

SPATIAL ANALYSIS BETWEEN YOUTH AND ADULT EDUCATION AND LABOR MARKET REMUNERATION

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ABSTRACT

This study analyzes the spatial distribution of migration from traditional high school to Youth and Adult Education (YAE) and its relationship with formal work remuneration. For this, the Exploratory Spatial Data Analysis (ESDA) technique was used through global and local analyses. The results of the global analysis indicate a negative spatial autocorrelation between migration from regular secondary education to YAE and formal work remuneration. The local analysis indicated that the Northeast had the highest proportion of municipalities in the cluster with high migration of individuals in the YAE and higher remuneration in the formal market, while the South region had the highest concentration of municipalities with a low proportion of municipalities in the cluster with low migration of individuals in the YAE and high remuneration in the formal job market. Therefore, it is concluded that the low quality of YAE teaching leads individuals to enter the formal job market with a lower pay.

Keywords: youth and adult education; education context, economic context, job market, regional development.

RESUMO

ANÁLISE ESPACIAL ENTRE EDUCAÇÃO DE JOVENS E ADULTOS E REMUNERAÇÃO DO MERCADO DE TRABALHO

Este estudo tem como objetivo analisar a distribuição espacial da migração do ensino médio tradicional para a Educação de Jovens e Adultos (EJA) e sua

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relação com a remuneração do trabalho formal. Para isso, foi utilizada a técnica de Análise Exploratória de Dados Espaciais (AEDE), por meio das análises global e local. O resultado da análise global indicou autocorrelação espacial negativa entre migração do ensino médio regular para a EJA e a remuneração do trabalho formal. A análise local indicou que o Nordeste apresentou a maior proporção de municípios no cluster com alta migração de indivíduos na EJA e com maior remuneração no mercado formal e a região Sul apresentou a maior concentração de municípios com baixa proporção de municípios no cluster com baixa migração de indivíduos na EJA e elevada remuneração no mercado de trabalho formal. Dessa forma, conclui-se que a baixa qualidade do ensino da EJA leva o indivíduo a entrar no mercado de trabalho formal com uma remuneração inferior.

Palavras-chave: educação de jovens e adultos; contexto da educação, contexto econômico, mercado de trabalho, desenvolvimento regional.

RESUMEN

ANÁLISIS ESPACIAL ENTRE LA EDUCACIÓN DE JÓVENES Y DE ADULTOS Y LA REMUNERACIÓN EN EL MERCADO LABORAL

Este estudio tiene como objetivo analizar la distribución espacial de la migración desde la educación secundaria tradicional hacia la Educación de Jóvenes y Adultos (EJA) y su relación con la remuneración laboral formal. Para ello se utilizó la técnica de Análisis Exploratorio de Datos Espaciales (AEDE), mediante análisis globales y locales. El resultado del análisis global indicó una autocorrelación espacial negativa entre la migración de la educación secundaria regular a la EJA y la remuneración del trabajo formal. El análisis local indicó que el Nordeste tenía la mayor proporción de municipios del cluster con alta migración de personas en la EJA y con mayor remuneración en el mercado formal y la región Sur tenía la mayor concentración de municipios con baja proporción de municipios del Clúster con baja migración de individuos en EJA y alta remuneración en el mercado laboral formal. Por lo tanto, se concluye que la baja calidad de la enseñanza EJA lleva a los individuos a ingresar al mercado laboral formal con menores salarios.

Palabras-clave: educación de jóvenes y adultos; contexto educativo, contexto económico, mercado laboral, desarrollo regional.

Introduction

Youth and Adult Education (YAE) plays a fundamental role in Brazilian society, offering a vital opportunity for young people and adults to complete their studies and expand their horizons. In a context marked by an increasingly demanding job market in which knowledge is the main driver of the economy, YAE emerges as an indispensable instrument for professional integration and the reduction of social disparities (Colavitto; Arruda, 2014).

However, the history of the YAE in Brazil is permeated by exclusions and denials of rights, reflecting struggles for rights in Brazilian society. Over time, the YAE has undergone several phases and significant historical milestones. Initially, its implementation took place in the 1940s, configuring itself as a differentiated system aimed at specific needs of the time. However, since the arrival of the Portuguese royal family in Brazilian lands, several attempts

at adult education have been carried out, but without clear objectives, educational and social commitment, or adequate public policies.

In the 1960s, the Brazilian Literacy Movement (MOBRAL) was created, which is one of the most significant literacy programs for young people and adults in Brazil. It was an initiative of the military government to eradicate illiteracy in Brazil through a mass education approach. Continuing with the objective of offering popular education, in the 1970s Basic Education policies were implemented, which included programs aimed at educating young people and adults in rural and urban areas. These programs aim to integrate formal education with student's socioeconomic and cultural realities, promoting popular education (Rummert; Ventura, 2007).

The Federal Constitution of 1988 and the Law of Guidelines and Bases of National Education (LDB) of 1996 were milestones that changed the understanding of education for adults and disadvantaged classes, as they provided for the rights of young people and adults to Elementary Education, mandating its provision to be regulated by public authorities (Rummert; Ventura, 2007).

Different historical milestones, such as the Literacy Programs established in Brazil (1959-1964) and the implementation of public policies for education, such as the Brazilian Constitution of 1988, which recognized everyone's right to education by affirming compulsory primary education and free, regardless of age (Rummert; Ventura, 2007; Vieira, 2010; Becker; Keller, 2020).

The Federal Constitution of 1988 and the Law of Guidelines and Bases of National Education (LDB) of 1996 were crucial milestones that changed the understanding of education for adults and for disadvantaged classes by guaranteeing the rights of young people and adults to Fundamental Education and mandating its regular supply by public authorities (Rummert; Ventura, 2007). Several other movements in favor of education, linked to historical moments,

were decisive for the evolution of YAE in Brazil, such as literacy programs that were consolidated due to public educational policies, supported by the 1988 Constitution, recognizing everyone's right to education, and establishing elementary education as mandatory and free, regardless of age (Rummert; Ventura, 2007; Vieira, 2010).

Considering this social, economic, and educational scenario, this study poses the following research question: What is the influence of migration from regular secondary education to EJA on formal work remuneration?

The main objective of this study was to analyze the spatial distribution of migration from traditional secondary education to youth and adult education (YAE) and its relationship with formal work remuneration. In this way, we intend to empirically verify whether there are spatial clusters in this migration to the YAE and whether this condition affects the average remuneration for formal work in Brazilian municipalities.

Investigating the spatial relationship between YAE and income is justified for several reasons. First, literature on this topic is still incipient, especially in the Brazilian context. This study fills this gap by providing empirical evidence on the importance of the YAE in reducing socioeconomic disparities. Second, the results of this study can support the formulation of more effective public policies to promote the retention of young people in regular education and for students in YAE, improve the quality of education, and enable better remuneration.

Finally, spatial analysis allows for a deeper understanding of the Brazilian labor market, considering regional disparities and the concentration of job opportunities. The present study aims to demonstrate that young people who complete regular education can have a better quality of education and thus have better opportunities in the job market due to the current fragility of the YAE (Mariano et al., 2023).

The remainder of this paper is organized as follows. Section 2 presents the Theoretical

Framework with a broad literature review on the YAE, labor market, human capital, remuneration, and productivity. Section 3 describes the econometric methodology used in the study. Section 4 presents an analysis of the research results, including an estimation of econometric models and spatial analysis. Section 5 discusses the results and implications for public policies. Finally, Section 6 presents conclusions and suggestions for future research.

Theoretical framework

The structure of Brazilian education has always been shaped by several factors, including social, economic, and political aspects. Throughout history, education has sought ways to face challenges and evolve according to society's needs.

With a brief review of this structure, it is possible to understand how we arrived at the present educational design. During colonial times, education in Brazil was limited to privileged classes and was oriented towards the training of religious, military, and colonial administrators, controlled by the Catholic Church and colonial governments (De Paula Silva; Sartori, 2016). In 1854, decree no. 1331-A regulated primary and secondary education in the Municipality of Corte, allowing schools that had more than one teacher to serve adults interested in learning; however, these classes had to take place twice a week, during free hours, on Sundays and holidays, and teach primary education content (BRASIL, 1854, Art. 71). This determination reveals the need to teach poor adults to read and write, as well as the state's lack of interest in educating citizens concerned about working to maintain their lives and who had not had the opportunity to access the school environment in their childhood. Despite the organization being designed regarding the country's economic growth, as well as the need for more prepared workers, the state did not recognize the obligation to provide this training (Torino; de Sousa; Rodriguez, 2024; De Paula Silva; Sartori, 2016).

Entering the imperial period in the 19th century, education became more accessible to popular classes, but it was still far from being a right for everyone. Education is aimed at training political and business leaders (Serra, 2023). In the period called the Old Republic, between 1889 and 1930, education became more formalized and structured since the Constitution of 1891 established mandatory education for all citizens, but this measure was not implemented due to the lack of resources and infrastructure. During this period of the industrialization of production processes, education for the generation of labor is rethought, as there is a need for people who are minimally capable of operating the emerging machinery (Torino; de Sousa; Rodriguez, 2024).

In this way, education aimed at the most disadvantaged population focused on training and labor and not on the development of human, social, and citizenship aspects. With the change from the agrarian socio-productive model to the industrial one, the government from the Ministry of Agriculture, Industry, and Commerce required various actions, among many others, the creation of Artificer Apprentice Schools, with specific legislation that differentiated them from others. Targeted trade institutions including those maintained by the federal government (De Paula Silva; Sartori, 2016; Serra, 2023). These institutions aimed to train workers and supervisors based on technical and practical knowledge to place less-privileged people in the job market.

From the period of the New Republic, 1930 to 1964, education went through a series of reforms that changed, period by period, the way of conceiving and structuring educational segments, the period of permanence in the school environment, teaching modalities and, in particular, to whom this education would be offered. The 1934 Constitution recognized the right to education for all, establishing that children aged 7 to 14 must attend free school, guaranteeing university autonomy, allowing universities to exercise freedom of teaching,

research, and management; inserting optional religious education; defining equal rights between men and women to education; and creating technical-professional courses, aiming to prepare citizens for the job market (De Paula Silva; Sartori, 2016; Becker, Keller, 2020).

With the coup d'état of 1964, Brazil entered a period of dictatorship and began to be governed by the military regime, which caused changes in all segments of society, including education. During this period, the ideology of those in power was reflected in the school environment, both in basic and higher education. Changes are evident in the improvements but also in the restrictions, as schools, universities, and teachers were heavily monitored to guarantee the imposed regime (Mansan, 2017; Becker, Keller, 2020). There was centralization and state control over the educational system with the appointment of school directors' supervisors and deans, as well as control of the content of textbooks and other educational materials. Teachers and students considered contrary to the ideology set by the state were persecuted and arrested, and many of them were killed. Disciplines such as moral and civic education and the Brazilian social and political organization were created, and teaching modalities such as Technical and Vocational Education and Youth and Adult Education (YAE) were expanded, as the military regime intended to meet the demands of the education market. Work and promote a country's economic development. Despite some investments in educational infrastructure, such as the expansion of technical schools, education has continued to reflect social and regional inequalities, with unequal access to quality education (Mansan, 2017; Huerta, 2018).

With the end of the period of military dictatorship, in 1985 the country entered a period known as a great transformation, and educational systems was once again impacted. However, before the end of the dictatorship, there were already movements that were organized to discuss the Brazilian educational issue, in

general, and in specific modalities such as YAE which until then had not been institutionalized. For example, in Paulo Freire, with his method of teaching adult sugarcane cutters to read and write, 300 workers became literate in 45 days. This method was disseminated and used by Popular Culture Centers coordinated by the National Student Union (UNE) to teach young and adult people to read and write (Becker; Keller, 2020; Mariano et al. 2023).

Due to the recognition of the work developed by Paulo Freire, the authors Becker; Keller (2020) recall that he was designated as responsible for creating the National Adult Literacy Program of the Ministry of Education and Culture, approved based on Decree 53,465 on 21 January 1964 and whose goal was to provide two million people.

In 1976, the federal government established Youth and Adult Education to educate those who had not yet had access to formal education, thus meeting the needs of a developing society (Mariano et al. 2023).

Considering the focus of this study, the following are reflective historical considerations about the YAE in Brazilian territory to had better understand this very specific scenario: the education of young and adult people in situations of social and economic disadvantage.

Institutionalization of Youth and Adult Education in Brazil

The roots of Youth and Adult Education (YAE) in Brazil, as we saw previously, date back to the beginning of the 20th century when isolated initiatives sought to meet the demand for education from people who did not have access to schooling at a regular age. However, the creation and institutionalization of the YAE as a formal teaching modality gained strength in the 1940s with the creation of the Brazilian Basic Education Movement (MBEB). MBEB, inspired by the principles of popular education, defended critical and transformative pedagogy and focused on the reality and needs of students.

In the 1960s, YAE gained momentum with the creation of the National Literacy Program (MOBRAL), which aimed to reduce high rates of illiteracy in the country. MOBRAL used innovative methods for the time, such as radio teaching, and made millions of young people and adults literate. Despite its criticism, the program represented an important milestone in the history of YAE (Torino; de Sousa; Rodriguez, 2024).

From the 1980s onwards, with the re-democratization of the country, YAE went through a process of reformulation and strengthening. The National Education Guidelines and Bases Law - Law No. 9394/96, enacted in 1996, recognizes YAE as a type of primary and secondary education, with the right to its own curriculum and qualified teachers. During this period, the country had approximately 15 million illiterate individuals (Becker; Keller, 2020). In 2000, Opinion CEB No. 11/2000 was approved by the National Education Council and the Chamber of Basic Education approved, in the same year, Opinion CEB No. 11/2000, established the curricular guidelines and functions for this type of education. teaching modality (Mariano et al., 2023).

With the institutionalization of the legal frameworks that legitimize the YAE, education focusing on the young and adult population, low-income, working, with a large gap in basic school content, and those with disabilities gained space in the educational scenario, strengthening this segment. The historical context with a precarious, utilitarian, compensatory, and supplementary vision gains a new conception towards its consolidation of YAE as a social and subjective right of state responsibility for offering, structuring, and maintaining this educational modality (Becker; Keller, 2020).

The YAE, in its current structure, targets people over 14 years of age and with no upper age limit, who did not have access to schooling at a regular age, or who abandoned it for different reasons. This diversity, a specificity of

great relevance to be considered by education professionals, translates into an audience with specific characteristics and needs, which requires a different pedagogical approach as this age range implies different levels of maturity, life experiences, and expectations concerning education. The motivation to study is another distinct element, as it can come from the desire to complete the interrupted school phase or even the search for better opportunities in the job market, as the search for better jobs is generally conditioned by schooling. Entering higher education, taking the National Examination for the Certification of Competences of Young People and Adults, one of the main mechanisms for entering universities in Brazil, is also a motivation for these students (Mariano et al., 2023).

This public is also characterized by different levels of education, from those who have never attended school to those who have completed primary or secondary education.

The YAE students, as previously mentioned, are individuals who require long working hours to maintain their lives and families, which necessitates reconciling studies with work and other responsibilities, such as taking care of the family and requiring flexibility and adaptability on the part of the school and the school curriculum. To attend primary school, these students must be over 14 years old, and to enroll in secondary school, they must be 17 years old or over (Mariano et al. 2023).

Considering the main functions of the YAE, namely, the reparative function that guarantees access to denied rights, such as a quality school, the equalizing function that aims to offer equal opportunities, and qualifying or permanent functions that update knowledge and develop human potential throughout life (Becker; Keller, 2020), is a fundamental right of all citizens and a crucial tool for the construction of a fairer, democratic, and inclusive society. Through YAE, it is possible to have access to better opportunities in life and contribute to the country's development. YAE must be

valued and strengthened with investment in infrastructure, teacher training, and adequate teaching materials so that it can fulfill its important mission.

Given the recognition of the relevance of the training offered by the YAE modality, especially for those students who leave school or those who need to leave regular education to enter the job market, an in-depth analysis of the challenges and opportunities that permeate this teaching modality is needed. In addition to recognizing its relevance, it is essential to implement concrete measures that enable access to YAE and the construction of an inclusive and effective educational environment for everyone involved, offering quality education so that it can provide access to the education market. work competitively with EJA students, being able to be equivalent, educationally, with regular education (Bezerra; Machado, 2017).

With the consolidation of the YAE as an essential public policy for the construction of a fairer and more democratic society and despite the challenges that still exist, such as school dropout and lack of infrastructure, this modality has contributed to social inclusion, the reduction of inequalities, and human development in Brazil. To support the implementation of public policies that strengthen this type of teaching, it is necessary to deeply understand who these students are, and what their perspectives, needs, and potential are in the knowledge society, which has knowledge and technology as its driving elements (Mariano et al. 2023).

Considering that the current public policies that design YAE in Brazil are influenced by international organizations such as UNESCO, for example, it is worth considering that its core lies in education with a qualifying function aimed at the world of work, with a focus on the development of skills and competencies necessary for operating in different sectors of the economy (Bezerra; Machado, 2017). The provision of quality education in the YAE modality can meet the demands of the job market and

the social role that this modality is intended to contribute to the development of society and individuals (Bezerra; Machado, 2017).

This study aims to deepen the understanding of the profile of students who abandon regular education, with a special focus on those enrolled in secondary education and who opt for the YAE modality to complete their academic training. Furthermore, we seek to analyze how these students are received in the job market, considering that their training may be considerably lower than that of students who follow the traditional teaching route, and this difference in training may be reflected in their remuneration. This raises important questions about equity and access to the job market for YAE students.

Human Capital, Productivity, Economic Development, and YAE

The concept of Human Capital transcends the notion of individual knowledge and assumes a central role in the economic development of a country. According to Schultz (1973), human capital theory postulates that education and training increase individuals' productivity, leading to higher wages and contributing to economic progress. This concept intertwines quantitative and qualitative elements, suggesting that the level of human capital in a country or region significantly influences society and creates conditions conducive to economic development. The qualitative aspects of human capital, such as technical training, knowledge, and specific attributes, directly affect human skills and productivity, thus impacting salary levels. As individuals acquire more education and skills, their job market value increases, leading to higher remuneration (Viana; Lima, 2010).

In turn, education increases individual productivity by equipping people with knowledge, skills, and competencies that allow them to perform tasks more efficiently and effectively (Viana; Lima, 2010). The human capital theory highlights that education contributes to

economic growth by making individuals more productive, which is reflected in increased wages and general economic progress. However, the quality of education is crucial, as it must be sufficient to increase productivity and contribute to economic and social advancement. Advanced skills and knowledge acquired through education lead to innovation and technological advancement, further boosting productivity in the economy. Therefore, the impact of education on individual productivity is not only immediate in terms of work performance but also long-term in promoting economic development (Becker, 1964).

Furthermore, several empirical studies measure and point to a relationship between increased education and productivity within the scope of Human Capital Theory, such as studies by Lucas (1988), Romer (1986, 1989), Mankiw, Romer, and Weil (1992), Benhabid and Spiegel (1994), Bergheim (2005), and Brazilian studies, such as those by Pereira (2001), Ferreira, Nakabashi, and Santos (2003), Nakabashi and Figueiredo (2008), Kroth and Dias (2012), and Bondezan and Dias (2016). Therefore, YAE presents itself as a public policy capable of overcoming the low productivity of the Brazilian workforce and allowing access to education for people who do not have adequate opportunities to study, train, and seek better-paying jobs (Becker; Keller, 2020).

By allowing workers with little education to train, YAE is of paramount importance as a public policy for educational inclusion, as it allows people to complete high school. This policy meets the premises of Human Capital theory, in which increasing years of schooling allows for an increase in productivity and income (Romer, 1986; 1989).

However, it is important to highlight that when applied indiscriminately and repeatedly, just as a selective educational policy does not act more effectively on basic education policies, the quality of teaching will invariably decline. Rummert and Ventura (2007) highlighted the partiality of Youth and Adult Education (YAE)

in Brazil concerning a utilitarian and impoverished educational conception that aligns with the country's subordinate economic position in the global market, focusing mainly on neuromuscular economic activities that require minimum educational investment. This educational approach for young and adult workers is narrowly tailored to the needs of the social capital model, positioning them predominantly as consumers rather than producers of technology. Furthermore, despite the constitutional recognition of education as a right, YAE has been relegated to a secondary position in educational policies, particularly after the reforms of the 1990s. Policies are characterized as compensatory and superficial, reinforcing the selective and exclusionary nature of education—the Brazilian public educational system (Rummert; Ventura, 2007). Therefore, as it is a secondary, compensatory, and superficial educational policy, its quality is questionable and precarious in most municipalities and causes a drop in the quality of education in general. To understand the quality of the YAE in Brazil and its impact on remuneration, an Exploratory Spatial Data Analysis (ESDA) model is developed and presented in the next section.

Methodology

The classification of this study consists of cross-sectional research of an applied nature that adopts a quantitative approach with descriptive objectives. Its transversal nature stands out for collecting data related to a period, providing an instantaneous view of the relationships between specific variables. Applied research, by generating practical knowledge and solutions to concrete issues, focuses on investigating one of the main factors that influences the transition from traditional secondary education to secondary education in Youth and Adult Education (YAE), the job market.

The quantitative approach uses the statistical method of Exploratory Spatial Data Analysis (ESDA), enabling the quantification of variables

related to the labour market and secondary education in YAE. Descriptive objectives were achieved by analysing the spatial autocorrelation between the mentioned variables.

The objective of this study is to examine the relationship between formal work remuneration and the migration of young people from traditional secondary education to YAE secondary education in a regional context. To achieve this objective, updated databases of the Annual Social Information List – RAIS (RAIS, 2024) and the School Census of the National Institute of Educational Studies and Research Anísio Teixeira – Inep (Inep, 2024) were used. These banks cover information on 5570 municipalities in December 2021 and 2023. However, information from 5563 municipalities (99.9%) was used, due to there being no enrollment in secondary education in 7 municipalities (Flexeiras-AL, Jequiá da Praia-AL, Roteiro-AL, Serra da Saudade-MG, São Pedro da Serra-RS, Chapada de Areaia-TO, Monte Santo do Tocantins-TO).

The proxy for the formal work remuneration variable was constructed using the relationship between the total formal work remuneration in December 2021 and the number of formal workers in the same period, as provided by the RAIS. As for the YAE variable, the proxy was measured by the proportion of students in YAE high school to the total number of students in traditional high school and YAE high school. In this way, we seek to verify the existence of a relationship between the average remuneration for formal work and the proportion of students in YAE secondary education in a regional context. For the estimates, Geoda software and Quantum GIS software were used to create thematic maps.

Method: Exploratory spatial data analysis (ESDA)

It is a fundamental technique for describing and visualizing spatial distributions, identifying atypical locations (spatial outliers), discovering patterns of spatial association (spatial clusters), and suggesting different spatial re-

gimes and forms of instability (Anselin, 1996). The first step in Exploratory Spatial Data Analysis (ESDA) is to check whether spatial data are randomly distributed. In intuitive terms, spatial randomness implies that the values of an attribute in a region do not depend on the values of that attribute in neighboring regions (Anselin, 1995).

From the ESDA, it is possible to extract global and local spatial autocorrelation measures by investigating the influence of spatial effects through quantitative methods. To conduct ESDA, it is necessary to establish a matrix of spatial weights that describes the dependence structure between the units of analysis (Anselin, 1988).

Spatial weight matrices are constructed based on contiguity and can be defined according to the neighborhood. The degree of connection in the spatial weight matrix can be determined using the geographic space criterion based on the idea of proximity defined by contiguity and/or geographic distance (Anselin, 1995). Among the spatial weight matrices commonly used in the literature are the Queen, Tower, and k-nearest neighbor matrices. The Queen matrix assigns $w_{ij} = 1$ to units that share a common boundary or vertex, and $w_{ij} = 0$ otherwise. In the matrix Tower $w_{ij} = 1$ if the units share a common border, otherwise $w_{ij} = 0$ (Sabater; Tur; Azorín, 2011).

Another proximity criterion for defining spatial weights is that of the k-nearest neighbors; According to Almeida (2012), this is a binary matrix in which proximity is based on geographic distance. Formally:

$$w_{ij}(k) = \begin{cases} 1 & \text{se } d_{ij} \leq d_i(k) \\ 0 & \text{se } d_{ij} > d_i(k) \end{cases} \quad (1)$$

Where $w_j(k)$ is the cutoff distance for region ii specifically so that it has k neighbors. By convention, $w_j(k) = 0$. Thus, $d_i(k)$ is the shortest distance to region *i* so it has exactly *k* neighbors. The expression indicates that proximity is determined by considering two regions as neighbors if they are within a cutoff distance

required to have a predetermined number of neighbors.

According to Almeida (2012), this convention has the advantage of balancing the connectivity of the matrix, ensuring that all spatial units have the same number of neighbors. Furthermore, this matrix ensures that there are no islands, that is, regions without neighbors. Therefore, in this work, several matrices are tested, and the one that presents the highest value of Moran’s I statistic is used, thus better representing the connection between the regions.

Results and discussions

In this section, descriptive statistics are presented on the proportion of students in secondary education in Youth and Adult Education (YAE) concerning the total number of students in traditional secondary education and secondary education in YAE in 2023 (YAE_SE), and

the average salary of December 2021 formal work at minimum wages (ARFW_MW). The spatial distribution of the YAE index (YAE_SE) was analyzed. Exploratory spatial data analysis (ESDA) was conducted to confirm the presence of a spatial pattern in the YAE index (YAE_SE) and the relationship between the YAE index (YAE_SE) and the average remuneration of formal workers (ARFW_MW).

The descriptive statistics are presented in Table 1. On average, in 2023, Brazilian municipalities will have approximately 10% of enrollments in YAE high school concerning the total enrolment in traditional high school and YAE high school, with there being a municipality that did not have any enrolment in high school from YAE to the municipality that had approximately 71% of enrolment in high school from YAE. Furthermore, it was possible to observe from the standard deviation and coefficient of variation that there was a high dispersion of the data.

Table 1 - Descriptive statistics of the Youth and Adult Education (YAE) index (YAE_SE) and the average remuneration of formal workers in minimum wages (ARFW_MW).

VARIABLE	AVERAGE	MINIMUM	MAXIMUM	STANDARD DEVIATION	COEFFICIENT OF VARIATION (%)
YAE_SE	0.10	0	0.71	0.10	100
ARFW_MW	2.11	0.26	10.56	0.55	26

Source: Own preparation with data from INEP and RAIS.

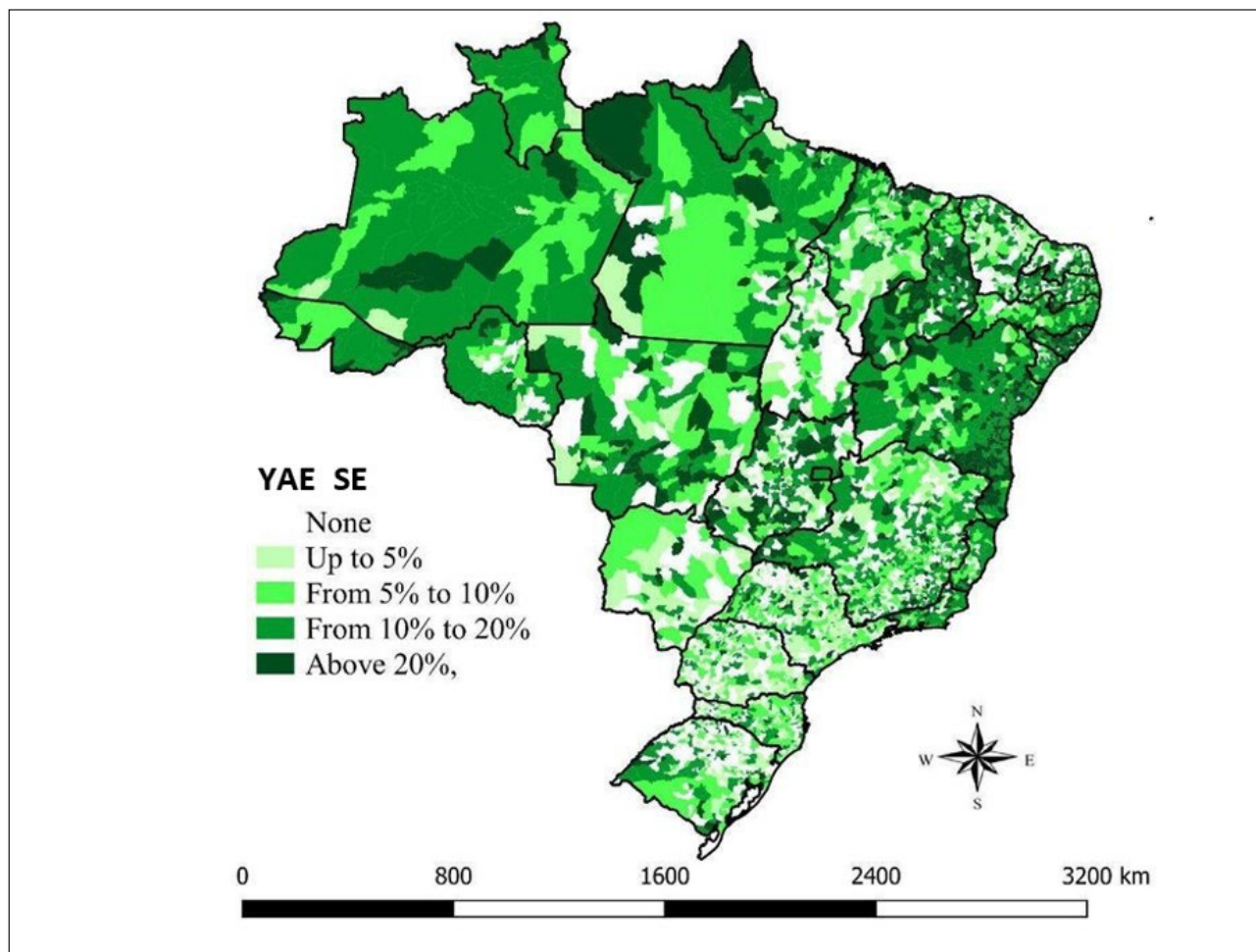
As for descriptive statistics related to remuneration, on average, Brazilian municipalities have a remuneration of 2.11 minimum wages in formal work, within a range that varies between an average remuneration of 0.26, minimum wage to an average remuneration of 10.56 minimum wages in formal jobs. Additionally, the average dispersion of the data was verified using standard deviation and coefficient of variation statistics.

YAE_SE quantile map was presented. Figure 1 shows a pattern in the spatial distribution of YAE migration at the municipal level. The

darker tones represent Brazilian municipalities with the highest YAE_SE indices.

The first classification (in white) represents municipalities without YAE enrolment in secondary education. The lowest classification range corresponds to municipalities with a YAE index of up to 5%. Next, we have municipalities that have 5% to 10% enrollments in the YAE index. Subsequently, municipalities in the range of 10% to 20% of enrolment in the YAE index are represented. Finally, the last range refers to municipalities with more than 20% enrolment in the YAE index.

Figure 1 - Quantile map of Brazilian municipalities' Youth and Adult Education index (YAE_SE).



Source: Own elaboration with data from INEP.

The municipalities with the highest rates of YAE in secondary education, that is, with the greatest migration from traditional secondary education to YAE secondary education, are concentrated in the northeast region. On the other hand, the southern region had the highest concentration of municipalities with the lowest rates of YAE in secondary education. Approximately two-thirds of the municipalities in the northeast region are in the two highest classifications of the YAE index in secondary education. Additionally, the Northeast region had less than 20% of the municipalities in the two lowest YAE_SE classifications.

In the southern region, the concentration of municipalities in the two lowest classifications of the YAE index in secondary education was also two-thirds, with more than half of the municipalities not showing enrolment in the YAE. Furthermore, the concentration of municipal-

ities in the two highest YAE_SE classifications in the southern region was only 15%.

Thus, the data indicate a possible pattern in the spatial distribution of the YAE index in high schools. Additionally, it also investigated whether migration from traditional secondary education to secondary education in secondary education influences the remuneration of formal workers. To confirm the hypotheses presented, considering the effect of region, an exploratory analysis of the spatial data was carried out.

Exploratory analysis of spatial data

Table 2 shows the results of the spatial autocorrelation of the Youth Index and Adults Education in High School (YAE_SE) and the relationship between the YAE Index and the average salary of formal workers (ARFW_MW). Five spatial weight matrices were tested in the estimation.

As the value of Moran's was above the expected value and was significant for all conventions, it can be inferred that there is positive spatial autocorrelation between the Youth Index and Adults Education in High School and negative spatial autocorrelation for the relationship between the Youth Index and Adults Education in High School and the average remuneration of formal workers by municipality, at a significance level of 1%.

For the analysis, the matrix of spatial weights

K five nearest neighbors was selected for the univariate analysis of the YAE index in high school, which presented the highest value of Moran's I according to the choice criterion suggested by Almeida (2012). For the bivariate analysis between the YAE index in high school and the average remuneration of formal work, the matrix of spatial weights K 10 nearest neighbors was considered, as it presented the highest value of Moran's I and provided greater connectivity between municipalities (Almeida, 2012).

Table 2 - Univariate (YAE_SE) and bivariate (YAE_SE vs ARFW_MW) Moran indices of Brazilian municipalities.

VARIABLE	CONVENTION	MORAN'S I	P-VALUE
YAE_SE	Queen	0.302*	-0.0002
	Tower	0.304*	-0.0002
	<i>K 5 neighbors</i>	0.331*	-0.0002
	<i>K 7 neighbors</i>	0.321*	-0.0002
	<i>K 10 neighbors</i>	0.311*	-0.0002
YAE_SE vs ARFW_MW	Queen	-0.057*	-0.0002
	Tower	-0.056*	-0.0002
	<i>K 5 neighbors</i>	-0.053*	-0.0002
	<i>K 7 neighbors</i>	-0.053*	-0.0002
	<i>K 10 neighbors</i>	-0.057*	-0.0002

Source: Own elaboration based on research results with data from INEP and RAIS. Note: *p<0.01.

Regarding the Youth Index and Adults Education (YAE), spatial autocorrelation, evidenced by the positive sign of Moran's I statistic, indicates that municipalities with a high YAE index are surrounded by municipalities with high YAE_SE, while localities with low YAE_SE are surrounded by municipalities with low YAE_SE index.

Educational inequalities in Brazil persist as obstacles to social and economic development. According to Neres, Gonçalves, and Araújo (2020), YAE was implemented as a compensa-

tory measure for individuals who were unable to attend regular education at the appropriate age. However, the YAE still faces challenges in guaranteeing access to quality education for all, a right that should be guaranteed universally.

Regarding the relationship between the YAE index and the average remuneration of formal workers, the negative sign of Moran's I statistic indicates that municipalities with high YAE_SE are surrounded by municipalities with low average remuneration of formal workers, and localities with a low index of YAE are sur-

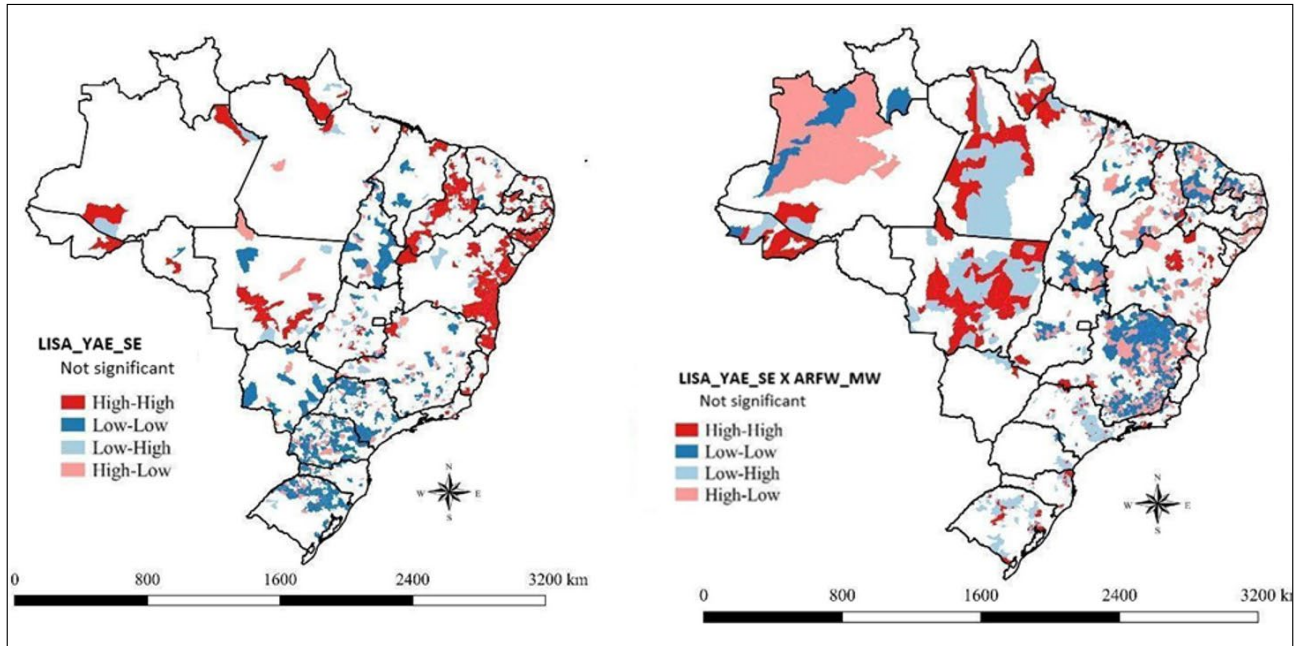
rounded by municipal units with high average wages for formal workers. This result corroborates the findings of Peres and Peres (2023), who showed an inverse relationship between the supply of YAE and per capita income in the Federal District.

The migration from regular education to YAE occurs mainly because of students' need to work (Bueno; Oliveira, 2023). As a result, many young people submit to jobs that pay less than their potential. However, returning to school for YAE can occur after the individual discovers the importance of studying to achieve a better

quality of life (Brenner; Carrano, 2023).

The cluster maps presented in Figure 2 (YAE_SE and YAE_SE x ARFW_MW) allow us to verify where the statistically significant spatial groupings at 5% were formed and divided into four categories of spatial association. Locations highlighted in red represent high-high (HH) spatial clusters, while units denoted in blue on the map display low-low (LL) spatial regimes. The spatial cluster highlighted in light pink refers to the high-low (HL) clusters and the spatial regime in blue corresponds to the low-high (LH) cluster.

Figure 2 - Cluster Maps univariate (YAE_SE) and bivariate (YAE_SE x ARFW_MW) of Brazilian municipalities



Source: Own elaboration based on research results with data from INEP and RAIS.

According to the cluster map referring to the Youth Index and Adults Education (YAE), it was observed that 30% (n=1663) of the municipalities were statistically significant at 5%. Furthermore, it was verified that the formation of HH-type clusters was concentrated in the northeast region. In the HH spatial agglomerations, the northeast region concentrated almost 30% (n=525) of the municipalities, while the other regions did not present 8% of these municipalities in this group. In turn, the southern region did not have even 1% (n=1) of municipalities in the HH cluster. In the Northeast region, the largest concentrations were

located in the states of Paraíba and Alagoas, with at least 60% of the municipalities.

In contrast, the southern region had the highest concentration of LL-type spatial clusters. It was observed that the southern region concentrated almost 37% (n=440) of the municipalities, while the other regions did not present even half of this proportion. Among the states in the southern region, the states of Paraná and Rio Grande do Sul were highlighted, with the highest concentrations in the LL cluster. Paraná had almost 40% (n=158) of the municipalities, and Rio Grande do Sul had almost 47%, while Santa Catarina had only 17%.

This result corroborates the findings of educational inequality in the study by Neres, Gonçalves, and Araújo (2020). The authors demonstrated a significant disparity in the literacy rate among people aged 15 years or over in different Brazilian regions. Similar to the results on migration to YAE, the study reveals that the Northeast has the highest illiteracy rate, while the South has the lowest. In other words, the northeast has the worst educational performance, while the south stands out as the best among the regions.

Youth index and adult education (YAE) and the average remuneration of formal workers in 34% (n=1871) of the municipalities were statistically significant at the 5% level. The formation of the HL-type cluster was concentrated in the northeast region. It is possible to verify in this grouping that the northeast region concentrated 20% (n=351) of the municipalities. In contrast, other regions did not exceed 10% of the municipalities in the HL cluster. At the state level, the highlights for the northeast region were the states of Paraíba and Alagoas, both with approximately 46% of the municipalities in the HL cluster.

Regional disparities in Brazil are historic, particularly in the northeast. Since the 20th century, development policies such as the creation of the Banco do Nordeste do Brasil (BNB), the Superintendence for the Development of the Northeast (SUDENE), and the Working Group for the Development of the Northeast (GTDN) in the 1950s have been implemented (Cavalcante, 2020). Although the 21st century has reduced the inequality differences between other regions, they persist (De Oliveira Carvalho, 2018).

The highest concentration of LH-type spatial clusters was observed in the southern region. It can be seen in this cluster that the southern region concentrated 14% (n=167) of the municipalities. In comparison, other regions did not exceed 10% of the municipalities in this cluster. At the state level, the highlight for the South region was the state of Rio Grande

do Sul, which presented 22% (n=110) of the municipalities in the LH cluster, while Paraná and Santa Catarina did not reach 13% of the municipalities in this cluster.

Rio Grande do Sul stands out on the national scene for its efficient industrialization and strategic geographic position. The state's agricultural area also stands out, as evidenced by Mello and Brum (2020), who demonstrate the efficiency of the soy production chain in Rio Grande do Sul. The authors highlight the cooperation mechanisms that support this chain, based on the market, in the creation of governance structures through cooperatives and cereal producers and in the industrialization of the sector.

This study reveals an inverse relationship between migration to the YAE and the average remuneration for formal work in municipalities. However, regional factors also influence migration to YAE and work remuneration. Among these factors, we highlight the inequality between regions and disparities in regional industrialization.

Final considerations

This study aimed to test the presence of spatial autocorrelation in the migration from traditional high school to Youth and Adults Education (YAE) through a YAE index and the relationship between migration from traditional secondary education to YAE and the average remuneration of formal work to empirically verify whether there are spatial clusters in migration to YAE and whether this migration affects the average remuneration of formal work in Brazilian municipalities.

The results showed a positive spatial dependence for the YAE index, that is, municipalities with high (low) migration to YAE are surrounded by municipalities with a high (low) YAE index. Furthermore, a negative spatial autocorrelation was inferred between the YAE index and average formal work salary. In this sense, municipalities with high (low) migration to

YAE are surrounded by municipalities with low (high) average remuneration for formal work.

Regarding cluster analyses, for the YAE indicator, the concentrations of municipalities with high migration to YAE were located in the northeast region, while the clusters of municipalities with low migration to YAE were concentrated in the southern region.

Regarding the relationship between migration to the YAE index and the average remuneration for formal work, the agglomerations of municipalities with high migration to YAE, surrounded by municipalities with low average remuneration for formal work, were mainly located in the Northeast region. The agglomerations of municipalities with low migration to the YAE, surrounded by municipalities with a high average remuneration for formal work, showed a greater concentration in the southern region.

Therefore, it can be concluded that in Brazil, the Northeast region has a high proportion of students who migrate from traditional high schools to YAE high schools. This low educational quality of YAE teaching leads individuals to enter the formal job market with lower pay. Therefore, it is necessary to have incentives for students to complete basic training in traditional education as well as improvements in the YAE modality for those who need to enter this modality of education because of the demands of life, aiming for a better quality of teaching and, consequently, helping students enter the job market with better pay.

Finally, the urgent importance of investing in Youth and Adult Education (YAE) is highlighted to improve not only the quality of education, but also to expand these students' access to the job market and promote better remuneration. YAE plays a crucial role in educational inclusion, allowing those who do not complete their studies in mainstream education the opportunity to resume their academic trajectory. By investing in the YAE, governments and educational institutions not only fulfil a moral duty to guarantee education for everyone, but also invest in economic and social development.

Students of this type of education who receive a quality education, aligned with the demands of today's society in which knowledge is the main asset, have a greater chance of entering the job market with solid and up-to-date skills, which can lead to significant improvements in their remuneration. Furthermore, by increasing the qualifications of these students/workers, the job market also benefits from a more qualified and diverse workforce capable of driving innovation and economic growth. Therefore, investing in YAE not only opens doors for students looking to complete their education but also contributes to a fairer and more prosperous society where everyone has the opportunity to reach their full potential.

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