Working paper

Teacher Mindsets and Student Learning: A Randomized Intervention in Rio de Janeiro.

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This study presents novel evidence from a randomized controlled trial (RCT) in Brazil, examining the impact of teachers' mindsets on student learning. The intervention involved workshops aimed at introducing the belief that intelligence is not fixed and collaboratively devising ways to integrate this mindset into classrooms. Findings reveal a significant positive effect of teachers' growth mindset on student outcomes, notably increasing Language and Mathematics results by approximately 1.0 standard deviation. Promisingly, indications of improved pedagogical practices, particularly in classroom culture and instruction, offer potential explanations for these effects.

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A 'growth mindset' is the belief that abilities can grow. This belief challenges the concept that each person has a fixed maximum potential of different abilities – including intelligence – that can be achieved (or not) by suggesting that the full potential of everyone can grow. Research has shown that the belief itself in the growth of one's potential can affect this same potential. In other words, having a growth mindset regarding intelligence affects a person's maximum academic performance (Dweck and Yeager 2021).

Many interventions have been applied to students, showing that it is possible to affect their mindsets, at least in the short run. The literature is also well established in showing the impact of student mindset interventions on how students face challenges, deal with frustration, put effort into

schoolwork and, therefore, on their academic achievement (Blackwell, Trzesniewski, and Dweck 2007; Yeager et al. 2019).

Students' growth mindset is influenced by factors such as family culture, social stimuli, school climate, and, in particular, by their teachers' perceptions and pedagogical practices (Rattan, Good, and Dweck 2012). Thus, it is relevant to investigate how teachers' mindsets affect their students' mindsets as well as their perceptions, expectations, and results. There is a growing interest in the role of teachers, with few studies assessing whether we can change teachers' beliefs and their impact on the beliefs and attitudes of the teachers themselves and their students.

Investigating the interplay between teachers' mindsets, pedagogical practices, and students' academic outcomes has lately garnered significant attention. Studies have explored diverse aspects of this relationship, analyzing how a growth mindset affects teachers' understanding of training course content (Claro 2016) and the connection between teachers' mindsets and the advice they provide to students facing academic challenges, studying students' responses to various forms of consolation (Rattan, Good, and Dweck 2012). Teacher beliefs are also known to be important moderators of teacher expectations regarding student learning (Rubie-Davies et al. 2015).

Although these theories have been shown to be important in sustaining students' growth mindsets by changing the classroom culture (Hecht et al. 2023; Yeager et al. 2022), limited knowledge exists regarding the effectiveness of enhancing teachers' mindsets to influence student learning, particularly in socially vulnerable settings like the Rio de Janeiro/Brazil municipal public system. Students in such contexts are more prone to stereotypical expectations about their abilities (Aronson, Fried, and Good 2002; Good, Aronson, and Inzlicht 2003), perpetuating a negative cycle of underperformance among socially disadvantaged groups. This study postulates that if teachers fix their beliefs about student learning based on their past failed experiences, students in vulnerable contexts will be fixed in the impossibility of learning.

This research intervention aims to answer two questions. First, whether we can change teachers' beliefs in a vulnerable context, and second, whether changes in teachers' growth mindset affect student learning. To answer these questions, we conducted a randomized controlled trial of a teacher training intervention consisting of workshops to 5th grade teachers in Rio de Janeiro, showing how the growth mindset can be translated into the classroom. We analyzed whether the changes in teachers' growth mindset due to the intervention affect students' performance in Language and Math standardized tests. An innovation of this research is that we also use direct

classroom observations to measure changes in teachers' pedagogical practices resulting from transformations in their beliefs.

A school year after the intervention, we returned to these schools to collect data on teacher growth mindset using translated versions of growth mindset questionnaires. We also used the student individual data from the Brazilian standardized test on Portuguese Language and Mathematics, the SAEB tests (Brazil 2019), and the student and teacher individual characteristics' information collected through questionnaires by the INEP. We also collected classroom observation data – using the TEACH Plus methodology of classroom observation (Molina et al. 2018b) – to analyze the mechanisms of change in pedagogical practices due to our intervention.

Our results show a significant change in teachers' growth mindset measured one school year after a relatively short intervention and a positive effect of teachers' increased growth mindset on student results. Notably, one standard deviation (SD) change in growth mindset increases Portuguese Language and Mathematics results by around 1.0 standard deviation. These significant results indicate the critical role of teachers' beliefs in influencing student learning, particularly in the context of vulnerable students dealing with significant stereotyping. There is also suggestive evidence that teachers with an increased growth mindset have improved their pedagogical practices, being such changes in the quality of the teacher practices an important mechanism of change in students' results due to teachers increased growth mindset.

The remainder of this paper is organized as follows. First, we present contextual information of the intervention, randomization strategy, and data collection issues. Sections II and III discuss the empirical strategies and results of the effect of the workshops on teachers' growth mindset and student results and of using the random assignment of schools to the workshop as an instrumental variable for the growth mindset to estimate its impact on student results. They also include a discussion of the exclusion restriction and the possible pathways by which the effect occurs. Section IV concludes by debating the implications of the results.

I. Experimental Design and Data

A. Sample

Rio de Janeiro is one of Brazil's wealthiest cities, and Latin American fourth most populated city. In 2019, Rio's 5th grade students' proficiency level[1] (equal to 5.8) were practically the same as Brazil's average (equal to 5.7), and its results have been growing slower than the rest of the country in the past years. However, Rio is marked by high inequality in its student performance results. Rio is also one of the most violent cities in Brazil. In 2017, it registered 35.6 homicides per 100 thousand inhabitants (IPEA 2019).[2] This situation is reflected in the daily routine of Rio's public schools (Ribeiro 2020), and impacts the student-teacher relationship and the ability of students to learn – particularly for those students coming from more vulnerable families that constantly have to deal with gun violence (Monteiro and Rocha 2017).

We invited all schools in Rio de Janeiro municipality with one or two 5th grade classes to a meeting to explain the research objectives. From all the 395 schools with one or two 5th grade classes in the city in 2019, 252 schools showed up in the meeting and 178 schools accepted to participate in the research. Acceptance to participate meant that both 5th grade teachers in a school with two classes also agreed to participate, so we initially had 323 5th grade teachers in our sample of 178 schools – 164 teachers in treatment schools and 159 in control schools.

Fifth-grade classes in Brazil are conducted by one teacher who teaches all the main subjects, except physical education and arts.[3] This restriction to small schools followed our choice to randomize schools, instead of teachers, to avoid the potential spillover of the treatment among teachers within the same school. Of the 178 schools that chose to participate, we randomly selected one group – 50% of the sample or 89 schools – to receive the treatment and 50% to serve as the control. The 89 treatment schools had 125 5th grade teachers who participated in the intervention throughout the 5 weeks.

Table 1 presents the comparison of some basic characteristics of the 178 schools in the sample and all other 487 schools in Rio municipality with a 5th grade. The schools from the sample are significantly smaller than other 5th grade schools in the Rio municipality, given our choice of

[1] IDEB ("Índice de Desenvolvimento da Educação Básica"/ Basic Education Development Index) refers to the country's proficiency index, combining student results in Portuguese Language and Mathematics in the SAEB ("Sistema de Avaliação da Educação Básica"/ Basic Education Assessment System) and approval rates. SAEB comprises a set of large-scale external assessments carried out periodically through the application of standardized instruments (cognitive and questionnaires) for specific stages of basic education (Brazil 2019).
[2] Homicide rates above 10 per 100 thousand inhabitants are considered by the UN as an indicator of epidemic violence.
[3] Some schools may also have specific teachers for computer or science laboratories, library, or other more specific subjects.

inviting schools with only one or two classes. The Math results in the schools from the sample were significantly higher than the other schools with 5th grade in Rio prior to the beginning of the study. However, none of the other school characteristics, including student socioeconomic and teacher characteristics, were significantly different between the sample schools and the Rio de Janeiro average, meaning that our sample is close to be representative of Rio de Janeiro 5th grade municipal public schools.

TABLE 1: EXTERNAL VALIDITY – SCHOOL CHARACTERISTICS

School characteristics	Sample schools	Other 5th grade schools in Rio	Diff
Portuguese Language 5th grade mean performance (2017)	216.65	214.81	1.85
Mathematics 5th grade mean performance (2017)	227.74	224.95	2.79**
Socioeconomic Level Index (2017)[4]	3.39	3.42	-0.03
5th grade enrollments	55.87	84.00	-28.13***
Age-grade distortion rate	22.67	21.67	1.00
% male students	52.22	52.14	0.08
% black students	10.91	10.21	0.70
% students whose mother has completed higher education	13.73	13.21	0.52
% students who work	12.75	12.25	-0.50
% black teachers	4.37	3.97	0.40
% teachers with master's degree	6.00	4.95	1.05
% teachers who teach at more than one school	20.82	21.98	-1.16
% of schools with a library	65.17	68.79	-3.62
% of schools with a science lab	8.99	10.68	-1.69
% of schools with internet access for student use	23.60	25.46	-1.87

Notes: $N_{\text{Sample schools}} = 178$, $N_{\text{Other 5th grade schools in Rio}} = 487$.

Source: School Census 2019; SAEB 2017 (Student performance results); INSE 2017 (Socioeconomic Level Index): (Brazil, n.d.)

*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

B. Intervention

The intervention was a structured workshop of 5 weeks for elementary education teachers, applied at the beginning of the school year (March and April 2019), intending to promote pedagogical practices with a 'growth mindset.' The content of the workshops aimed at building the belief that, just like a muscle, intelligence can be increased through effort, coping with adversity, and permanent efforts to improve. We hypothesize that in promoting changes in beliefs about intelligence, implementing mindset workshops helps teachers in their pedagogical practices to improve student learning. In this way, we aimed to stimulate teachers to reflect on what a classroom with a growth mindset is like and what that means to the pedagogical practices of each teacher. The effect of teachers' mindsets on student learning could occur through changes in their

[4] The Socioeconomic Level Indicator (INSE) is calculated by the National Institute of Educational Studies and Research Anísio Teixeira (INEP), Brazil, using a questionnaire applied to students to assess the socioeconomic profile of students in Brazilian schools. INEP uses a statistical methodology to attribute a value from 1 to 8 to each student, allowing a comparative analysis of the socioeconomic profile between schools and regions (Brazil 2021).

pedagogical practices and through the impact of teachers' mindsets on students' mindsets, which, in turn, could affect student learning.

The workshops drew on past research for its content and included discussions about brain functioning and its relationship to the concept of mindset, the re-signification of error as fundamental to the learning process, and the elaboration of strategies to deal with error and frustration in the learning process (Paunesku et al. 2015). Finally, the workshops dealt with the role of effort and the concept of "stereotype threat" in vulnerable contexts (Steele and Aronson 1995; Good, Aronson, and Inzlicht 2003).

The design of the workshops included the participation of a specialist on the subject who, together with a teacher from the municipal network of Rio de Janeiro, defined the content and way of presenting it. Teacher trainers from the Rio network, not the researchers, delivered the workshops. Since our goal was for the teachers to change their mindset, this was important because the trainers were more sensitive to the correct language to use with the teachers. In addition, we believe that having classroom experience in a public network is vital to create a connection between trainers and teachers, allowing an actual change in teachers' mindsets.

All workshops included an introduction to the content, videos, activities, and discussions to engage the group. In addition, there were moments for reflection and sharing so that participants could relate the content to their pedagogical practices in the classroom. After each workshop, there was a homework to be done with their students until the next week, which had a high rate of participation and engagement of teachers, demonstrating the interest and importance given by the group in the intervention.[5]

Of the 89 schools receiving treatment, 85 had teachers attend the workshop at least once. Among the 164 teachers in these schools, 117 participated in the first day of the workshop, while 103 participated in the final day. It is important to consider whether teachers have been punctual for the workshop meetings as it reflects their level of engagement in the intervention. Out of 117 participants in the first meeting, 37 arrived late. The third meeting had the lowest rate of tardiness, with 24 teachers arriving. We had six cases of 'always-takers'[6] teachers from 3 control schools; despite not being selected, these teachers attended the first day of the workshop. Two of them,

[5] For a more detailed description of the five workshops' content, please check the section "Mindset Intervention with Teachers, Brazil" of the RTI guidebook (Norman et al. 2022).

[6] According to Marbach and Hangartner (2020): "*Always-takers* always take the treatment, independent of whether they are assigned or not."

both from the same school, even insisted on participating in the second day. However, they did not attend the last three meetings.

This intervention format was designed the year before, in 2018, as a pilot intervention developed in partnership with Rio de Janeiro's municipal system. The pilot consisted of workshops and focus groups with 11 voluntary teachers from the public school system in Rio de Janeiro, in addition to questionnaires applied to these teachers and their 5th grade students.

C. Data Collection and Attrition

The intervention was conducted between March and April 2019. At the end of October and November of the same year, we returned to the sample schools and conducted one-hour classroom observations using the TEACH Plus methodology in addition to administering questionnaires about the growth mindset of teachers. It is important to note that the analyses done in this study differ from those of other studies in the literature that estimate short-term effects for teachers' growth mindset interventions (Foliano et al. 2019) in the sense that we only returned to the schools eight months after the intervention.

The questionnaires were developed by our research team to measure, through objective scales, how much the participant's mindset is one of growth, according to the definition established in the international literature. For that, we used the "Implicit Theory of Intelligence Scale" (ITIS) (Abd-El-Fattah and Yates 2006). Abd-El-Fattah and Yates (2006) developed a 14-item questionnaire to measure what they call the 'implicit theory of intelligence,' referring to the idea that people can learn new skills that can increase their intelligence. Inspired by the work of Carol Dweck, Abd-El-Fattah and Yates' questionnaire was administered to university students in Australia and Egypt. All the items in the questionnaire were used in this study. In addition, while Abd-El-Fattah and Yates (2006) use a 4-level likert scale, we used a 6-level one, to standardize the complete survey. We translated these questions to Portuguese with two independent translators, who then came together to arrive at a single consensus version. We then discussed the understanding of the questions in the pilot focus groups to guarantee the interpretation of the questions were as intended and adapt them to the local context of 5th grade teachers in Rio de Janeiro municipal public schools.

We also included social desirability questions, since it may be socially desirable to have a 'growth mindset.' That is, it may be more socially acceptable to answer that everyone can learn, rather than what the person really thinks about intelligence. To control for this type of desirability-biased

response, we included Reynolds (1982) questions – an abbreviated version of the consecrated social desirability scale developed by Crowne and Marlowe (1960) – in our survey. This scale, with 13 items, asks how much the participant agrees with statements that, while highly socially desirable, are rarely practiced by anyone in real life, such as "I am always willing to admit that I made a mistake." The individual who responds this is true of him is probably doing so because he is considering what should be answered rather than what he does or believes.

We collected classroom observation data to evaluate the effect of our intervention on teachers' pedagogical practices. We use a standardized classroom observation instrument, called TEACH Plus, which combines measurement of "Teacher Use of Time" - teacher time on task, pedagogical practices, and student engagement, drawn from the Stallings "classroom snapshot" method (Bruns and Luque 2014) – with measures of instructional quality ("Quality of Teaching Practices") embodied in the TEACH instrument developed by the World Bank in 2018 (Molina et al. 2018a).[7]

Our instrument categorizes the 'Quality of Teaching Practices' component into three main areas: 'Classroom Culture,' 'Instruction,' and 'Socioemotional Skills,' each with nine corresponding elements that indicate twenty-eight behaviors. These behaviors are assessed during two 15-minute observations, and are classified as low, medium, or high levels based on gathered evidence. The scores for these behaviors are then translated into a five-point scale, which provides a quantified assessment of the teacher's techniques in class (Molina et al. 2018b).

The concept of 'Classroom Culture' refers to the teacher's ability to cultivate an environment that promotes effective learning for all students. This encompasses the creation of a supportive atmosphere that prioritizes respect and utilizes positive language, while also addressing the individual needs of students and dismissing gender stereotypes. Furthermore, it includes the establishment of clear and positive expectations for behavior, the recognition of positive conduct, and the proficient management of negative behavior.

The second area of the 'Quality of Teaching Practices' indicator – 'Instruction' – measures how well teachers foster critical thinking and analytical skills to deepen students' understanding. It evaluates how effectively teachers communicate lesson objectives, give clear explanations,

[7] The TEACH Plus instrument is an adaptation of the TEACH instrument designed by classroom observation experts for evaluating the impact of education interventions in classroom dynamics. This project was the first time this adaptation of the TEACH instrument was used. I thank Barbara Bruns and Fatima Alves for adapting the instrument and training the observers to collect the data in Rio de Janeiro. The manual for the Stallings instrument can be found here: https://www.worldbank.org/en/programs/sief-trust-fund/brief/the-stallings-classroom-snapshot (The World Bank n.d.). The manual for the TEACH instrument can be found here: https://www.worldbank.org/en/topic/education/brief/teach-helping-countries-track-and-improve-teaching-quality (The World Bank n.d.).

connect activities to content or students' lives, and demonstrate through examples or thinking aloud. It also measures how well teachers assess understanding, adjust their teaching strategies, offer constructive feedback, and encourage critical reasoning through open-ended questions and reasoning tasks.

The category of 'Socioemotional Skills' pertains to the assessment of a teacher's proficiency in promoting student autonomy, perseverance, and social and collaborative skills. This involves providing students with opportunities to make decisions and assume significant roles within the classroom environment, acknowledging their efforts and presenting mistakes as an integral part of the learning process, and encouraging the development of teamwork and interpersonal abilities through peer engagement.

For the "Use of Class Time" indicator, observers take 10 "snapshots" of the classroom at regular intervals throughout the class and encode what the teacher and students are doing at that moment. The "snapshot" refers to the observation of what the teachers and the students are doing at that exact moment of the class (Bruns, Costa, and Cunha 2018). The "Use of Class Time" indicator categorizes classroom activities into three types: "Instructional activities," "Classroom management," and "Teacher off-task." "Instructional activities" refers to all academic activities developed during class time, "Classroom management" involves the teacher's actions in disciplining or organizing the classroom, while "Teacher off-task" refers to instances when the teacher engages in non-class-related activities during class.

Twenty-two coders conducted classroom observations and administered teacher questionnaires during their visits to schools. To guarantee the comparability and quality of the collected data, the coders were certified and had to follow a strict protocol during the school visits. During the field work, two supervisors, who are certified in the TEACH Plus methodology, were present to provide support to the coders with any logistical or technical queries related to the instruments. School visits were not scheduled – the schools were informed about the period of the data collection but the dates of the visits were not shared.[8] This was to ensure that the closest possible observation of a regular class was achieved. During a one-hour period of the class, the coder sits at the back of the classroom and takes notes. The aim is to avoid disturbing the class dynamics as much as

[8] The protocol was different for the schools in areas of armed conflict. They corresponded to 45 of the 178 sample schools, according to the Secretariat of Education's determination of "conflagrated areas." In these schools, the date of the visit was shared with the school less than a week before the visit. This was necessary for the school to warn the research team in case a shooting happened on the visit date. Even with this precaution, during three school visits, the coder witnessed shootings in the surrounding community. In these situations, the classroom observation and questionnaire application were rescheduled.

possible. Although the presence of an external individual in a 5th grade classroom may not go unnoticed by the students, there is no reason for any possible disturbances in the classes to be different between treatment and control schools. The teachers also did not know the evaluation instruments that would be utilized – the growth mindset questionnaire (ITIS questions) was not shared with the teachers (we did not administer the questionnaire prior to the intervention), and the teachers were only informed about how the visit would be but had no information on the categories of analysis of the TEACH Plus instrument.

Some schools from the sample were lost when applying the teachers' questionnaires and conducting the classroom observations, due to refusal by the teacher to answer the questionnaire or to have its class observed. The reasons given for these refusals were discomfort with the idea of observation, despite having previously expressed interest in participation and (in the treatment schools) having received training, as well as concerns about the research taking up class time during a busy end-of-year period. Out of 323 teachers from 178 schools, 273 responded to the questionnaires, and 274 classes were observed from 152 schools. As presented in Table 2, the 26 schools that we lost were similar to those with complete information, except for a percentage of students whose mothers had completed higher education, in which our schools with complete information had 3.87 percentage points higher than the other sample schools. All other observed characteristics were similar across the two groups when we compared student performance in Math and Language prior to the intervention (the 2017 student performance results), the socioeconomic level prior to the intervention (in 2017), and the 2019 school, teachers and students' characteristics.

TABLE 2: ATTRITION ANALYSIS

School characteristics	Schools with complete information	Other schools from the sample	Diff
Portuguese Language 5th grade mean performance (2017)	217.00	215.58	-1.42
Mathematics 5th grade mean performance (2017)	227.85	227.87	0.02
Socioeconomic Level Index (2017)	3.39	3.44	0.05
5th grade enrollments	56.74	50.81	-5.93
Age-grade distortion rate	22.74	22.28	-0.46
% male students	52.01	53.46	1.45
% black students	10.66	12.37	1.70
% students whose mother has completed higher education	14.30	10.43	-3.87***
% students who work	12.92	11.76	-1.16
% black teachers	4.32	4.65	0.32
% teachers with master's degree	5.72	7.64	1.92
% teachers who teach at more than one school	22.09	13.60	-8.49
% of schools with a library	67.11	53.85	-13.26
% of schools with a science lab	9.21	7.69	-1.52
% of schools with internet access for student use	23.68	23.08	-0.61

Notes: $N_{\text{Sample schools}} = 178$, where $N_{\text{Schools with complete information}} = 152$, and $N_{\text{Other schools from the sample}} = 26$.
* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Source: School Census 2019; SAEB 2017 (Student performance results); INSE 2017 (Socioeconomic Level Index): (Brazil, n.d.)

D. Randomization and Balance

We ran a two-level clustered randomized experiment with treatment at the second (school) level. Fifty percent of the 178 candidate schools from the municipality were randomly selected to the treatment group and the other 50% to the control group. The randomization was done by pairing, using the predicted value of the students' results inferred from the characteristics of the schools in previous years. We used data from the student performance standardized exam (SAEB) in 2015 and 2017 (Brazil 2015; 2017) and the School Census in 2016 and 2018 (Brazil 2016; 2018) to predict what scores the schools would likely achieve in the mathematics student performance standardized exam in 2019. Equation **Erro! Fonte de referência não encontrada.** presents the equation used to estimate the coefficients that would then be used to predict the 2019 SAEB results.

1) $$SAEB_{Math_{2017,j}} = \alpha + \beta_1 SAEB_{Math_{2015,j}} + \beta_2 Perc_1 SAEB_{Math_{2015,j}} + \beta_3 Perc_{10} SAEB_{Math_{2015,j}} + \beta_4 Perc_{25} SAEB_{Math_{2015,j}} + \cdots + \beta_n SAEB_{Port_{2015,j}} + \beta_{n+1} Perc_x SAEB_{Port_{2015,j}} + \beta_{n+2} N_{classes_{2015,j}} + \beta_{n+n} Student\_charact_{2016,j} + \varepsilon_j$$

In this regression, $SAEB_{DiscYear,j}$ represents the average Mathematics or Portuguese SAEB test results of school *j* in the years *2015* or *2017*. We used the predicted value of SAEB Mathematics test results to do the pairing. The variables $Perc_x SAEB_{DiscYear,j}$ represent the *x* percentile value of the school in the SAEB test. We included the 1st, 10th, 25th, 50th, 75th, 90th and 99th percentiles for both Portuguese and Mathematics (in addition to school averages across subjects) to predict the next SAEB (two years later) in Mathematics. We noticed that – after an exploratory analysis of the characteristics of the schools, teachers and students in the SAEB and School Census – the distribution of the school in the previous standardized test in Portuguese and Mathematics proved to be the best predictor for the results in the following years.[9]

We also included in the regression model the number of 5th grade classes participating in the schools' SAEB test ($N_{classes2015,j}$), in addition to some student' characteristics ($Student\_charact_{2016,j}$). As characteristics of 5th grade students, we include students' average age, proportion of girls, proportion of black' and black and *pardo*' students, proportion of students with

[9] We estimated, also in an exploratory way, the machine learning model *rlasso* to predict the average results of schools. However, simple regression generated a better prediction of the results.

special needs, using data from SAEB student questionnaire, and school size (total number of classes in the school) from the School Census data.

We estimated, through the regression model presented in Equation **Erro! Fonte de referência não encontrada.**, the β_n coefficients of the variables of 2015 (from the SAEB data) and 2016 (from the School Census data) to predict 2017 SAEB Mathematics test scores per school. Using these estimated coefficients, we estimate the predicted value for each school' 2019 SAEB Math results. Then, we organized the schools in pairs considering the closest values (from lowest to highest) in the 2019 SAEB Math predicted values from the model specified above with data from the 2017 SAEB and the 2018 School Census. Nine of the 178 schools enrolled did not have data from the 2017 SAEB. For these, we only used data from the 2018 School Census to predict the 2019 SAEB results.

After pairing, we generated a random value for each school, and the school with the highest value generated in each pair was assigned to be the treatment, with the pair to be the control. After the random draw, we disclosed the results of the schools selected to participate in the workshop to all the schools. Thereafter, we divided the treated teachers among the 8 classes of the workshops, based on these teachers' indication of their time preferences.

Table 3 shows the balance between treatment and control schools across all observable characteristics, including previous performance in SAEB tests, socioeconomic level, and students, teachers, and school' characteristics. We observe that, except for mother education and percentage of schools with internet access for student use, which are higher in treatment schools with a difference that is significant at 10%, all other observed characteristics are similar. As presented below, we added several controls in our estimations, including pair fixed effects and schools, teachers, and students' characteristics to deal with these differences.

TABLE 3: SCHOOL COMPARISONS BY TREATMENT STATUS

School characteristics	Treatment	Control	Diff
Portuguese Language 5th grade mean performance (2017)	228.12	227.53	0.59
Mathematics 5th grade mean performance (2017)	216.62	217.44	-0.82
Socioeconomic Level Index (2017)	3.41	3.37	0.04
5th grade enrollments	59.22	62.95	-3.74
Age-grade distortion rate	21.70	23.64	-1.94
% male students	52.99	51.45	1.54
% black students	11.42	10.40	1.02
% students whose mother has completed higher education	14.68	12.79	1.89*
% students who work	12,89	12,61	0.28
% black teachers	5.11	3.62	1.49
% teachers with master's degree	6.55	5.44	1.11
% teachers who teach at more than one school	21.93	19.74	2.18
% of schools with a library	65.17	65.17	0.00
% of schools with a science lab	10.11	7.87	2.25
% of schools with internet access for student use	29.21	17.98	11.24*

Notes: $N_{Treatment} = N_{Control} = 89$. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Source: School Census 2019; SAEB 2017 (Student performance results); INSE 2017 (Socioeconomic Level Index): (Brazil, n.d.)

According to the 2018 School Census, our sample schools have a harmonic average of 60 students in 5th grade, divided into two classes on average. According to our power calculation, the minimum detectable effect size for the main results (our MDES) is 0.13 for Mathematics and 0.12 for Portuguese on the SAEB standardized student test.

II. Empirical Strategy

A. Teachers' Growth Mindset

Our first question is whether we were able to impact teachers' growth mindset. Our estimation, presented in Equation **Erro! Fonte de referência não encontrada.** below, analyzes whether teachers in schools that were randomly assigned to treatment are more likely to report higher growth mindset compared to teachers in control schools. In this equation, j refers to classes and k to schools. As controls, we include an index of social desirability, pair and coder fixed effects, and controls for teacher characteristics, school size, and student characteristics.

2) $Teachers\ Growth\ Mindset_{jk} = \beta_0 + \beta_1 Treatment\ school_k + \beta_2 Social\ Desirability_{jk} + \beta_3 Pair\ FE_k + \beta_4 Coder\ FE_k + \beta_5 School\ size_k + \beta_6 Teacher\ charact_k + \beta_7 Student\ charact_k + \varepsilon_{jk}$

Table 4 presents the descriptive statistics of the variables used in the estimations. We have 8,217 students with outcome variables (5th grade SAEB Portuguese Language and Mathematics mean performance) in 273 classes where teachers have answered the questionnaire. Some schools were visited by more than one coder, so we have 58 combinations of coders that are included as controls in our estimations. However, since we were able to collect data from only 152 schools, there are 26 schools without assigned coders. Therefore, our estimations that control for the assigned coders consider the 152 schools, and have 7,115 students.

The outcome variables, as well as the teachers' growth mindset and the social desirability control variables are standardized, with mean zero and standard deviation equal to one. The data used as

controls in this estimation come from the questionnaires applied by our research team to the sample of teachers and students in treatment and control schools and the SAEB questionnaires.[10]

TABLE 4: DESCRIPTIVE STATISTICS

	N	Mean	SD	Min	Max
Portuguese Language 5th grade mean performance (2019)	8217	0,000	1,000	-2,568	2,509
Mathematics 5th grade mean performance (2019)	8217	0,000	1,000	-2,728	2,859
Teachers Growth Mindset	273	0,000	1,000	-2,854	2,302
Social desirability	273	0,000	1,000	-3,239	1,677
School size: Number of 5th-grade classes in the school	178	1,843	0,550	1	4
Coders				1	22
Pairs				1	89
5th grade students' characteristics:					
Black or *Pardo*	8153	0,548	0,498	0	1
Does not have a personal computer	8153	0,318	0,466	0	1
Went to a private school	8153	0,288	0,453	0	1
Reproved (one or more times before)	8153	0,201	0,401	0	1
Abandoned school (one or more times before)	8153	0,093	0,291	0	1
Has a job	8153	0,762	0,426	0	1
5th grade teachers' characteristics:					
Black or *Pardo*	277	0,390	0,489	0	1
5 or more years of experience as a teacher	277	0,097	0,297	0	1
Teacher works 40 hours or more per week	277	0,271	0,445	0	1
Teacher works in two schools or more	277	0,209	0,408	0	1
Has not suffered any aggression from student	277	0,877	0,329	0	1
Tenured teacher	277	0,892	0,311	0	1

Sources: Standardized test results and teacher questionnaires: SAEB 2019 (Brazil 2019). Teacher's Growth Mindset questionnaire were applied in Nov/2019. Teachers' Growth Mindset questions are adapted from Implicit Theory of Intelligence Scale (ITIS) (Abd-El-Fattah and Abd-El-Fattah, 2006). Teachers' social desirability questions are adapted from Reynolds (1982).

Since not all students who did the test and not all teachers in the sample schools filled out the SAEB questionnaire, we imputed the data for these control variables by the mean value of the class (for students), school or regional coordination (for teachers). For each variable, we created another dummy variable equal to one whenever it was imputed. There were 18 imputed values for teachers SAEB questionnaire variables, and 64 imputed values for students SAEB questionnaire variables.

Most sample schools have two 5th grade classes (132 out of the 178 sample schools), so we have, on average, 1.843 5th grade classes in the school. Changes in teachers throughout the year (from the workshop to the data collection) could have happened in any of the sample schools. We consider treatment schools those that were randomly selected and the teachers in the beginning of the year have accepted to participate in the workshop, independently of whether they have moved to other schools or left the municipal school system.

For example, even though we have only invited schools with one or two 5th grade classes to participate in the workshops, there were seven schools that increased the number of 5th grade

[10] These controls are different from the data presented in Tables 1, 2 and 3, in which we use administrative data from the 2017 SAEB questionnaires and the 2019 School Census, also collected by the Ministry of Education.

classes throughout the year (five of which are treatment schools). In these cases, unless the same teachers taught the other classes (which is possible when one class was in the morning and the other is in the afternoon – and we have some anecdotal evidence that this is common in the schools), the teachers from the third and fourth classes in the treatment schools did not necessarily have participated in the workshop. However, these schools are still considered as treatment schools, meaning that when we are estimating the effect of treatment assignment on the outcomes, we are analyzing the intent-to-treat (ITT) effect. Also, as previously mentioned, not all teachers in treated schools have participated, or fully participated in the treatment. The effect of the treatment on those who were treated (TOT) is probably higher.

B. Randomization: Student results

To estimate if this increase in growth mindset is associated with increased student outcomes, we first estimate whether those students in schools where the teachers have participated in the workshop had higher performance in Mathematics and Language tests. Equation **Erro! Fonte de referência não encontrada.** presents the estimated regression for the effect of being in a treated school on student achievement, measured by student performance in Mathematics and Language in SAEB tests (Brazil 2019).

3) $$Test\ score_{ijk} = \beta_0 + \beta_1 Treatment\ school_k + \beta_2 Pair\ FE_k + \beta_3 Coder\ FE_k + \beta_5 School\ size_k + \beta_6 Teacher\ charact_{jk} + \beta_7 Student\ charact_{ijk} + \varepsilon_k$$

As presented in Table 4, we include controls for pair and coder fixed effects, school size, and teacher and student characteristics. Differently from the other estimations, equation 3 does not control for social desirability since it does not include a measure of growth mindset.[11] We can include individual student data from the SAEB questionnaires, which are applied to students – as well as to teachers – together with the standardized tests. We estimate Equation **Erro! Fonte de referência não encontrada.** separately for Portuguese Language and Mathematics. Since treatment assignment happens at the school level, we clustered our standard errors clustered at the school level.

[11] Since the coders visited these schools, we kept the coder fixed effects to maintain the similarity to the other estimations.

C. Instrumental variable (IV): Student results

Finally, we are interested in whether teachers with a growth mindset led to higher student learning compared to other teachers with a fixed mindset. Since the schools were randomly assigned to treatment and control and, therefore, were the teachers in these schools, we use the intervention as an instrument for the increase in teachers' growth mindset. As estimated in Equation **Erro! Fonte de referência não encontrada.**, we observe a significant increase in perceived growth mindset due to the intervention, so we can use the random assignment to the workshop as a first-stage effect to growth mindset. Then, we estimate the changes in growth mindset that are due to the randomized intervention on student achievement results.

Equations 4.1 and 5.2 present the first- and second-stage estimations using the random assignment to the workshop as an instrument to the increase in teachers' growth mindset. The IV estimation includes the same controls used in equation 2, but disaggregated to the individual level. Since the SAEB test and questionnaires data does not allow us to connect the teachers who answered their questionnaires with our teacher's data, the growth mindset variable is on the school level.[12] The same is true for the social desirability index.

First-stage:

4.1) $$Teachers\ Growth\ Mindset_k = \beta_0 + \beta_1 Treatment\ school_k + \beta_2 Social\ Desirability_k + \beta_3 Pair\ FE_k + \beta_4 Coder\ FE_k + \beta_5 School\ size_k + \beta_6 Teacher\ charact_{jk} + \beta_7 Student\ charact_{ijk} + \varepsilon$$

Second-stage:

5.2) $$Test\ score_{ijk} = \beta_0 + \beta_1 Teachers\ \widehat{Growth}\ Mindset_k + \beta_2 Pair\ FE_k + \beta_3 Coder\ FE_k + \beta_5 School\ size_k + \beta_6 Teacher\ charact_{jk} + \beta_7 Student\ charact_{ijk} + \varepsilon$$

While not all teachers in treated schools have participated, or fully participated in the treatment, the instrumental variable (IV) estimation is analyzing the effect of increased growth mindset due to the intervention. This means that we are only using the variation in growth mindset that is due to the randomization, and then analyzing the effect of having an increased growth mindset to affect

[12] Thirty-nine schools from the sample had only one 5th grade teacher. In these cases, the teachers' growth mindset variable refers to the specific teacher.

students. Therefore, in the IV estimation, we are estimating the treatment on the treated (TOT) for the complier subpopulation – the local average treatment effect (LATE) (Marbach and Hangartner 2020) – as we are interested in knowing the effect of the growth mindset, and not of whether we have a good workshop.

An important assumption for our two-stages least-squares estimation is that the randomized intervention has only affected student performance indicators through our instrument (the "exclusion restriction"). To test for this hypothesis, we need to analyze whether our intervention has affected teachers' behavior in other ways that are not through their beliefs. There is also no reason to believe that there were 'defiers' – teachers who would always do the opposite of their assignment – in our intervention.

D. Exclusion Restriction and Mechanisms of Change

There may be two pathways through which increased teachers' growth mindsets may be associated with higher student learning. The first pathway by which the effect could occur is through changes in teachers' pedagogical practices. For example, teachers with increased growth mindset may revise their pedagogical practices and, therefore, give more effective classes to improve their student learning. While we know that certain pedagogical practices are associated with student learning (Kane et al. 2011), we need to analyze whether the changes in pedagogical practices due the intervention are changes coming from changes in beliefs, rather than a general improvement in pedagogical practices.

Secondly, teachers may impact students' growth mindset, and the increase in student learning occurs through the changes in students' beliefs. That is, the change in teachers' behavior and practices may impact students' beliefs which, in turn, affects students' behavior in the classroom and with school tasks in general. Increased growth mindset can motivate students to adopt 'learning goals' (goals aimed at increasing their ability), to take on more rigorous learning experiences, and to persist when encountering difficulties, which are then important for greater learning (Yeager et al. 2019; Blackwell, Trzesniewski, and Dweck 2007).

To analyze whether our exclusion restriction holds (if the intervention has affected student achievement only through changes in teacher beliefs), we test the treatment effect on different pedagogical practices. Building upon our prior discussion, the intervention's primary objective revolves around providing teachers with strategies for fostering a 'growth mindset classroom.'

With this objective, we do not expect general changes in pedagogical practices that are not associated with teacher beliefs, such as changes in teachers' time-use in the classroom. The TEACH Plus classroom observation instrument allows us to compare teachers' use of time with other teachers' practices that we expect to be related to teachers' growth mindset beliefs. To do so, we estimate a similar model to the one presented in equation 2, with indicators for the 'Quality of Teaching Practices,' and indicators for the 'Use of Class Time' as outcomes.

Our hypothesis is that changes in teacher beliefs toward a growth mindset will impact all these three areas of 'Quality of Teaching Practices.' Teachers who believe that effort can enhance students' intelligence are likely to create a positive learning atmosphere and avoid dismissing students based on negative behaviors – as these negative behaviors would not be associated with lack of intelligence – leading to improved 'Classroom Culture.' Additionally, a growth mindset environment would encourage teachers to promote higher-order thinking, tied to the 'Instruction' indicator. Furthermore, teachers who believe in the benefits of constructive criticism are expected to foster more autonomy, perseverance, and social-collaborative skills in the classroom. On the other hand, we do not anticipate changes in the amount of time teachers spend on activities, as this would depend on the content to be taught, and our intervention did not work on any pedagogical strategy referring to any specific content-knowledge.

III. Results

A. Teachers' Growth Mindset

We aim to understand whether our intervention impacted teacher beliefs regarding intelligence. Figure 1 shows the kernel density of the teachers' growth mindset index by treatment and control schools. We observe a significant shift in teachers' growth mindset in the schools randomly assigned to treatment.

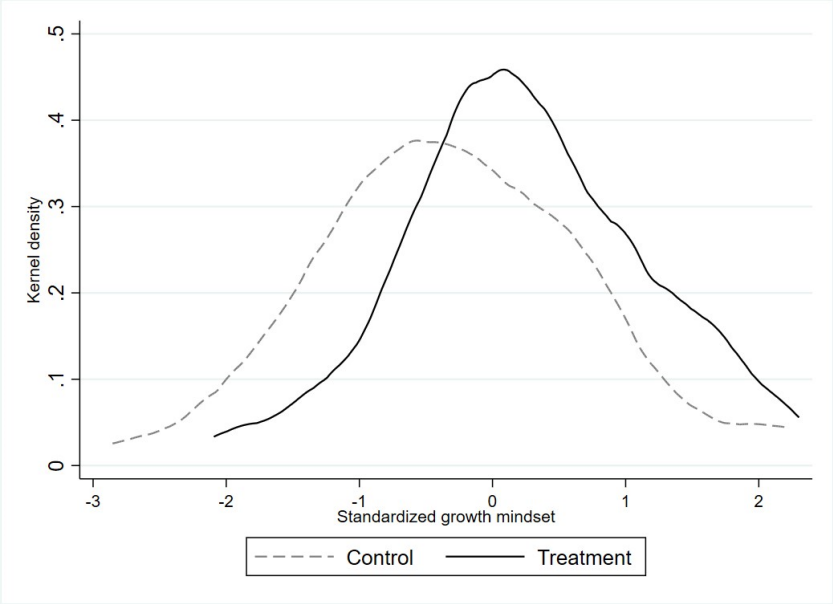

FIGURE 1: TEACHER'S GROWTH MINDSET

Notes: $N_{Treatment} = N_{Control} = 89$.

Sources: Teacher's Growth Mindset questionnaire were applied in Nov/2019. Teachers' Growth Mindset questions were adapted from the Implicit Theory of Intelligence Scale (ITIS) (Abd-El-Fattah and Yates 2006).

Table 5 presents the results estimated using equation 2. Column [1] only controls for the social desirability index, as well as controls for the assigned pairs used for randomization, and for fixed effects for the coders who visited the schools to collect data. Column [2] adds a control for the number of 5th grade classes in the school (school size). Column [3] adds teacher characteristics' controls, from the SAEB teacher questionnaires (Brazil 2019). Column [4] adds individual student characteristics, also from the SAEB questionnaires.[13]

TABLE 5: TREATMENT EFFECTS ON TEACHER'S GROWTH MINDSET

	[1]	[2]	[3]	[4]
	Teacher's Growth Mindset			
Treatment school	0.514	0.513	0.451	0.574
	[0.122]***	[0.121]***	[0.135]***	[0.128]***
R^2	0.48	0.49	0.51	0.55
N	273	273	273	273
Pair FE	Yes	Yes	Yes	Yes
Coder FE	Yes	Yes	Yes	Yes
Social desirability	Yes	Yes	Yes	Yes
School size	No	Yes	Yes	Yes
Teacher characteristics	No	No	Yes	Yes
Student characteristics	No	No	No	Yes

Notes: Standard errors clustered at school level. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Sources: SAEB teacher questionnaire (Brazil 2019). Teacher's Growth Mindset questionnaire were applied in Nov/2019. Teachers' Growth Mindset questions were adapted from the

[13] Teacher and student controls used in the estimations are described in Table TABLE 4.

Implicit Theory of Intelligence Scale (ITIS) (Abd-El-Fattah and Yates 2006). Teachers' social desirability questions are adapted from Reynolds (1982).

The results presented in Table 5 indicate a positive and significant effect of the intervention (*p-value < 0.01*) for those teachers in the schools selected to participate in the workshops, meaning that we were successful in impacting teachers' growth mindset with a relatively short intervention and that this effect existed eight months after the intervention. Particularly, in our preferred model (column [4]), being in a treated school increased teachers' growth mindset by 0.574 SD.

The interpretation of this effect on teachers is contingent upon the tool employed to assess growth mindset. In this study, we utilized the "Implicit Theory of Intelligence Scale" (ITIS) developed by Abd-El-Fattah and Yates (2006), which was translated and adapted to suit our needs. Limeri et al. (2020) posits that individuals' definition of intelligence can vary across contexts, which can impact how they respond to mindset scale inquiries. Nevertheless, given that our instrument was specifically customized to the group under investigation, we do not believe that any discrepancies in the results between the treatment and control groups are due to divergent interpretations of the scale – especially after including all control variables in the estimation. We did not apply the questionnaire prior to the intervention so the mindset questions would be new both to treatment as to control schools.

B. Randomization: Student results

Then, we are interested in estimating the effect of being in a treated school on SAEB test results. Table TABLE 6 and Table TABLE 7 present the estimated effects after estimating equation 3 for Mathematics and Portuguese Language, respectively. Like Table 5, each column adds new controls, with column [4] being our preferred model.

TABLE 6: STUDENT RESULTS - TREATMENT EFFECTS ON MATHEMATICS

	[1]	[2]	[3]	[4]
	Math Test Scores			
Treatment school	0.282	0.232	0.202	0.141
	[0.071]***	[0.072]***	[0.075]***	[0.066]**
R^2	0.14	0.15	0.15	0.24
N	7,115	7,115	7,115	7,115
Pair FE	Yes	Yes	Yes	Yes
Coder FE	Yes	Yes	Yes	Yes
School size	No	Yes	Yes	Yes
Teacher characteristics	No	No	Yes	Yes
Student characteristics	No	No	No	Yes

Notes: Standard errors clustered at the school level. * $p<0.1$; ** $p<0.05$; *** $p<0.01$
Sources: Standardized test results and teacher questionnaires: SAEB 2019 (Brazil 2019).

TABLE 7: STUDENT RESULTS - TREATMENT EFFECTS ON LANGUAGE

	[1]	[2]	[3]	[4]
	Language Test Scores			
Treatment school	0.277	0.223	0.221	0.154
	[0.071]***	[0.065]***	[0.068]***	[0.057]***
R^2	0.11	0.11	0.11	0.21
N	7,115	7,115	7,115	7,115
Pair FE	Yes	Yes	Yes	Yes
Coder FE	Yes	Yes	Yes	Yes
School size	No	Yes	Yes	Yes
Teacher characteristics	No	No	Yes	Yes
Student characteristics	No	No	No	Yes

Notes: Standard errors clustered at the school level. * $p<0.1$; ** $p<0.05$; *** $p<0.01$
Sources: Standardized test results and teacher questionnaires: SAEB 2019 (Brazil 2019).

Our results presented in Tables Table 6 and Table 7 indicate that students in schools in which the 5th grade teachers were assigned to treatment had a significant increase in Math *($\beta_1 = 0.141$, p-value < 0.05)* and in Portuguese Language *($\beta_1 = 0.154$, p-value < 0.01)*. Before controlling for the individual student characteristics, the effects of both subjects were around to 0.20 SD increase in test performance. Putting these results in perspective, Evans and Yuan (2022) find a median effect size of 0.10 SD on learning among randomized controlled trials conducted in low- and middle-income countries. Chetty, Friedman, and Rockoff (2014) find that a 1 standard deviation improvement in teacher value-added raises normalized test scores by approximately 0.14 SD in Math and 0.1 SD in English. According to Evans and Yuan (2019), in low- and middle-income countries, students learn between 0.15 and 0.21 SD of literacy ability over the course of a school year. Using these metrics, the results found indicate that our intervention led to an increase of about one year of student learning, considering our preferred model.

C. IV: Student results

Going to our main question, of whether teachers with growth mindset increase student performance, Table 8 and Table 9 present the results estimated according to equations 4.1 and 5.2 for Mathematics and Portuguese Language, respectively. Like the previous tables, the controls are added from column [1] to column [4], with column [4] being our preferred model. The first-stage estimation differs from the one presented in Table 5 by only the fact that teachers' growth mindset indicator in the IV-estimation is in the school level, rather than by individual teachers. As above, the intent-to-treat effect of the intervention is positive and significant in increasing teachers' growth mindset *($\beta_1 = 0.192$, p-value < 0.01)*.

TABLE 8: STUDENT RESULTS – GROWTH MINDSET EFFECTS ON MATHEMATICS

	[1]	[2]	[3]	[4]
First-stage	Teacher's Growth Mindset			
Treatment school	0.203	0.207	0.193	0.192
	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Second-stage	Math Test Scores			
Teacher's $\widehat{\text{Growth}}$ Mindset	1.532	1.346	1.282	1.007
	[0.373]***	[0.360]***	[0.401]***	[0.376]***
N	7,115	7,115	7,115	7,115
Pair FE	Yes	Yes	Yes	Yes
Coder FE	Yes	Yes	Yes	Yes
Social desirability	Yes	Yes	Yes	Yes
School size	No	Yes	Yes	Yes
Teacher characteristics	No	No	Yes	Yes
Student characteristics	No	No	No	Yes

Notes: * p<0.1; ** p<0.05; *** p<0.01

Sources: Standardized test results and teacher questionnaires: SAEB 2019 (Brazil 2019). Teacher's Growth Mindset questionnaire were applied in Nov/2019. Teachers' Growth Mindset questions are adapted from Implicit Theory of Intelligence Scale (ITIS) (Abd-El-Fattah and Abd-El-Fattah, 2006). Teachers' social desirability questions are adapted from Reynolds (1982).

TABLE 9: STUDENT RESULTS – GROWTH MINDSET EFFECTS ON LANGUAGE

	[1]	[2]	[3]	[4]
First-stage	Teacher's Growth Mindset			
Treatment school	0.203	0.207	0.193	0.192
	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Second-stage	Language Test Scores			
Teacher's $\widehat{\text{Growth}}$ Mindset	1.399	1.219	1.291	0.993
	[0.374]***	[0.362]***	[0.408]***	[0.381]***
N	7,115	7,115	7,115	7,115
Pair FE	Yes	Yes	Yes	Yes
Coder FE	Yes	Yes	Yes	Yes
Social desirability	Yes	Yes	Yes	Yes
School size	No	Yes	Yes	Yes
Teacher characteristics	No	No	Yes	Yes
Student characteristics	No	No	No	Yes

Notes: * p<0.1; ** p<0.05; *** p<0.01

Sources: Standardized test results and teacher questionnaires: SAEB 2019 (Brazil 2019). Teacher's Growth Mindset questionnaire were applied in Nov/2019. Teachers' Growth Mindset questions are adapted from Implicit Theory of Intelligence Scale (ITIS) (Abd-El-Fattah and Abd-El-Fattah, 2006). Teachers' social desirability questions are adapted from Reynolds (1982).

By using the treatment assignment as an instrument to teachers' growth mindset, we find that teachers with increased growth mindset improve student test performance by 1.007 SD in Mathematics, and by 0.993 SD in Language, after controlling for all student individual-level characteristics, as well as to teacher's individual-level characteristics, school size, social desirability index, and pair and coder fixed effects. These results indicate that teachers who changed their beliefs due to the intervention have impacted their students by around one standard deviation. Using Evans and Yuan (2019) metric (one year represents 0.15 to 0.2 SD in test

performance results), we find that a one standard deviation increase in growth mindset index leads to the remarkable increase of between 4.7 and 6.8 years of additional schooling.

While extraordinary, it is important to note that students in treatment schools have not observed an improvement of one standard deviation in the school year, but rather that a one standard deviation increase in teachers' growth mindset is associated with a one standard deviation increase in student learning. As presented in Table 5, our intervention was able to increase teachers' growth mindset by 0.574 SD, considering the most complete model (column 4). However, these results demonstrate a very important role that growth mindset exert in improving student learning in the context of this study.

D. Exclusion Restriction and Mechanisms of Change

To test the exclusion hypothesis, necessary for the estimation of the IV-regression model, Table 10 and Table 11 present the results of the regression estimation of the treatment effect on teachers pedagogical practices. As discussed above, our hypothesis is that our intervention affects student learning through changes in teachers' growth mindset, and, therefore, these changes in teachers' growth mindset are reflected in their pedagogical practices, affecting, consequently, students. While it may affect students' beliefs or just affect student learning (through more effective practices) without changing student's beliefs, it is necessary for our estimation that our intervention has not affected other types of teachers' practices that are unrelated to changes in beliefs – such as changes in teachers' use of class time.

Table 10 presents the effect of the intervention on the TEACH score – referring to the overall quality of teacher pedagogical practices – and of the categories that compose this overall indicator: whether the teacher promotes a positive classroom culture; the quality of teacher instruction; and whether the teacher promotes the development of socioemotional skills for the students. Table 11 then analyzes the effect of the intervention on teachers' use of class time, analyzing whether teachers in schools randomly selected to participate in the treatment were more likely to spend more time in academic activities, versus classroom management, or to be 'off-task.'

As presented in Table 10, teachers' pedagogical practices have significantly changed in the treatment schools, and this improvement in quality of pedagogical practices measured by the TEACH overall score comes predominantly from a change in the classroom culture and in the teachers' instruction. These results indicate that our intervention has significantly affected

teachers' behavior in the classroom, suggesting that changes in pedagogical practices – particularly in classroom culture and quality of instruction – are likely to be the main mechanisms that a teachers' growth mindset affect students' performance.

Interestingly, we do not observe significant variation in the promotion of socioemotional skills in schools where teachers have participated in the workshops. To understand why we do not observe effects on the promotion of socioemotional skills due to our intervention, we further investigate the variations in the components of this indicator across treatment and control schools. There are three elements composing the Socioemotional indicator: 'Autonomy,' 'Perseverance,' and 'Social and collaborative skills.' We estimated the effect of the intervention on these elements using a model similar to equation 2,[14] and observed an increase in the Perseverance element, but no change in Autonomy or Social and collaborative skills.

A possible interpretation for these results may be that the attribute of 'Perseverance' in education is more intrinsically tied to the educators' beliefs than autonomy and social and collaborative skills. This is because it encompasses crucial behaviors such as acknowledging the efforts of learners, maintaining a positive outlook towards their struggles, and fostering the setting of realistic objectives. On the other hand, the development of autonomy and social and collaborative skills may not be impacted by a teacher's mindset of growth because they may not be viewed as being directly related to cognitive abilities.

in the Appendix. As presented in Table A.1, we only observe an increase in teacher practices related to pursuing perseverance in the students.

TABLE 10: TREATMENT EFFECTS ON TEACHERS' QUALITY OF TEACHING PRACTICES

	[1]	[2]	[3]	[4]
	TEACH score	Classroom culture	Instruction	Socioemotional skills
Treatment school	0.446	0.518	0.387	0.195
	[0.118]***	[0.089]***	[0.136]***	[0.134]
R^2	0.64	0.65	0.57	0.61
N	274	274	274	274
Subject dummies	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes
Coder FE	Yes	Yes	Yes	Yes
School size	Yes	Yes	Yes	Yes
Teacher characteristics	Yes	Yes	Yes	Yes
Student characteristics	Yes	Yes	Yes	Yes

Notes: Standard errors clustered at the school level. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Sources: Classroom observations using the TEACH Plus instrument occurred in Nov/2019.

[14] Not shown here, available upon request.

TABLE 11: TREATMENT EFFECTS ON TEACHERS' USE OF CLASS TIME

	[1]	[2]	[3]
	Instructional activities	Classroom management	Teacher off-task
Treatment school	0.017	-0.012	-0.005
	[0.025]	[0.020]	[0.017]
R^2	0.14	0.10	0.11
N	2,740	2,740	2,740
Snapshot FE	Yes	Yes	Yes
Subject dummies	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes
Coder FE	Yes	Yes	Yes
School size	Yes	Yes	Yes
Teacher characteristics	Yes	Yes	Yes
Student characteristics	Yes	Yes	Yes

Notes: N refers to 273 classes times 10 classroom observation' snapshots. Standard errors clustered at the school level. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Sources: Classroom observations using the TEACH Plus instrument occurred in Nov/2019.

More importantly, the improvement in pedagogical practices is not reflected in general changes in pedagogical practices – the use of time, for example, was not affected by our intervention (as we can see in Table 11). These results also indicate that our intervention did not affect all aspects of the classroom, but rather those aspects – we argue – related to the observed changes in teachers' growth mindset.

IV. Conclusion

While we already know that an increased student growth mindset is associated with higher student learning, the literature is still incipient in analyzing whether an increased teacher growth mindset is associated with higher student learning, particularly in the context of social vulnerability. That is, if we can increase teachers' growth mindset, would they change their behavior in such a way that they become more effective in improving their students' learning?

We conducted a randomized intervention on teachers' growth mindset to understand whether teachers with a belief that intelligence is not fixed, but rather it can grow, affect their students positively in terms of learning. While beliefs undoubtedly intertwine with other intrinsic characteristics influencing teacher effectiveness in enhancing student learning, we can accurately gauge the precise impact of teachers' growth mindset on student development through a rigorous approach. By randomly assigning 5th grade schools to participate in a 5-week workshop, dedicated to cultivating ideas and strategies for fostering a 'growth mindset classroom,' we can effectively measure the direct effects on student learning. A school year after the intervention, we returned to

these schools to collect data on teacher growth mindset using translated versions of growth mindset questionnaires already established in the literature. We also used the student individual data of the standardized test on Portuguese Language and Mathematics, the SAEB tests applied by the INEP/Brazilian Ministry of Education (Brazil 2019), and the student and teacher characteristics' information collected through questionnaires collected by the INEP.

We found that the teachers who participated in the workshops significantly improved their perceived belief that their intelligence could grow. Moreover, students from schools in which teachers have been selected to participate in the workshops have significantly increased their performance on Portuguese Language and Mathematics standardized tests applied by the Brazilian Ministry of Education. Particularly, being in a treated school increased Mathematics student performance by 0.14 SD, and Portuguese Language by 0.154 SD.

While it is interesting to learn that our intervention was successful in increasing teachers' growth mindset and student learning, our main interest is understanding whether teachers with growth mindset are positively impacting student learning. For that, we used the random assignment to the intervention as an instrument to the increase in growth mindset. We find that students in schools where teachers have an increased growth mindset performed significantly better in Portuguese Language and Mathematics. Particularly, we find that one standard deviation increase in teachers' growth mindset index is associated with 1.007 SD increase in Mathematics, and 0.993 SD increase in Language performance.

We collected classroom observation data to analyze the mechanisms of change in pedagogical practices due to our intervention. There is evidence that teachers with increased growth mindset have improved their pedagogical practices, considering the TEACH Plus methodology of classroom observation. The change in teachers' pedagogical practices due to an increased growth mindset happens particularly through changes in 'Classroom Culture' and 'Instruction.' That is, teachers with a reported growth mindset treat students with greater respect, define behavior expectations more clearly, and recognize students' positive behavior more often. In addition, we observed that teachers with increased growth mindsets do not dedicate more time to academic activities, even though the quality of the activities developed improves.[15]

[15] Cruz (Upcoming) presents the impact evaluation of the randomized intervention on teachers' pedagogical practices considering the TEACH Plus methodology.

This study provides strong evidence that we can alter the beliefs of teachers regarding intelligence to a growth mindset with a brief intervention (a five-meeting workshop held in-person). The intervention proved effective even in a real-life setting with socially vulnerable students in Rio de Janeiro's public school system. Moreover, we found that such changes in teachers' growth mindsets are important for student learning. While teachers' beliefs regarding intelligence are just one piece of all the factors that involves teacher-student interaction and the ability of teachers to affect student learning, the impressive effects found in teachers' growth mindsets on student test performance show that more flexible beliefs regarding intelligence play an important role in increasing learning. Continuing Education Courses – regularly offered by education networks – can, therefore, become an important means to expose teachers to theories and practices related to growth mindset. Hence, our results indicate that this type of intervention has powerful policy potential for improving educational results, particularly in vulnerable contexts.

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