

Exploring Education in Brazil

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Research Design

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Replication materials / \LaTeX sources: 📁 PanfoliF/Research-Proposal-RD-NEW

Version: v0.0 | **Last updated:** January 8, 2026

Keywords: game theory

JEL: C72; D82

Prepared for: Research Design, taught by Prof. Dr. Sean Carey

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January 8, 2026

Abstract

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Introduction

This paper proposes a research project on educational data. The aim is establish causality between variables of interest using state of the art causal inference techniques. The Brazilian context offers interesting sources of variation among data as well as granular observations. These are key factors in providing robust empirical analysis.

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- Unit of analysis
- research question
- hypothesis

Tutte e tre vanno bene evidenziate per il prof

Motivation: under many aspects there is little knowledge of what causes good educational outcomes **citation**. Many factors concur in forming students, thus scholars have always had hard times in distinguishing chains of causes and effects. The proposed paper could provide some more evidence.

Data: such a high aim requires the best tools. The author put a lot of effort in the data collection step, many institutional websites have been surfed until the best source of data came out. The Brazilian Education Panel Databases (Huberts et al., 2025), appears the best source of observation for the proposed task. Not only it provides researchers with granular data, it also comes from a reliable and well known institution, namely IDB (Interamerican Development Bank).

Methodology: If we are to establish causality in a credible way, we need to use causal inference methodologies. The author will provide the reader with extensive explanation of employed identification strategy in the methodology section (Methodology). The following lines briefly anticipate that section: The identification strategy selected for our aim is split in two: first, due controls come along with two regressions. Secondly, a Difference in Difference application of these

regressions, should isolate with more efficacy the causal effect of independent variables on dependent one. An appropriate review of the literature provides for suitable control variables.

My goal is to distinguish two channels: standardized test performance (*extensive margin*) and grade progression outcomes (*intensive margin*).

Policy value: The following pages are intended to create value for policy makers. Putting aside cumbersome vocabulary and context related dictions, they should inform policy making in the field of education in a simple and transparent manner. The results of the analysis may open new ways of investing in education and shed light on wiser policy aims.

1 Literature Review and Historical Setting

Knowledge and insights on the historical context and institutional settings are drawn from Encyclopedia Britannica (Ball, James, et al., 2026; Ball, Schneider, et al., 2026), Glossario of Atlas Geográfico Escolar (CEON, n.d.) and Southey (2012).

These norms will serve as instruments to predict a changes in schools quality. They are expected to positively affect the outcome variables.

A preliminary analysis of the literature on education in developing countries, highlighted a study from Turmena and Bitencourt (2022). The journal article constitutes the milestone of this article and serves as main reference for the literature on education in Brazil. This paper suggests that the "Law No. 5.692/1971 (Reforma do Ensino de 1^o e 2^o Graus)" had a major effects on education. I will exploit data related to this law.

2 Data

2.1 Data Collection

All projects begin with data collection, which is a crucial step. However it takes a lot of time and effort.

In order to select the best source, many datasets have been explored and many institutional websites have been visited. Potential data sources included IPUMS (“IPUMS Online Data Analysis System”, n.d.) and the Instituto Brasileiro de Geografia e Estatística (“Portal Do IBGE”, 1967). Additionally, aggregated data may be retrieved from (Instituto Brasileiro de Geografia e Estatística (IBGE), n.d.-a, n.d.-b, n.d.-c, n.d.-d, n.d.-e, n.d.-f, n.d.-g, n.d.-h, n.d.-i, n.d.-j, n.d.-k, n.d.-l, n.d.-m, n.d.-n, n.d.-o, n.d.-p, n.d.-q, n.d.-r, n.d.-s, n.d.-t, n.d.-u, n.d.-v, n.d.-w, n.d.-x, n.d.-y, n.d.-z, n.d.-aa, n.d.-ab, n.d.-ac, n.d.-ad, n.d.-ae; Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Inep), n.d.-a, n.d.-b). Eventually, an article from Rubiane Daniele Cardoso de Almeida et al. (2023) offers panel data on some demographic aspects.

The Brazilian Education Panel Databases (Huberts et al., 2025), which covers the period from 1996 to 2015, was selected as main source of data.

2.2 Description of Data

3 Methodology

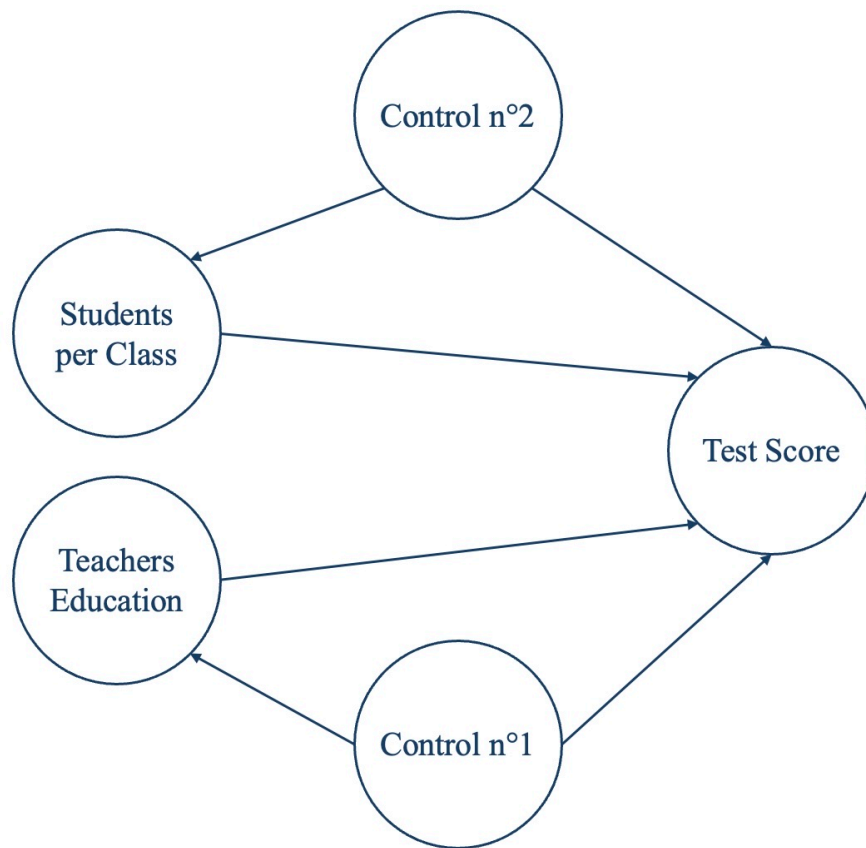


Figura 1: *Causal DAG.*

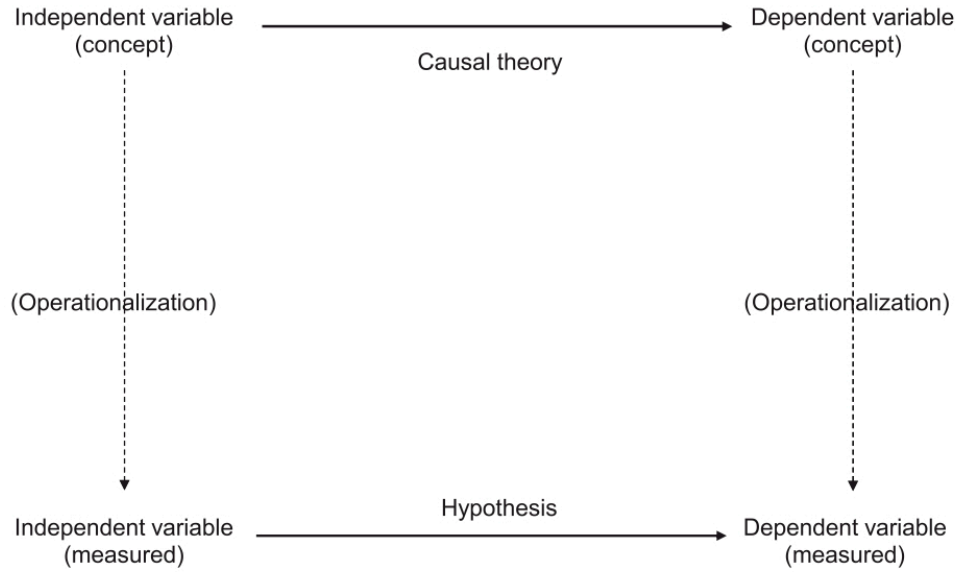


Figura 2: *Figure 1.2 From theory to hypothesis*

To establish causality between the dependent and independent variables, the analysis will employ causal inference techniques. As a possible solution to the identification problem the study will provide results from a Difference-in-Difference. This technique is able to isolate the effect produced by the introduction of the laws in the variables that approximate education quality. Nonetheless, without appropriate control variables no identification strategy is reliable. Following best practices of the political science field, only a deep analysis of the literature will provide for suitable control variables.

3.1 Extensive Margin

The first of the two regression presented in the paragraph looks at the extensive margin. Therefore, it investigates the relationship between teachers quality and test scores. The equation used is the following:

$$Y_{smt}^{score} = \beta_0 + \beta_1 TQ_{smt} + \beta_2 INFRA_{smt} + \gamma X_{smt} + \mu_m + \lambda_t + \varepsilon_{smt}$$

Teachers quality is measured as number of students per class *or* as teachers education.

Identification also relies on:

-*Municipal FE*: this is a way to control for possible unobserved variables that might bias the analysis. To the eyes of statisticians this is a mere intercept that captures the mean value for a town.

-*State FE*: the same concern we had for the municipal level, motivates the use of FE at the state level. However, concern comes along with a great fortune. Cunningham (2021, chap. 2, p. 462) says: "I have a bumper sticker on my car that says "I love Federalism (for the natural experiments)". [...] United States is a never-ending laboratory. Because of state federalism, each US state has been given considerable discretion to govern itself with policies and reforms. Yet, because it is a union of states, US researchers have access to many data sets that have been harmonized across states, making it even more useful for causal inference."

-*Year FE*: since our dataset (Huberts et al., 2025) offers several years, we will exploit time variation too. The methodological solution to make use of panel data is again FE. In fact, thanks to this instrument, we are able to isolate the variation among years and discard the magnitude of variation in a single year.

This strategy isolates the effect of teachers quality on students test scores, which is commonly referred to as *outcome variable*.

Controls: The vector of controls is X_{smt} , while γ is the vector of coefficients. It represents the effects of control variables on our outcome variable. The selected controls are:

3.2 Intensive Margin

The second regression presented in the paragraph looks at the intensive margin. Therefore, it investigates the relationship between teachers quality and rates of failure. The

equation used is the following:

$$Y_{smt}^{failure} = \beta_0 + \beta_1 TQ_{smt} + \beta_2 INFRA_{smt} + \gamma' X_{smt} + \mu_m + \lambda_t + \varepsilon_{smt}$$

Teachers Quality is measured as number of students per class *or* as teachers education. Again, identification relies on municipal FE, state FE and year FE.

4 Limitations

- Omitted Variable Bias - Provide tests for observable implications in as many as possible narrow, focused, controlled circumstances - Do not include control variables that are a consequence of the key IV. -> maybe in some cases, the state may decide to invest in best school, this means that teaching quality or infrastructures may depend on test score.

Conclusion

The puzzle motivating this paper was deliberately simple: two elephant-human encounters occur in broadly similar environments, yet they generate sharply different behavioural trajectories. In one occasion, the elephant's threat is forceful but calibrated; in the other, violence is followed by a striking form of care.

Acknowledgements

Artificial intelligence-based tools were employed solely to improve linguistic clarity and grammar. No AI system contributed to the development of the research questions, theoretical framework or conclusions presented in this paper.

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