein, this article addresses the verification of the influence of home background as a performance determinant in the selection process to a Brazilian federal technical education institution.

The study, therefore, was undertaken in the Rio Grande do Norte Federal Institute of Education, Science and Technology (IFRN), one of the largest in Brazil's technological network, with approximately 35,000 students. The data used were provided by the institution and refer to the integrated high school selection process for 2013.

This article consists of four (4) sections after this introduction; the first discusses the theory of the home background; the second addresses the methodological procedures adopted, and the statistical tools; the third presents the results and discussions and lastly, the study is concluded by answering the proposed specific objective and confirmation (or otherwise) of the raised hypotheses.

## 2. LITERATURE REVIEW

### 2.1 Home background

The theoretical framework of the home background began with the ideas of Schultz (1961), creating the theory of educational capital, which was soon expanded by Becker (1964), with the publication of the theory of human capital. Corroborating the theories of Schultz (1961) and Becker (1964), Coleman (1966) ran a widespread survey in the United States of America (USA), ratifying the theory of educational capital and the theory of human capital with regard to the influence of home background as the prime determinant of student performance.

After the end of World War II, Schultz (1961) studied the reasons why some countries, having participated in that war, managed to have a speedy economic recovery, and concluded that such a short period was due to the educated and healthy population of those countries. Also according to Schultz (1961), education makes people productive and with balanced health, increasing the return on investment in that area. These conclusions by Schultz (1961) led to the idea of “educational capital”, directly related to investments in education, the premises of which are the basis of the theory of human capital, developed later by Becker (1964).

The theory of human capital was created by Becker (1964) arising, in principle, from two basic hypotheses: the individual's earnings increase with the rise in his or her level of education; and studying has direct costs in financing school material and teachers' pay, but there are also indirect costs evidenced when a student drops out or gives up part of the wage that could be earned if he or she were to interrupt their studies to start working.

From the theory of human capital, several authors (Björklund & Salvanes, 2011; Coleman, 1966, 1988; J. Guimarães & Sampaio, 2013; Mendolia & Siminski, 2017; Sirin, 2005; Smith et al., 2016; White, 1982) began investigating the factors that would lead people to be less or more professionally successful considering their family origin. One of the first studies to deal with this issue was Coleman's (1966), considered by Bonamino and Franco (1999) one of the most influential studies on education, because it investigated to what extent the differences in race, religion, geographic origin and social origin would affect the educational opportunities.

The US government undertook a survey with a sample of approximately 645,000 students spread over five (5) levels of education. Data were collected on characteristics of the teaching staff, students and their families, in addition to the school infrastructure. The work in question showed that the differences in student performance were explained on a larger scale by the socioeconomic variables rather than by the intraschool variables. Such conclusions led Coleman (1966) to perceive that the background would influence a student's performance far more than the actual school infrastructure. From this perspective, the study by Coleman (1966) encouraged a number of other studies on this topic, classified later in economic literature as home background; in other words, how household income and parental influence on the school performance is normally analyzed on the child's school performance. Therefore, individuals whose parents had better learning opportunities tend to study more and, consequently, enjoy better jobs, while individuals with parents with low learning indices tend to study less and achieve less visible employment.

Since then, researchers have been studying the subject to find answers that could contribute to public education policies, with studies developed in a wide variety of countries: Germany (Woessmann, 2003); Australia (Mendolia & Siminski, 2017; P. Miller, Charles & Martin, 1997); Brazil (Arias, Yamada & Tejerina, 2004); China (Zhao, Valcke, Desoete & Verhaeghe, 2012); USA (Caldas & Bankston, 1997; Lee & Barro, 2001; Louis & Zhao, 2002; Sirin, 2005; Smith et al. 2016; White, 1982); UK (Ermisch & Francesconi, 2001) and so on.

From this viewpoint, strides have been taken in relation to the topics concerning the home background from every angle of the research in respect of studies with children, adolescents or adults. Discussion on this matter is primarily centered on USA studies, extending to other countries, one of which is Brazil.

## 2.2 Progress in home background studies

Home background or socioeconomic status (SES) is probably the group of contextual variables most commonly used in educational research. Investigators are increasingly examining the educational processes, including academic performance, in respect of the home background (Duncan, Brooks-Gunn & Klebanov, 1994; Coleman, 1988; McLoyd, 1998).

White (1982) was the first to review literature on the subject, concentrating on 200 published studies before 1980; the link between home background and school performance was examined and showed that it varies significantly with a series of factors, such as the SES types and measures of academic performance. Since the publication of the meta-analysis by White (1982), a large number of empirical studies have explored the same link.

After the results of White's meta-analysis (1982), Sirin (2005) reviewed the literature on the use of home background and academic performance factors in journals and articles published between 1990 and 2000. The sample consisted of 101,157 students, 6,871 schools and 128 school districts, and was collected from 74 separate samples. The results showed that there is a medium to strong link between home background and academic performance. As the overall results suggest, the researchers must assess the student's family context, regardless of their main research focus.

Also according to Sirin (2005), although the ongoing trend in the study of academic performance suggests that the economic and social context is the key to understanding educational attainment, it is still common practice to mention the home background in the introductory and discussion sections of scientific articles without in fact including it in the measurement model. Researchers should not be limited to discussing the context, but to measuring and assessing the economic and social context in relation to their area of special interest.

Duncan et al. (1994) developed an investigation about economic deprivation and early childhood development in the USA from a sample of 895 people from eight (8) large North American centers. The purpose was to check if there had been a correlation between early child development in their early years – up to five years old – and home background factors. The result of the survey indicated a close correlation between the student's cognitive development and home background factors, principally income and the mother's schooling. The analyses of Duncan et al. (1994) corroborate those of Coleman (1966) regarding the influence of the socioeconomic variables on student performance.

Among other matters, Lefebvre and Merrigan (1998) investigated the influence of the parental work and home background factors as determinants of children's academic performance in Canada. The results suggest that the mothers' work has little influence on their children's performance, the household income having little impact on the average of investigated students, but strongly impacting low-income families. The study also revealed that there was a close relationship between the student's performance and educational characteristics of their parents, as has already been mentioned by Duncan et al. (1994).

On the other hand, Louis and Zhao (2002), using data from the US General Social Survey between 1989 and 1994, examined the effects of family structure, SES and satisfaction with adult life. The authors resorted to the regression analysis to show that both family structure and the SES of the family are associated with adult life satisfaction. However, neither family structure or its SES was significant

after including a set of adult life experience variables in the models and, according to the authors, requiring more powerful variables to explain the researched phenomena.

The studies by Louis and Zhao (2002) diverge from those preceding them (Becker, 1964; Coleman, 1966; Duncan et al., 1994; Lefebvre & Merrigan, 1998; White, 1982) referring to the lack of influence of the home background variables. The surveys by Becker (1964) and Coleman (1966) are pioneer and groundbreaking compared to the impact of background variables for the students, a fact unconfirmed in Louis and Zhao (2002).

From a Brazilian viewpoint, the selection process of the University Entrance Examination Foundation (Fuvest) for 2000 was the topic chosen by Emilio, Belluzo and Alves (2004). Based on data of this university entrance examination and on the 1999 National Household Sample Survey (PNAD), the authors confirmed the factor leading to the selection bias.

At the end of the survey, Emilio et al. (2004) concluded that ethnics contributes to a negative effect on the candidate's final score, and also how the mother's schooling is shown to be a key determinant for the individual's success.

The study by Arias et al. (2004) investigated the role of ethnics, home background and education in the wage inequality between white and black Brazilians. The authors used regressions to check the differences in human capital, including teaching quality and parental schooling. The results indicated higher return for education varying according to the skin color gradient.

From a macro view, Woessmann (2004) estimated the effects of home background characteristics in the student performance in the 17 educational systems in Western Europe and the USA in order to compare them. The data of 10,973 North American and 104,433 European students from 15 countries were analyzed.

The conclusions of Woessmann (2004) demonstrated that home background has strong effects in both Europe and the USA on student performance. The difference in this achievement between children of parents with less and those with better schooling is noticeable in many countries. Moreover, the model analyzed in this study can respond to at least 9% of the total test-score variation (in Iceland), or exceed the 26.4% (in Sweden). France and Belgium, however, achieved the most equitable achievement for students from families with different backgrounds, while the United Kingdom and Germany were less influenced by this factor.

Riani and Rios-Neto (2008) examined the academic performance determinants of Brazilians in elementary and high schools, considering factors such as home background and school structure in the municipalities. For this purpose, the educational production function was used based on a two-level hierarchical logistics model and the data belong to the Basic Education Assessment System (Saeb). The results evidenced that the student's mother's schooling is a strong impacting factor in the student's achievement, as is also the municipal school infrastructure (quality of human resources and services provided).

Two studies (Cavalcanti et al., 2010; D. B. Guimarães & Arraes, 2010) addressed the student achievement in federal university entrance examinations in Northeast Brazil. Cavalcanti et al. (2010) studied the obstacles imposed on a student from Brazilian public schools when sitting the university entrance examination of the largest public university in the Northeast — the Federal University of Pernambuco (UFPE).



The differences between the students from public and private schools were quantified. The data correspond to a universe of 56,723 candidates in the selection process for 2005. It was found that the examination results of students from public schools range on average from 4.2% to 17% lower than the examination results of students from private schools, after control for the individual, family and or school characteristics. Another major result is that the family origin (mother's income and years of schooling) is a key indicator for the examination results.

The research of D. B. Guimarães and Arraes (2010), on the other hand, analyzed the candidate performance determinants for the entrance examination of the Federal University of Ceará (UFC) in 2004. An educational output production function was used to measure performance. The results are striking with regard to the influence of home background on the candidates' achievement. Parental schooling and household income are determinants for the candidate's approval, and whether he or she is working. The higher the education and household income the greater the chances are of the student's acceptance.

Castelar et al. (2010) examined the role of determinant factors of acceptance in the public examination of the Banco do Nordeste do Brasil (BNB) in 2003, when 232,308 candidates applied. The logit model was used as an analytical tool. The main results were that household income, type of schooling, coming from a metropolitan region, age and having studied in a private elementary school are fundamental for the candidate's acceptance; while low personal income and having only secondary school education diminish the chances of the candidate's acceptance.

Tran and Nathan (2010) analyzed the link between a number of students registered in a pre-university engineering course, the Lead The Way Project, and student achievement in sciences and mathematics. Using the multiple regression analysis ( $n = 176$ ) one of the results found was the negative impact caused by the household income variable, both for the sciences discipline - a strong impact ( $-0.614$ ), and for the mathematic discipline ( $-0.269$ ).

Now on another aspect, Zhao et al. (2012) aimed their studies to investigate the link between the family's socioeconomic level and the performance in mathematics based on a multilevel analysis involving a broad sample of students in elementary education in China. The survey was applied to 10,959 students and analyzed using multilevel regression.

A weak link was found between the socioeconomic level and academic achievement in China. The link did not have linear behavior but a quadratic curve, which can be explained based on Chinese cultural beliefs regarding education, exams and social class mobility. The authors understand that the Chinese context differs from international literature, because Chinese children are taught in the Confucian method, thereby learning from an early age to fight for their future.

The fact that Louis and Zhao (2002) had already recognized that background variables have no influence on the performance of Chinese students (Zhao et al., 2012) has already been recognized, in a study carried out in the USA on the effect of the home background as a determinant for happiness in an individual's adult life.

Using the same UFPE database deployed earlier by Cavalcanti et al. (2010) when studying barriers imposed on a student from Brazilian public schools, J. Guimarães and Sampaio (2013) checked the determinants of student achievement in the UFPE university entrance examination. Special attention is given to the importance of the variables of home background, parental schooling and household

income in relation to student achievement. Data from the UFPE 2005 entrance examination were used, in which 56,723 candidates had applied.

The results suggest that parental schooling, as already confirmed by D. B. Guimarães and Arraes (2010), and a study environment are determinant factors for good student performance. Moreover, the aforementioned performance relates positively to the probability of attending private schools and private tutoring.

Emilio et al. (2004) and Castelar et al. (2010), in their studies on the Fuvest university entrance examination and the BNB public competition, respectively, found the same effect observed by J. Guimarães and Sampaio (2013), on the importance of mother's and father's schooling in the student's performance.

Using the reality of Madagascar, Glick, Randrianarisoa and Sahn (2011) investigated the link of neighborhood characteristics and schooling factors from children in the 8-10 and 14-16 age groups. Accordingly, the educational, neighborhood and achievement score variables of these students were considered in the study. Unlike the majority of usage test studies in developing countries, the study uses samples of representative children instead of school children, and combines detailed information on schooling and family origin. The results showed greater causality with regard to the influence of mother's schooling. Even these effects, however, are significantly attenuated when the choice of home or school is controlled. Skills are also affected by aspects of the primary schools, including the teacher's experience and infrastructure.

When applying a theory of social capital, M. K. Miller et al. (2014) used a research tool designed to collect information on the size, structure and composition of networks and social resources of students for engineering studies and careers. The data were collected from 1,410 engineering undergraduates in five (5) US institutions. The participants were invited: a) to reflect on the moment when they were deciding to study engineering; b) to identify names of people who they considered influential; and c) to identify the resources that were accessed through that social network.

Demographic analyses of the clusters revealed less pronounced access to the resources by Hispanic students, as well as those whose parents or acquaintances were not engineering graduates.

Mazzonna (2014) investigated how and to what extent the association between the family's SES during childhood and old age relating to health, income and cognition varies in 11 European countries. The Survey on Health, Aging and Reform in Europe (Share) and Sharelife was used, which gathers information about interviewees' recollection and their family origins in childhood.

Also analyzed were which factors led to the inter-generational persistence of human capital, and academic achievement, schooling and the results of the job market. The findings show a link between the childhood SES and results of advanced age and a wide heterogeneity between the results of the countries in the study.

In a North American context, Smith et al. (2016) used logistic regressions to assess two generations, examining the cross-generational changes in transitions focusing on each family's differences. For this purpose, US-born people between 16 and 32 years old were considered. It was found that the young adults of the younger generation were less likely than the older generation: a) to have completed their education; b) to fully enter the workforce; c) to marry; or d) to become parents at 30 years old. It was found that young people from the least wealthy background found it harder to complete their studies.



Mendolia and Siminski (2017), on the other hand, did a study based on the Household, Income and Labour Dynamics in Australia (Hilda) Survey, in order to quantify the role of education as a transformation mechanism in which the family context could affect the economic results of the individual. Through multidimensional treatments, it was estimated that educational attainment explains between 21% and 37% of the effect of home background on hourly earnings in Australia and only 13% to 19% of this effect on wealth.

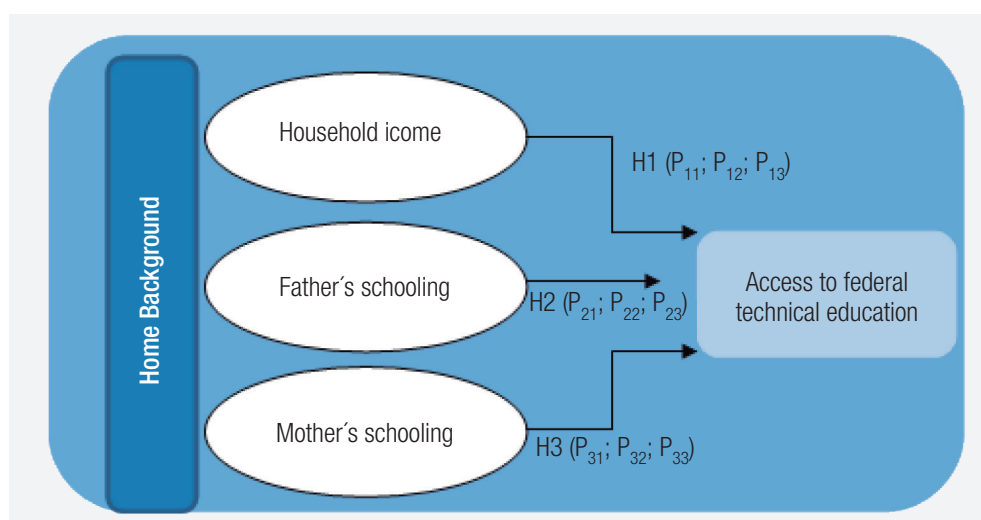
After achieving the home background theoretical framework, this is where the survey hypotheses arise. The survey is based on the hypothesis that the home background directly influences attainment in access to Brazilian federal technical education. In order to obtain the best possible result for the research question, it was decided to split the basic hypothesis into three secondary hypotheses, as in Figure 1:

**H<sub>1</sub>:** The higher the candidate's household income, the greater are the chances of entering Brazilian federal technical education.

**H<sub>2</sub>:** The father's schooling positively influences the candidate's performance, increasing the chances of entering Brazilian federal technical education.

**H<sub>3</sub>:** The mother's schooling positively influences the candidate's performance, increasing the chances of entering the Brazilian federal technical education.

**FIGURE 1** SURVEY HYPOTHESES



Source: Elaborated by the authors.

In order to more clearly understand the causality measured for each schooling level of the parents of students applying for vacancies, both for the admissions examination and the Citizenship and Technological Indication Program (ProITEC), proposals were prepared for the hypotheses 2 and 3, as follows:

P<sub>2.1</sub> The father having completed no more than elementary schooling has a positive influence on the performance of the student applying for a vacancy in Brazilian federal technical education;

P<sub>2.2</sub> The father having completed no more than high school has a positive influence on the performance of the student applying for a vacancy in Brazilian federal technical education;

P<sub>2.3</sub> The father having completed no more than university education has a positive influence on the performance of the student applying for the vacancy in Brazilian federal technical education.

P<sub>3.1</sub> The mother having completed no more than elementary schooling has a positive influence on the performance of the student applying for a vacancy in Brazilian federal technical education;

P<sub>3.2</sub> The mother having completed no more than high school education has a positive influence on the performance of the student applying for a vacancy in Brazilian federal technical education;

P<sub>3.3</sub> The mother having completed no more than university education has a positive influence on the performance of the student applying for a vacancy in Brazilian federal technical education.

### 3. MATERIALS AND METHODS

This study considered the population to be candidates for vacancies in the IFRN Integrated High School Technical Education (11,486 candidates in the overall selection process and 5,522 candidates in ProITEC) for admission in 2013 in their various courses spread over 14 campuses: Natal Central, Natal Zona Norte, Parnamirim, São Gonçalo do Amarante, Nova Cruz, João Câmara, Macau, Ipanguaçu, Apodi, Mossoró, Pau dos Ferros, Caicó, Currais Novos and Santa Cruz.

The data used in this study are secondary, since they were obtained from databases provided by the IFRN through its Dean's Office for Education (Proen). Database 1 considered all candidates to ProITEC for 2013, while database 2 corresponds to the candidates in the admissions examination<sup>4</sup>, also for 2013.

Based on the consulted literature, some of the most frequent variables were selected from the latest main studies in the field in Brazil and abroad. The variables mentioned most often were those chosen to underpin the theoretical framework of this study: race, education system, mother's schooling, father's schooling, household income, gender and age.

The variables chosen from the previous studies play the role of the independent variables that are the components of home background (household income, mother's and father's schooling). The remainder (gender, education system, age and race) acts as the control variables.

#### 3.1 Data analysis and interpretation

The analysis was divided into three (3) stages. The first stage analyzed clusters, designed to separate objects that have some similarity and create a high degree of internal homogeneity through the chosen variables. This procedure was adopted because the IFRN campuses were distributed throughout the state of Rio Grande do Norte, which would enable the study some kind of bias.

To measure the influence of home background variables on the candidates' performance for each cluster, a multiple regression was used in the second stage of the analysis. The final score of the candidates (E-score) was taken as dependent variable Y, both in database 1 and 2.

The “X” is a matrix of explanatory variables that seek a casual link with the variable Y and comprise the independent variables of the home background: father’s and mother’s schooling, and household income. There also is a matrix of control variables, represented herein by “W” (race, education system, age and gender). These links are represented in equation 1.

$$E\text{-score} = \beta_0 + \beta^*X + \beta^*W + \varepsilon \quad (1)$$

where  $\beta_0$  represents the constant of the model;  $\varepsilon$ , the remainder; while  $\beta$  means the parameter explanatory vector for matrices X and W. If the explanatory vector signals are not considered, a model is expected as proposed in equation 2.

$$E\text{-score} = \beta_0 + \beta_1^* \text{father's schooling} + \beta_2^* \text{mother's schooling} + \beta_3^* \text{household income} + \beta_4^* \text{race} + \beta_5^* \text{education system} + \beta_6^* \text{age} + \beta_7^* \text{gender} + \varepsilon \quad (2)$$

In the third stage of the study the logistic regression was used to obtain a causal and probabilistic model from the databases of the selection processes for 2013.

The independent variables for these models are those already used in the multiple regression (parental schooling and household income), forming the matrix “Z”, and the control variables also continue the same, as follows: race, education system, age and gender. The latter make up the matrix of variables “V”.

The dependent variable “Y”, at this stage of the study, is dichotomic, referred to as “Status” and characterizes the candidate as Passed (value 0) or Failed (value 1). The link between the independent and dependent variables adopts for this statistical tool a logarithmic function, as in Equation 3.

$$\ln \left( \frac{P(y)}{1-P(y)} \right) = \beta_0 + \beta^* Z + \beta^* V + \varepsilon \quad (3)$$

where  $\beta_0$  represents the constant variable of the model;  $\varepsilon$ , the remainder; while  $\beta$  means the explanatory parameter vector for the variables Z and V in relation to logit (Y). The tool will find a function for each of the clusters formed in stage 2 of the study; thereby enabling the influence of mapmaking of the home background by clusters in the educational institution investigated herein.

#### 4. REGRESSION ANALYSIS

First, the cluster analysis for both databases was applied. Database 1 (admissions examination) was divided into two clusters. The first (cluster 1) formed by the campuses: Apodi, Currais Novos, Ipanguaçu, João Câmara, Nova Cruz and Pau dos Ferros, while the second (cluster 2) corresponds to campuses Caicó, Macau, Mossoró, Natal Central, Natal Zona Norte, Parnamirim, Santa Cruz and São Gonçalo do Amarante. These results were confirmed using the k-means test.

Database 2 (ProITEC) was also divided into two clusters, the first (cluster 3) consisting of campuses Apodi, Caicó, Ipanguaçu, João Câmara, Macau, Nova Cruz, Parnamirim, Pau dos Ferros, Santa Cruz and São Gonçalo do Amarante. On the other hand, the second (cluster 4) was formed by campuses Currais Novos, Mossoró, Natal Central and Natal Zona Norte.

The study was divided into four clusters and two regressions were run for each cluster, one being multiple and the other logistic, totaling eight regressions.

The analyses were done individually by clusters and all regression results were grouped together in Table 1 in order to better reach the conclusions of this study.

**TABLE 1** SUMMARY OF REGRESSIONS OF THE STUDY

Causal signs	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
	(MR)	(LR)	(MR)	(LR)	(MR)	(LR)	(MR)	(LR)
Elementary_father							+	+
High school_father	+			-	+		+	+
University_father	+	+			+		+	+
Elementary_mother			-	-				
High school_mother							+	
University_mother								
Income_stand	+	+	+	+	+		+	
Education system	-	-	-	-	N/a	N/a	N/a	N/a
Gender	-		-		-	-	-	-
Race		-	-		-	+		+
Age	-	-	-		-	-	-	-
Coefficients of regression								
Elementary_father							9.100	1.636
High school_father	9.955			1.278	8.740		20.853	2.770
University_father	18.634	1.730			15.413		17.317	3.194
Elementary_mother			-8.850	1.240				
High school_mother							12.081	
University_mother								
Income_stand	62.140	3.230	71.019	1.779	34.449		27.450	
Education system	-43.095	2.245	-22.000	1.634	N/a	N/a	N/a	N/a
Gender	-9.281		-15.555		-12.350	1.395	-13.673	1.320
Race		1.262	-7.872		-4.903	1.834		1.801
Age	-7.757	1.098	-3.548		-11.673	1.423	-12.742	1.409

**Source:** Elaborated by the authors.

**Note:** MR = Multiple regression; LR = Logistic regression; N/a = the education system variable does not comprise the ProITEC model, since the students are already from the public school.

The household income was the most influential variable on the performance of students applying for IFRN vacancies, from among the variables addressed in this study. There are positive effects in all multiple regressions, with a coefficient varying from 27.450 (cluster 4) to 71.019 (cluster 2).

It should be mentioned that the household income was the most influential variable for the candidates in the admissions examination (clusters 1 and 2), a finding corroborated by the results of the logistic regression, since the *income\_stand* was not significant for the models of clusters 3 and 4 (ProITEC). This phenomenon can be explained by the low variability of the data, whose values vary between BRL 70.00 and BRL 2,814.00, with the standard deviation of BRL 469.81.

The variable components of the father's schooling (*university\_father*, *high school\_father*, *elementary\_father*) evidenced influence on the candidates' performance for all clusters studied. In clusters 1, 3 and 4 a positive effect was found for the two types of regression, highlighting the variables *university\_father* and *high school\_father*, whose effects of the multiple regression varied from 8.740 (cluster 3) to 20.853 (cluster 4) and from 15.413 (cluster 3) to 18.634 (cluster 1) respectively; and, for logistic regression, the *university\_father* variable showed a variation from 1.730 (cluster 1) to 3.194 times (cluster 4) with more chances of the candidate's acceptance in the IFRN.

Two negative effects occurred in the logistic regression of cluster 2, one for the *high school\_father* variable and the other for *elementary\_mother* and, in fact, the latter also had a negative causality in the multiple regression. These results can be explained by the high predictive power of the *income\_stand* variable in this model. In the most specific case of the *elementary\_mother* variable, the results found in literature already confirm the negative influence of this variable, as commented by Emilio et al. (2004) and J. Guimarães and Sampaio (2013).

The other variables of the mother's schooling (*university\_mother* and *high school\_mother*) were in general insignificant, which diverges from the specialized literature on background for the *university\_mother* variable (Emilio et al., 2004; J. Guimarães & Sampaio, 2013; Harding, Jencks, Lopoo, & Mayer, 2018) and for the *high school\_mother* variable (J. Guimarães & Sampaio, 2013; Woessmann, 2004). The *high school\_mother* variable only had a positive effect for cluster 4, the coefficients of the father's schooling all being significant, demonstrating a low explanation of the *high school\_mother* variable.

The control variables were in accordance with the recommendations in literature, principally the influence of the education system variable for clusters 1 and 2, of which public school students may even have a deficit of 43.095 points in the final e-score of the admissions examination. Another strongly impacting variable is age, since for every year above average there may be a drop of up to 12.742 (cluster 4).

It is also worth emphasizing that women in all clusters showed negative effects and the race variable caused a negative impact for the admission examination in relation to the group of blacks, browns and indigenous. In clusters 3 and 4 (ProITEC), the results accompanied the survey analyses of J. Guimarães and Sampaio (2013) with a positive effect for the group of blacks, browns and indigenous from a public school.

## 5. HYPOTHESIS TESTING

Going back to the hypotheses, test  $t$  was applied to the multiple regressions and the Wald test to the logistic regressions, as shown in Table 2, in order to confirm or refute the hypotheses maintained so far.

**TABLE 2** RESULTS OF THE T TEST AND WALD TEST FOR THE SURVEY HYPOTHESES

		Cluster 1		Cluster 2		Cluster 3		Cluster 4	
		(MR)	(LR)	(MR)	(LR)	(MR)	(LR)	(MR)	(LR)
HYPOTHESIS 1 – Household income									
Income_stand	Test $t$	5,805	9,306	9,230	8,449	5,805	1,409	3,427	0,083
	Value $p$	0,000**	0,002**	0,000**	0,004**	0,000**	0,235	0,001**	0,773
HYPOTHESIS 2 – Father's schooling									
Proposition (2.1)	Test $t$	-0,017	0,725	-1,4311	0,370	0,277	0,012	2,014	4,460
Elementary_father	Value $p$	0,986	0,394	0,152	0,543	0,782	0,912	0,044*	0,035*
Proposition (2.2) High school_father	Test $t$	2,185	1,448	-0,364	6,582	2,889	2,991	3,681	23,771
	Value $p$	0,029*	0,229	0,715	0,010**	0,004**	0,084	0,000**	0,000**
Proposition (2.3)	Test $t$	2,303	7,030	0,446	0,532	2,120	2,640	1,987	7,024
University_father	Value $p$	0,021*	0,008**	0,665	0,466	0,034*	0,104	0,047*	0,008**
HYPOTHESIS 3 – Mother's schooling									
Proposition (3.1)	Test $t$	0,577	0,033	-2,620	4,042	-0,743	0,098	0,147	0,003
Elementary_mother	Value $p$	0,564	0,857	0,009**	0,044	0,458	0,754	0,883	0,956
Proposition (3.2) High school_mother	Test $t$	0,363	0,012	-0,617	3,576	-0,748	0,154	3,944	3,697
	Value $p$	0,717	0,913	0,537	0,059	0,454	0,695	0,000**	0,055
Proposition (3.3)	Test $t$	1,389	2,432	0,217	0,075	-0,701	0,09	0,400	0,115
University_mother	Value $p$	0,165	0,119	0,828	0,784	0,483	0,764	0,689	0,735

**Source:** Elaborated by the authors.

**Note 1:** \* Significance level = 95% (value  $p < 0.05$ ) \*\* Significance level = 99% (value  $p < 0.01$ ).

**Note 2:** MR = Multiple regression; LR = Logistic regression.

Tests were performed with significance levels of 95% and 99%, the assessed results of which did not represent considerable difference in causality. The first hypothesis to be tested concerns the influence of household income. Hypothesis  $H_0$  was rejected for all multiple regressions and clusters 1 and 2



of the logistic regression, the alternative hypothesis  $H_1$  was accepted. Hypothesis  $H_0$  was accepted for the logistic regressions of clusters 3 and 4 (ProITEC), refuting hypothesis  $H_1$ . Hypothesis  $H_1$  was confirmed for clusters 1 and 2, using the two statistical tools; that is, it can be said that the chances of admission to federal technical education increase the higher is the candidate's household income in the admissions examination. In the case of ProITEC, this hypothesis is assumed through the multiple regressions, since the logistic regressions are not significant.

The results found in hypothesis  $H_1$  are underpinned by the studies of Duncan et al. (1994), Tran and Nathan (2012), J. Guimarães and Sampaio (2013) and M. K. Miller et al. (2014), who conclude, in their analyses, how important the household income variable is as a determinant factor of student achievement.

Hypothesis  $H_2$  addresses the influence of the father's schooling on the student's achievement, and was accordingly divided into three propositions ( $P_{2.1}$ ,  $P_{2.2}$ ,  $P_{2.3}$ ). Hypothesis  $H_0$ , for proposition  $P_{2.1}$ , was rejected only in relation to cluster 4, and was accepted for the other clusters, which suggests a low influence of the father's elementary schooling as a determinant variable for his child's admission to the IFRN. Such findings are corroborated by the studies of Lefebvre and Merrigan (1998), Emilio et al. (2004), Cavalcanti et al. (2010), D. B. Guimarães and Arraes (2010) and J. Guimarães and Sampaio (2013), which demonstrated low significance for the variable, or a negative effect.

The second proposition ( $P_{2.2}$ ) addresses the father's influence with completed high school schooling. Clusters 1, 3 and 4 showed rejection of the null hypothesis  $H_0$  and acceptance of the hypothesis proposed by the survey, as attested by the works of Lefebvre and Merrigan (1998), Emilio et al. (2004), Cavalcanti et al. (2010) and J. Guimarães and Sampaio (2013). Only for cluster 2 was there acceptance of the null hypothesis  $H_0$  and rejection of the alternative  $H_1$  in the context of the logistic regression, confirming the survey by D. B. Guimarães and Arraes (2010). Although the variable is statistically significant, it has a negative causality in contrast to the proposition.

It may be considered that, in ProITEC and cluster 1 (Apodi, Currais Novos, Ipanguaçu, João Câmara, Nova Cruz and São Gonçalo do Amarante) of the admissions examination, the father's schooling has a positive influence on the child's performance, while in cluster 2 (Caicó, Macau, Mossoró, Natal, Natal Zona Norte, Parnamirim, Pau dos Ferros and Santa Cruz) of the admissions examination, the high school\_father variable has no influence whatsoever.

The third and last proposition of hypothesis  $H_2$  ( $P_{2.3}$ ) addresses the influence of education when the father has graduated from university. The results reject the null hypothesis  $H_0$  for the regressions of clusters 1 and 4, and with significance for the multiple regression of cluster 3. The propositions of cluster 2 were refuted, accompanying the results of proposition  $P_{2.3}$ .

The tests confirm for clusters 1, 3 and 4 the initial hypothesis  $H_2$  that the father's schooling positively influences access to the Brazilian federal technical education, confirming what has already been found in the analyses by Lefebvre and Merrigan (1998), Emilio et al. (2004), Cavalcanti et al. (2010), D. B. Guimarães and Arraes (2010), J. Guimarães and Sampaio (2013) and M. K. Miller et al. (2014) on the influence of the father's university level as a variable with positive impact on the student's performance.

Hypothesis  $H_3$  addresses the influence of the mother's schooling on the student's attainment, and was accordingly split into three propositions ( $P_{3.1}$ ,  $P_{3.2}$ ,  $P_{3.3}$ ). Hypothesis  $H_0$  for proposition  $P_{3.1}$  was accepted for clusters 1, 3, 4 and rejected for cluster 2, but refuted when the proposition was observed,

which shows that the mother's elementary schooling has a negative influence on the context of cluster 2 as a determinant variable for the student's admission to the IFRN. This behavior was also noticed in earlier studies undertaken by Emilio et al. (2004) and J. Guimarães and Sampaio (2013).

The second proposition ( $P_{3,2}$ ) addresses the mother's influence with completed high school education. Clusters 1, 2 and 3 showed acceptance of the null hypothesis  $H_0$  and consequent rejection of the hypothesis proposed by the survey ( $H_1$ ). Only for cluster 4 was there rejection of the null hypothesis and acceptance of the alternative  $H_1$ , concerning multiple regression. Weak influence is found for the high school\_mother variable on the student's performance, since it was only significant for the multiple regression of cluster 4.

In the studies by Emilio et al. (2004) and J. Guimarães, Sampaio (2013), the high school\_mother variable presented a negative causality, which could denote the absence of an explanation for this database, but the specialized literature (Castelar et al., 2010; Cavalcanti et al., 2010; Duncan et al., 1994; D. B. Guimarães & Arraes, 2010; Woessmann, 2004; Riani & Rios-Neto, 2008) considers the mother's schooling to be decisive in the student's performance, diverging from the findings in the study herein.

The third proposition of hypothesis  $H_3$  ( $P_{3,3}$ ) concerns the influence of education when the mother has graduated from university. The results accept the null hypothesis  $H_0$  for all scenarios built in this survey. As shown in Table 6, the propositions of all clusters were refuted diverging from the results in the literature (Castelar et al., 2010; Cavalcanti et al., 2010; Duncan et al., 1994; D. B. Guimarães & Arraes, 2010; Lefebvre & Merrigan, 1998; Riani & Rios-Neto, 2008; Woessmann, 2004) that had compelling findings about the importance of the university\_mother variable for student achievement.

For clusters 1, 2 and 3, the tests refute the initial hypothesis  $H_3$  that the mother's schooling has a positive influence on the access to Brazilian federal technical education. Cluster 4 confirmed the hypothesis only for the high school\_mother variable.

## 6. CONCLUSIONS

The purpose of this study comprised the analysis of the influence of the home background as a determinant of student achievement to access the IFRN professional technical education. Therefore, five (5) specific objectives were adopted in order to solve the proposed research question and also three (3) hypotheses, resulting from the analyses of the literature review.

The hypotheses formulated for this study were tested with 95% and 99% significances using the test  $t$  (multiple regressions) and the Wald test (logistic regressions). Hypothesis  $H_1$  was confirmed for all clusters with 99% significance, and it may be said that the chances of admission to Brazilian federal technical education increase the higher the candidate's household income.

Proposition  $P_{2,1}$  was confirmed only for cluster 4, denoting low parental influence with elementary education on the children's achievement. On the other hand, propositions  $P_{2,2}$  and  $P_{2,3}$  were confirmed for clusters 1, 3 and 4. Considering the above, it must be concluded that the influence of the father's schooling variable has a positive effect for the candidates to ProITEC, concerning the parents with high school and university education. Now in relation to the admissions examination, only cluster 1 had a positive influence from the father's schooling. It follows, therefore, that for the admission examination, the father's schooling has a positive influence on the campuses of small and medium-sized towns inland, while the campuses of the capital and large and medium cities (cluster 2) showed no statistical significance.

Propositions  $P_{3.1}$  and  $P_{3.3}$  had no statistical significance and were rejected. Only one proposition  $P_{3.2}$  was confirmed for cluster 4. In the light of the above, it can be said that the mother's schooling did not influence the candidates' attainment to the places in the federal technical education for 2013, considering the rejection of hypothesis  $H_3$  in this study.

With regard to the control variables studied, a negative influence was evidenced when the candidate to a place in the studied education institution is female, then the fact of being a woman leads on average to a disadvantage in the final e-score. Other key variables in this analysis are race and education system. The results assured that IPP students and those from public schools had a major disadvantage in the e-score, which could be confirmed by the significant shortcomings in Brazilian primary education and also in the racial intolerance so present in today's society. Concerning the age variable, for each extra year, the candidates increase their chances of up to 1.409 times rejection. The positive logit values show a 1.32 times increase in the chances of rejection of female candidates, compared to the men.

The results from this study provide analytical and theoretical subsidies that may act as an aid to decision making of the Brazilian technical education institutions, especially the IFRN, related to their access policies. It is worth stressing the importance of analyses and results obtained by this investigation, since it is the first to address the influence of home background, having the Brazilian federal technical education as an object of study.

The discussions in this study may also subsidize studies for the public education authorities in terms of greater participation of black, brown and indigenous people in university chairs, and may through affirmative middle-term public policies reopen the discussion on the percentages of quotas in accordance with the regional characteristics of ethnic background. This measurement must reflect in the household income variable, thereby reducing its interference so overwhelming in the students' performance. Considering the results presented by public school students, a deep reflection was evidently necessary on the efficacy of the education provided to the students by states and municipalities, since they reveal serious learning shortcomings in selection processes.

Concerning home background variables, it can be said that they are determinants of the candidate's attainment to the federal technical education in respect of the *father's schooling* and *household income* variables, as advocated by Becker (1964) in the theory of human capital. The *mother's schooling* variable was not significant for the databases of this study. It was also evidenced that the methodology adopted reinforces the social management process of the Brazilian authorities, providing them with a reliable method to check the coverage of their social policies, especially with regard to racial quotas and public school efficiency.

For future studies the application of the adopted methodology is suggested, using data from at least three subsequent years, in order to better assess the results for technical education. The study can also be extended by including the school infrastructure variables, via multilevel regression, now commonly used by the specialist literature.

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