Rio PREFEITURA | FUNDAÇÃO JOÃO GOULART | NudgeRio

SAEB

THE IMPACT OF NUDGE ON EDUCATIONAL DEVELOPMENT

SUMMARY

EXECUTIVE SUMMARY

External assessments are opportunities for the school community, teachers, principals, parents/guardians and students to get involved in improving the quality of teaching. Every two years, 5th and 9th graders take the Basic Education Assessment System Test (SAEB), an external assessment prepared by the Ministry of Education. With a view to adapting to this assessment, Rio de Janeiro's municipal school system uses the SAEB Mock Test for its students. The aim of the intervention was to encourage 5th and 9th grade students in Rio de Janeiro's municipal school system to commit to the SAEB Mock Test, by strengthening their relationship with their parents/guardians and sending them messages encouraging them to take the test, during the period in which the assessment was being carried out. To this end, the affirmative hypothesis "It is possible to improve students' performance in the 'SAEB Mock Test' when they are encouraged by their parents/guardians" was evaluated. To test this hypothesis, the experiment sought to encourage family participation, in which parents received WhatsApp messages from the Municipal Department of Education (SME/RJ) with emotional stimuli, asking them to pass them on to their children/students and thus affect their performance on the SAEB Exam, based on commitment behavior. The intervention included three treatment groups and a control group for the 5th grade and two treatment groups and a control group for the 9th grade. The results of the experiment showed that the most effective message increased the average Portuguese language and math scores of the 9th graders by 4.1% compared to the control group, while the 5th grade messages were not

effective compared to the control group.

Keywords: Education. SAEB. External evaluations. Nudge.

1. INTRODUCTION

According to Thaler and Sunstein (2008), Nudge is any aspect of the choice architecture that promotes behavioral change without prohibiting or significantly altering economic incentives. Nudges are considered an important strategy in the field of public policy, as they make it possible to test the effectiveness of executive projects in a less costly manner, stimulating better decisions, with a consequent change in behavior, resulting in greater benefits for citizens and society.

The purpose of the experiment conducted by NudgeRio, the Applied Behavioral Science unit of Rio de Janeiro City Hall, was to carry out controlled interventions for the SAEB Mock Test, with subsequent large-scale application of the "winning" interventions, i.e. the most effective ones, in the SAEB Exam.

The Basic Education Assessment System (SAEB) is a set of assessments carried out by the Anísio Teixeira National Institute for Educational Studies and Research (INEP), a body linked to the Ministry of Education (MEC), whose function is to assess the quality of Brazilian basic education and diagnose the factors that can interfere with student performance. One of these instruments is the SAEB Exam, administered every two years. The results obtained, together with those of the School Census, are used to calculate the Basic Education Performance Index

(IDEB).

The Municipal Department of Education of the City of Rio de Janeiro (SME/RJ), as a tool to prepare students for the SAEB Exam, runs the SAEB Mock Test. This mechanism aims to prepare students emotionally, pedagogically and didactically for the test, which will therefore have an impact on the assessment of the quality of primary education.

Given the importance of the role of parents/guardians in the educational process, it is believed that students who are encouraged by these actors tend to perform better in assessments, whether internal or external. In response to a request from the Municipal Secretary of Education, the NudgeRio team came up with an experimental design with the aim of improving the performance of 5th and 9th grade students in the municipal school system in the SAEB Exam, based on stimulating commitment behavior.

2. JUSTIFICATION

The results of the SAEB Mock Test and the SAEB Exam do not produce bonuses or burdens for the students' academic lives. In this sense, this could be one of the reasons why parents/guardians and their own children/students are not very motivated and engaged in preparing for and taking the assessments. External evaluations are important for public and school management as they provide a more accurate assessment of the development and quality of basic education in the country. Additionally, they are part of a set of measures that analyze, impact, and may compromise the allocation of resources for education, with student

effort being an essential component of this process.

In order to understand the relationship between the school community (parents, students, teachers, principals and managers) and the external evaluations, the SME/RJ has been investigating the level of engagement of students in participating in these evaluations, since they do not have a direct impact on their school life. The relevance of the SAEB Exam is that it is an instrument for analyzing basic education, which allows us to assimilate the educational strategies distributed throughout the country, to account for them to society and to see if they are in line with the various social realities and public agendas demanded by the population.

3. EXPERIMENTAL METHODOLOGICAL APPROACH

3.1. METHODOLOGY

The study is of an applied nature, as it aims to generate knowledge to solve problems. It is an experimental approach that used qualitative and quantitative data to reflect on the objectives, the questions to be formulated for the purposes of the investigation and analysis of the environmental and operational context of the evaluation. Regarding the technical procedure, variables that may influence the experimental subjects were observed, with context delimitation, selection of causal mechanisms, treatment and control groups, thus ensuring internal and external validity while outlining the experiment.

The nudge SAEB Mock Test project consisted of five phases for the study of behavioral principles, which will be described in this report. The definitions considered in each phase sometimes overlap, which is a good

thing, because at each stage it is possible to see what the stakeholders consider to be relevant to the project. It is part of the validation process and the documentation of evidence to check the path that is being taken. In this way, it is possible to create approaches that are more likely to be effective, increase the chances of isolating variables and present questions that can be tested and statistically modeled.

The understanding of the issues related to the problem to be addressed, as well as the definition of the experimental question and the hypotheses that could be measured and tested, were validated with theoretical and practical approaches. Concepts from disciplines such as Statistics, Psychology, Behavioral Economics, Design Thinking and Strategic Marketing were considered, in an integrative and comprehensive modeling, in a transdisciplinary way. The analytical set presented is based on evidence and experimentation, and has therefore been defined as Applied Behavioral Science.

3.1.1. OBJECTIVES OF THE NUDGE PROJECT

The use of various theoretical resources and primary and secondary data is part of the effort to understand the issue to be addressed in the project. In this sense, the construction of the approach this demand for a municipal public agenda. The idea behind the study is to show the importance of the SAEB Exam and Simulated Test for students in the 5th and 9th grades of elementary school, even if it doesn't result in a direct academic gain for the individual.

The aim of the project is to create intervention to stimulate the commitment of 5th and 9th grade students in Rio de Janeiro's municipal

school system to the SAEB Mock Test, by encouraging a closer relationship with their parents/guardians during the period of the assessment.

Aligning strategic visions is one of the premises of the nudge SAEB Mock Test project and is fundamental to understanding its environmental and operational context, since it operates in different macro-political dimensions, such as the quality education index, integration with the community and commitment to basic education.

3.1.2. DEFINING THE PROBLEM

The definition of the problem, i.e. which aspect of the public agenda would be dealt with in the project, was validated in meetings with the SME/RJ and the monitoring team appointed by it. At this stage of the project, meetings were held to understand how the NudgeRio team could work with the SME/RJ, as well as to initially capture the restrictions that existed for the execution of the experiment.

Secondary data was presented, from which it was possible to indicate best practices and actions that had an impact on the IDEB score in cities across Brazil. The data comes from research conducted by various institutions, articles, and interviews with specialists. The initial research and the observed data set resulted in a list of predictions. That is, aspects and best practices that have an impact on student performance in the SAEB Exam in the municipality of Rio de Janeiro. And so, possibilities were presented for investigation, assumption and experimentation, namely:

a) Extracurricular activities;

b) Creation and dissemination of targets for schools;

c) Monitoring of school indices;
d) Monitoring and Engagement of Teachers and Students;
e) School environment - Cleanliness;
f) Socio-economic level of families;
g) Specific activities with students in situations of social vulnerability;
h) Family participation.

It's important to note that these aspects go beyond the classroom, but are relevant to the school community (parents, students, principals and managers) and were part of the analytical process to understand how it would be possible to create an intervention that would meet the public agenda, from some perspective, with the nudge methodology. Based on the meetings and research, it was decided that the project should be carried out with the participation of the students' families and guardians.

One of the factors attributed to the problem is the students' commitment to taking the SAEB Mock Test and the SAEB Exam. Poor performance in these evaluations does not result in direct and noticeable harm to the student's school life, but they are important tools for improving primary education in the country. From this perspective, the NudgeRio team decided that the problem at work in this context is student engagement and the experimental subjects are the 5th and 9th grade students in the SAEB Mock Test.

Reflection on the experimental approach also validates the experimental question which, in this study, was based on the triad: Quality Education Index, Integration with Community and Commitment to Basic

Education. The experimental reflection phase assesses whether it is possible to encourage the participation of parents in their children's education, and consists of the intervention's macro and strategic field of action. The strategic dimension is taken into account so that the project can be presented as part of public policies or government macro-policies

In the study design, the causal relationship proposed in the experiment verifies whether students/children stimulated by guardians/parents tend to have greater commitment and, consequently, better performance in the SAEB Mock Test. The experiment will assess whether students who receive encouragement from their guardians tend to improve their performance on the . In this sense, the experiment will evaluate a hypothesis considering the environmental and operational aspects related to the project.

3.1.3. ANALYZING THE CONTEXT

3.1.3.1. GOVERNMENTAL STRATEGIC DIMENSIONS

The Municipal Department of Education, an organ of the City of Rio de Janeiro (PCRJ), is responsible for drawing up the municipal education policy in the city of Rio de Janeiro, coordinating its implementation and evaluating the results, with the aim of ensuring excellence in Early Childhood Education, Primary Education and Youth and Adult Education.

It should also be noted that one of the public agendas currently on the municipal executive's agenda is the Sustainable Development Plan (PDS) for the city of Rio de Janeiro. The PCRJ has held waves of votes to choose the so- called priority challenges, i.e. the main interests of the population for the implementation of public policies. The votes are

presented from two perspectives, local and global. Locally, the demands are analyzed territorially by neighborhood and globally, they are the proposals indicated to be fulfilled by the executive for the city as a whole. At the time this project was carried out, the priority of the Education department, based on public demand, was: "Quality education consolidating the school as a place of integration with the community".

The municipal education network[1], at the time of the experiment (2019), had 1,540 school units and served 626,778 students, making it the largest in Latin America. It had 39,017 teachers and 13,968 administrative support staff. The SME/RJ has 11 Regional Education Coordinators (CREs) in its structure, as shown in Figure 1 below:

[1] Data from the Municipal Department of Education website. Accessed on: January 2020.

Figure 1: Illustration of the location of the CREs - Municipality of Rio de Janeiro

Source: Municipal Department of Education

The CREs are responsible for articulating and disseminating the educational policy drawn up by the SME/RJ, monitoring the implementation and development of this policy with the educational facilities.

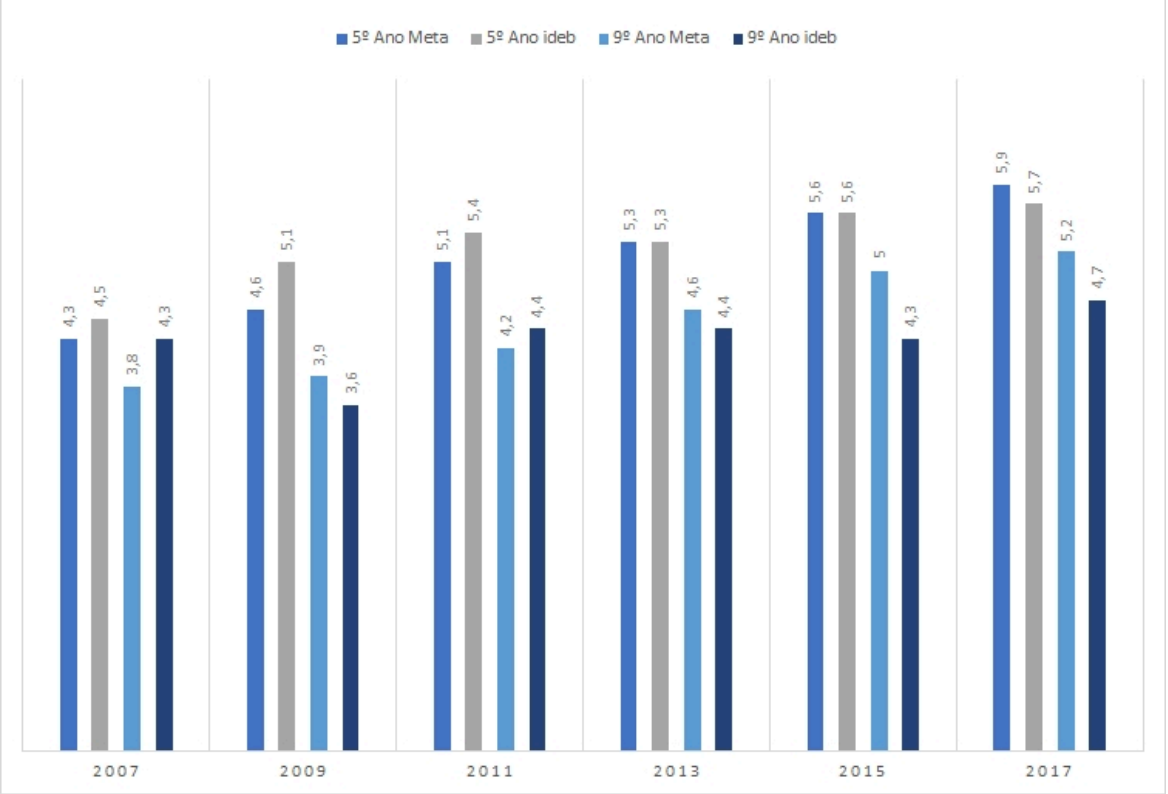
The executive strategic dimension is associated with the IDEB, developed in 2007 by INEP, and is one of the main federal educational policy guidelines for municipalities. The IDEB measures the quality of learning and guides the development targets for improving education. In this sense, "the IDEB was created to be an instrument for monitoring the quality of education, made up of quantifiable targets widely disseminated throughout the country, which society must take ownership of and for which public managers can be held accountable" (FERNANDES, 2010, p.4). It

is within this context that the SAEB Exam is administered, and the SAEB Mock Test is conducted, which consists of a test for students with the goal of improving their performance in the SAEB Exam.

The SAEB Exam has existed since 1990 and has undergone successive changes over the years. The subjects assessed by the SAEB Exam are: Portuguese Language (focus on reading) and Mathematics (focus problem solving). However, in 2019, the assessment process included students in the 2nd year of elementary school in the Portuguese Language and Mathematics skills and added the skills linked to Natural Sciences and Human Sciences for the 9th year of elementary school.

According to Graph 1, the 2017 results for the 5th and 9th grades of education in the Municipality of Rio de Janeiro show that the IDEB was below projection.

Graph 1: IDEB targets and results for the initial and final years - Municipality of Rio de Janeiro



Source: Available at: https://www.qedu.org.br/cidade/2801-rio--de-janeiro/aprendizado

The graph shows that, in 2017, the SME/RJ did not reach its target for both 5th and 9th grade students. One of the measures taken by the Secretary of Education to achieve the IDEB target, by improving performance in the SAEB Exam, was to encourage the commitment of guardians/parents in relation to the educational process of their students, in order to involve them in this process.

3.1.3.2. ENVIRONMENTAL CONTEXT

The context analysis included in-depth interviews to understand and validate how the aspects and best practices indicated in the research apply within the scope of municipal schools. This phase also focused on

analyzing and validating sample data from the results of the socioeconomic questionnaires applied to students and teachers in order to understand the profile of the children and adolescents who took the SAEB Exam in 2017.

The interviews were semi-structured, with a pre-prepared script, which allowed the interviewees to gather information spontaneously. The following people were interviewed: the Municipal Secretary of Education, the Chief of Staff, municipal school principals (general and deputy), public education managers, teachers and regional coordinators, all of whom had extensive experience of day-to-day school life. The aim of the interview was to validate methodological preferences for the design of the experiment, align stakeholder divisions and understand the resources needed and available. In this sense, it was important to understand, from the interviewees, the benefits of taking the SAEB Exam, the main barriers and incentives, in terms of stimuli and behavioral influences, and how these behaviors were perceived, considering the classification into expected behaviors and behaviors to be changed.

The study of the relationship between experimental questions, best practices and experimental subjects, based on primary and secondary data, resulted in the functional analysis of behavioral stimuli, which was based on:

- the government's strategic dimension;
- models of behavior;
- behavioral stimuli;
- heuristics;

- biases;
- expected behavior;
- behavior to be changed in the decision-making context studied
- who can be intervened against;
- if anyone else is affected in the decision architecture;
- the functional relationship of behavior,
- function of the intervention;
- what treatment can be applied;
- framework for decision-making;

The experimental subjects, those who will receive the stimulus to change their behavior, are 5th and 9th grade students from municipal schools in Rio de Janeiro.

3.1.3.3. BEHAVIORAL PRINCIPLES

The fact that the experiment is developed as an executive project helps to create and define criteria for choosing one experiment over another. This section reflects on specific conceptual model, in which categories and relationships were created to understand the *gap* between an individual's action and intention.

These are nudge classification models, which include emotional, cognitive and social biases and the dual model of thinking, System 1 or System 2. Another relevant aspect is that this conclusion also considers the project's execution capacity and constraints, measurement and experimentation, whether the use of information is clear, the decision-making structure, and what can help the experimental subject decide to change their behavior for their own benefit and for society's.

The definition of the experimental subjects made it possible to validate the possible treatments for this audience in the context studied, as well as highlighting the relevance of an approach that activates emotional stimuli from these subjects. At this stage of the project, it was also decided that the intervention would be to send messages to guardians via WhatsApp. We then assessed how the WhatsApp messages could be sent and then carried out the study and indicated the possible frameworks and emphases, behavioral effects that could be effective in the context of the intervention, the function of the intervention, bias, the dimension of action in government strategy and the conduct expected from the treatment.

The intervention prioritized emotional stimulation when sending messages to guardians, asking them to talk to their children about the SAEB Mock Test and to take the opportunity to send or say the message indicated to their son/daughter. The messages were sent via WhatsApp in three formats: text, audio and images.

The participation of the students' parents/guardians is part of the intervention mechanism (functional relationship) and is constituted as a function so that these individuals, affected by the experiment in a secondary way, are stimulated in the decision-making architecture. Emotion is considered a factor of expectation in making choices, based on emotional stimuli, activated by impulse or motivation, resulting in the operational behavioral practice of passing on messages to children/students.

The present experiment, however, will not measure how important it was for these parents to encourage their children in their academic life, but we note that this is a prediction identified in the study. Thus, in a descriptive

way, considering the functional analysis of behavior, we could say that, for the intervention, the participation of parents and guardians, culturally perceived as authorities in the education of young people, is a reinforcing event for a student. It is also a discriminative event, establishing the occasion on which this student may be reinforced by these parents/guardians.

The behavioral principles were categorized as follows to reflect the behavioral effect that would produce the appropriate stimulus for behavioral change:

- Strategic Governmental Dimension: Scope of the experiment for the SME/RJ, considering its strategic guidelines for the current public agendas, the vision of the public managers responsible for the topic in the SME/RJ and the implementation actions, projects and public policies.
- Behavioral Effect: Identification and description of behavioral effects, environmental aspects and functions of behavior, acting in the context of the experimental approach.
- Behavior Model: Framework for understanding behavior.
- Behavioral stimuli: Behavioral stimuli activated by the treatment to increase the chances of enhancing a behavioral effect and exhort the desired behavior, which will be expressed in the expected conduct.
- Behavior to be changed: Identification and prediction of current behavior patterns that do not benefit the experimental subject in the decision-making process for the expected behavior.
- Expected course of action: Expected course of action with treatment.

- Biases: Mapping the biases involved in decision-making.
- Heuristics: Mental shortcuts activated by the treatment in order to increase the chances of achieving/potentiating some behavioral effect and exhorting the behavior that will present itself in the expected conduct.
- Intervention Function: Decision architecture strategies.
- Intervention: Type of treatment.
- Message Format: Type of communication for the decision-making expectation, mapped in the functional analysis of behavior
- Emphasis: Type of Framing and Valence - Positive and Negative.

Through these steps it was possible to evaluate the behavioral principles robustly and qualify a design for the intervention and the Basic Behavioral Typology in the context.

3.1.3.4. INDICATING TREATMENT

The indication of treatments is the result of validating the entire process mentioned in the previous stages and understanding the behavioral principles at work in the context studied. In addition, this stage defines the experimental phase of the project (trial), the treatment groups, the frequency of the interventions and how to approach the experimental subject.

The hypothesis to be tested is the statement: "It is possible to improve students' performance in the SAEB Mock Test when they are encouraged by their parents/guardians". To test it, the intervention indicated was to encourage family participation, in which parents receive

WhatsApp messages from the SME/RJ with emotional stimuli for their children.

The dependent variable is the average score for the Mathematics and Portuguese Language assessments in the SAEB Mock Test. The independent variable can be defined as the treatments in the experiment, namely: sending audios with texts and photos with texts. The messages are set out in item 4, "Intervention and Conduct of the Experiment (Trial)".

3.2. SAMPLES

In order to reduce the sampling error and improve the accuracy of the results when comparing the treatment and control groups, the use of stratified random sampling was chosen in this experiment.

3.2.1. SIMILARITIES OF THE GROUPS

Strata are made up of groups of individuals with common characteristics and this allows the groups to be homogeneous in the chosen characteristics and heterogeneous when compared to each other. The strata are well defined when the common characteristic factors of the individuals correlate with the objective of the study. The data set from the 2017 SAEB Exam was used to define the common factors.

Several factors were highly correlated with the average rating were considered as candidates for characteristic variables for the strata, for example:

- hours dedicated to studying,
- carrying out complementary activities at home,
- study environment,

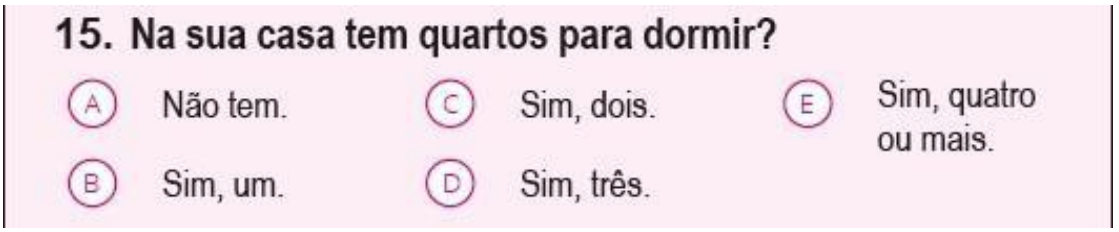
- family support,
- easy access to textbooks,
- affinity with the teacher,
- school infrastructure,
- motivating school environment.

Since many of these factors are difficult to measure, proprietary indicators were created: the **Student Comfort Indicator Aggregated by School (ICA-ae)** and the **Parental Participation in Children's Education Indicator (IPREF).** For this purpose, the student questionnaire administered by INEP during the 2017 SAEB Exam was used.

The questionnaires completed by 5th and 9th-grade students contain 51 and 57 items, respectively. From both questionnaires, items 15, 16, and 26 were analyzed.

Item 15 was used to determine the number of bedrooms available for sleeping in the student's household (see Figure 2).

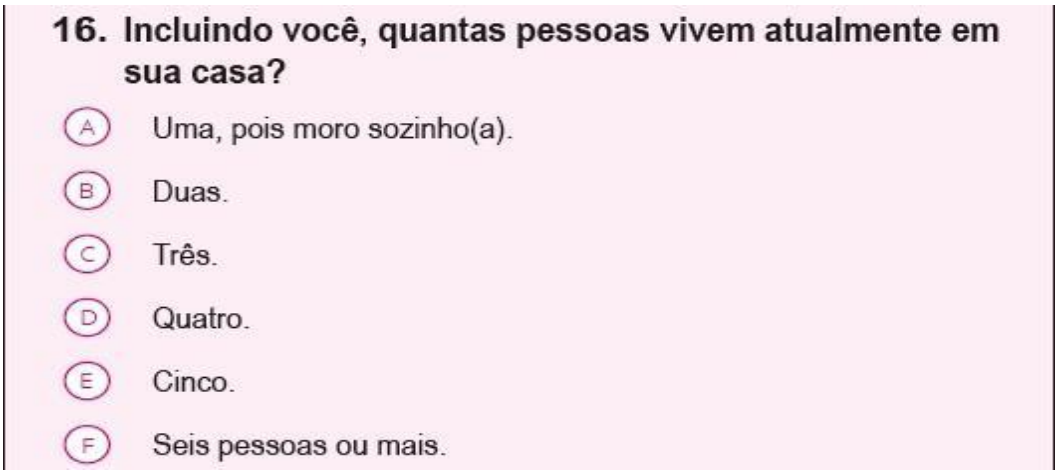
Figure 2: Item 15 of the student questionnaire



Source: Prova Brasil 2017

Item 16 gave the number of people living in the student's house (see figure 3).

Figure 3: Item 16 of the student questionnaire


16. Incluindo você, quantas pessoas vivem atualmente em sua casa?

A Uma, pois moro sozinho(a).

B Duas.

C Três.

D Quatro.

E Cinco.

F Seis pessoas ou mais.

Source: Prova Brasil 2017

A. Building the ICA-ae

Working on the hypothesis that a student who has their own room is more likely to devote themselves to their studies, the ICA, the Student Comfort Index, was initially created ("Comfort" here referring only to the possibility of the student having a suitable environment for their studies at home).

The ICA comes from the quotient between the answer to item 16 (fig. 3) and the answer to item 15 (fig. 2). In this way, the indicator measured the number of people per bedroom.

In order for the indicator to be a positive value other than zero, it was decided to relate options A to E of question 15 to values from 1 to 5, respectively, and options A to F question 16 to values from 1 to 6, respectively. Thus, the indicator ranged from a minimum value of 0.2 (1 person in 5 rooms) to a maximum value of 6 (6 people in just 1 room). It is important to note that in this first step, the lower the value obtained, the higher the "comfort index".

These values were then normalized between 0 and 1, with 0 being the worst case (maximum quotient value equal to 6) and 1 being the best case (minimum quotient value equal to 0.2), and were classified according to table 1. Note the inversion: now we have the lowest value corresponding to the worst "comfort index".

This normalized and inverted value is the ICA (Student Comfort Indicator). The different values obtained were grouped into four classifications, as shown in Table 1.

Table 1: ICA Classifier - Student Comfort Indicator

VALOR DO INDICADOR	CATEGORIA (CLASSIFICAÇÃO)
< 0,52	Sem Conforto
> = 0,52 e < 0,69	Pouco Confortável
> = 0,69 e < 0,80	Confortável
> = 0,80	Muito Confortável

Prepared by Sérgio Bastos - Data Scientist

Each student has their own ICA; information needed to be consolidated by school. This gave rise to the ICA-ae (Aggregate Student Comfort Indicator by School).

The consolidation algorithm is simple: a weighted sum. Students with an ICA indicating "no comfort" have a weight of 1. The classification "not

very comfortable" has a weight of 2 and so on.

Table 2 illustrates the ICA-ae calculation for a fictitious school with 87 students. The possible results for this school could range from 87 (all students "not comfortable") to 348 (all students "very comfortable"). This range of possibilities (87-348) was divided into four bands of equal size, i.e. subtract 87 from 348, resulting in 261 and divide this value by 4 bands.

Table 2: Example of the values for each range, considering a school with 87 students

INDICADOR DE CONFORTO DO ALUNO AGREGADO POR ESCOLA (ICA-AE)		
CATEGORIA	**VALOR MÍNIMO POSSÍVEL**	**VALOR MÁXIMO POSSÍVEL**
Sem Conforto	87	152
Pouco Confortável	153	217
Confortável	218	282
Muito Confortável	283	348

Prepared by Sérgio Bastos - Data Scientist

Table 3 shows the results observed in this fictitious school, where 1 student was classified as "not comfortable", 10 as "not very comfortable", 16 as "comfortable" and 60 as "very comfortable". The weighted sum results in 309. This is the ICA-ae observed, placing this school in the 283 to 348 range and therefore in the "Very comfortable" category. It is important to note that each school is classified into its own possibilities, and schools are never compared to each other.

Table 3: Example of the results at the hypothetical school in table 2

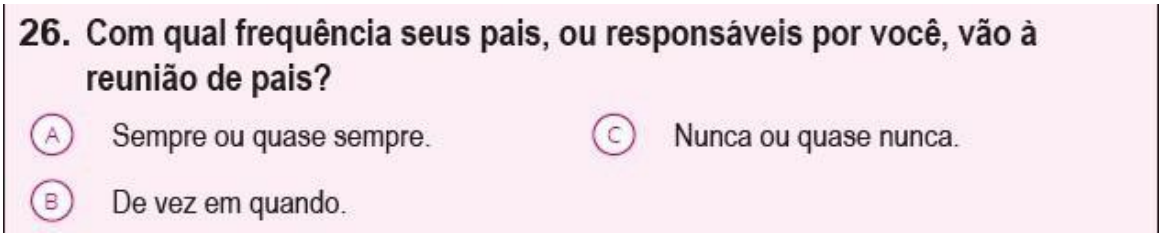
INDICADOR DE CONFORTO DO ALUNO AGREGADO POR ESCOLA (ICA-AE)			
CATEGORIA	**PESO DA CATEGORIA**	**QUANTIDADE DE ALUNOS**	**RESULTADO PONDERADO**
Sem Conforto	1	1	1
Pouco Confortável	2	10	20
Confortável	3	16	48
Muito Confortável	4	60	240
TOTAL	-	87	**309**

Prepared by Sérgio Bastos - Data Scientist

B. The construction of IPREF

The Indicator of Parents' Participation in Children's Education (IPREF) is based on item 26 of the Prova Brasil student questionnaire (fig. 4). The hypothesis now is that the recurrent presence of parents or guardians at school meetings indicates that they value the student's education.

Figure 4: Item 26 of the student questionnaire



Source: Prova Brasil 2017

Again, four categories were created: students who answered "never

or almost never" had a weight of 1; "once in a while" had a weight of 2 and "always or almost always" had a weight of 3. Table 4 shows a hypothetical case where, in a school with 88 students, 32 answered "never or almost never", 7 "once in a while" and 49 "always or almost always". The result for this school is 193, placing it in the "participative parents" category.

Table 4: Example of the results in the hypothetical school with 88 students

INDICADOR MÉDIO ESCOLAR DE PARTICIPAÇÃO DOS RESPONSÁVEIS NA EDUCAÇÃO DOS ESTUDANTES			
CATEGORIA	**PESO DA CATEGORIA**	**QUANTIDADE DE ALUNOS**	**RESULTADO PONDERADO**
Nunca	1	32	32
De vez em quando	2	7	14
Sempre	3	49	147
TOTAL	-	88	**193**

Prepared by Sérgio Bastos - Data Scientist

Table 5 illustrates the range of possibilities for this school, which varies from 88 (all students answering "never or almost never") to 264 (all answering "always or almost always"). With these extremes (which are specific to each school and depend on the total number of students), four equal ranges were created: "non-participating parents," "slightly participating parents," "participating parents," and "highly participating parents."

Table 5: Example of the values for each range, considering a school with 88 students

INDICADOR DE PARTICIPAÇÃO DOS RESPONSÁVEIS NA EDUCAÇÃO DOS FILHOS		
CATEGORIA	**VALOR MÍNIMO POSSÍVEL**	**VALOR MÁXIMO POSSÍVEL**
Pais não participativos	88	132
Pais pouco participativos	133	176
Pais participativos	177	220
Pais muito participativos	221	264

Prepared by Sérgio Bastos - Data Scientist

Therefore, in the hypothetical example, as the school's score was 193, it was classified in the third band, "participative parents".

The indicators were analyzed in the schools that took part in the SAEB Exam in 2017. The indicators obtained from the 2017 data were used to define the strata of schools participating in the nudge project in 2019. This was possible because the schools that took part in the SAEB Exam in 2017 would be the same ones that would take part in the 2019 SAEB Mock Test and, consequently, the SAEB Exam in 2019.

The strata identified above (ICA-ae x IPREF) and the respective number of school units for the 5th and 9th grades are shown in Table 5.

Table 6: School Units - ICA-ae x IPREF

INDICADOR DE CONFORTO DO ALUNO AGREGADO POR ESCOLA (ICA-AE)					
CATEGORIA →		CONFORTÁVEL		MUITO CONFORTÁVEL	
↘ IPREF		5º ANO	9º ANO	5º ANO	9º ANO
INDICADOR DE PARTICIPAÇÃO DOS RESPONSÁVEIS NA EDUCAÇÃO DOS FILHOS (IPREF)	POUCO PARTICIPATIVO	297	36	238	204
	PARTICIPATIVO	28	7	28	46
	MUITO PARTICIPATIVO	16	1	21	18

Prepared by Sérgio Bastos - Data Scientist

Although both indicators were initially classified into four categories, only the categories shown in table 6 were identified among the schools evaluated.

3.2.2. NEYMAN'S OPTIMAL ALLOCATION (internal validity)

Once the strata had been defined, the Neyman distribution was chosen instead of the proportional distribution. Neyman's optimal stratification is more advantageous than proportional stratification, as it determines the sample size within each stratum in such a way that more homogeneous strata include proportionally fewer individuals than heterogeneous strata. In this way, it can be said that the optimum stratification is the one that minimizes the variance of the variables defined in the stratum. As presented in Cochran (1997), the equation that determines the optimum allocation of individuals in the strata is shown in

figure 5.

Figure 5: Representation of the Neyman equation

$$n_h = n \times \frac{\frac{N_h S_h}{\sqrt{C_h}}}{\sum_{h=1}^{H} \frac{N_h S_h}{\sqrt{C_h}}}$$

Where:

$n_h \Longrightarrow$ Size of sample elements in stratum h;

$n \Longrightarrow$ Size of sample elements;

$N_h \Longrightarrow$ Size of stratum elements;

$S_h \Longrightarrow$ Standard deviation of the variable of interest in stratum h;

$C_h \Longrightarrow$ Cost of research in stratum h.

If the costs of obtaining data in the strata do not depend on the stratum, as is the case in this work, the equation shown in figure 6 can be simplified, as shown in figure 6.

Figure 6: Representation of the Neyman equation

$$n_h = n \times \frac{N_h S_h}{\sum_{i=0}^{n} N_h S_h}$$

3.2.3. DETERMINING THE SAMPLES IN THE STRATA

As the aim of this nudge project was to improve the overall average

of the school units in the SAEB Mock Test, the dependent variable chosen to generate the samples was the average of the Mathematics and Portuguese Language and Literature tests. The sample size of the school units was determined based on the average of all the school units in the 5th and 9th grades.

Table 7 shows the figures obtained from the 2017 SAEB Exam data.

Table 7: Data from the 2017 SAEB Exam - municipal 5th and 9th grades - Rio de Janeiro

PLANEJAMENTO AMOSTRAL	MATEMÁTICA		PORTUGUÊS		MAT/POR	
	5º ANO	9º ANO	5º ANO	9º ANO	5º ANO	9º ANO
MÉDIA	5,303	5,477	6,196	5,810	5,751	5,644
DESVIO PADRÃO	0,751	0,701	0,634	0,851	0,651	0,740
NÍVEL DE CONFIANÇA	0,950	0,950	0,950	0,950	0,950	0,950
ERRO ADMITIDO - 2%	0,11	0,12	0,12	0,13	0,12	0,12
TAMANHO DA POPULAÇÃO	628	312	628	312	628	312
TAMANHO DA AMOSTRA	193	131	101	171	124	137
TAMANHO DA AMOSTRA CORRIGIDA	148	93	88	111	**105**	**96**

Prepared by Sérgio Bastos - Data Scientist

Assuming an error of 2% of the mean value of the tests at a 95% confidence level, three samples of 105 school units (UEs) were generated for the 5th grade treatments and two samples of 96 UEs for the 9th grade treatments.

For the school unit strata shown in Table 7, it can be seen that the

standard deviations for 5th grade are quite close to each other, which shows that the strata are homogeneous and that the sample analysis could have been carried out without defining strata. The same was not true of the strata in the 9th grade schools, as some strata were not homogeneous in relation to others.

As the group of 9th grade schools was heterogeneous, we opted for stratified random sampling for both years.

Table 8: Standard Deviation of the Average Portuguese and Math test scores for the 5th and 9th grade school units in the strata

DESVIO-PADRÃO	CONFORTO			
PARTICIPAÇÃO DOS PAIS	CONFORTÁVEL		MUITO CONFORTÁVEL	
	5º ANO	9º ANO	5º ANO	9º ANO
POUCO PARTICIPATIVOS	0,637	0,436	0,651	0,732
PARTICIPATIVOS	0,653	0,622	0,640	0,763
MUITO PARTICIPATIVOS	0,649	0,710	0,629	0,757

Prepared by Sérgio Bastos - Data Scientist

The equation shown in figure 6 was applied to obtain the sizes of the strata shown in table 9. The decimal values were approximated to integer values and the school units were randomly selected within each stratum.

Table 9: Sample size in the strata for the 5th and 9th grade school units

AMOSTRA	CONFORTO			
PARTICIPAÇÃO DOS PAIS	CONFORTÁVEL		MUITO CONFORTÁVEL	
	5º ANO	9º ANO	5º ANO	9º ANO
POUCO PARTICIPATIVOS	49	7	40	66
PARTICIPATIVOS	5	2	5	15
MUITO PARTICIPATIVOS	3	0	3	6

Prepared by Sérgio Bastos - Data Scientist

The treatment groups were constructed by the NudgeRio team based on the SAEB 2017 data and sent to the SME/RJ to set up the WhatsApp lists. It is important to note that in 2019 some UEs stopped working in the 5th and/or 9th grades and the sample size changed. The school units that were not randomly allocated to the treatment groups, 313 and 120 UEs, respectively in the 5th and 9th grades, were randomly selected to make up the control group, 102 and 95 UEs.

Finally, each project with a nudge methodology and an experimental approach may have a specific or more appropriate set of tools and theoretical basis. However, in order for criteria to be defined and for the best application for each one to be perceived and evaluated, a rigorous analytical process is required, which also takes place during the execution of the project, i.e. it will not always be what was planned, as some research biases and intervening variables may bring to light the need to use other experimental designs. In the case of this project specifically, all of these phases have been necessary.

4. INTERVENTION AND CONDUCTING THE EXPERIMENT (TRIAL)

The Nudge tool was applied to parents/guardians of 5th and 9th graders in Rio de Janeiro's municipal school system.

The messages were prepared by the NudgeRio team and sent by the Social Media Coordination of the Municipal Education Department of the Municipality of Rio de Janeiro, through the creation of transmission lists via the WhatsApp application. These messages aimed to encourage the student's commitment to the SAEB Mock Test, strengthening the relationship between parents and children in the period leading up to the exam.

In summary, the treatment group approach considered aspects for which the use of the Whatsapp tool was appropriate for hypothesis testing, such as: emotion as an expectation factor for decisions; exposure to stimuli, based on a social norm involving similar exchanges between people, in this case children/students and parents/guardians; and the premise that people tend to take risks to avoid social losses, when compared to the involvement of other parents in their children's upbringing.

For each sample, a message (audio, text and/or image with text) was sent to those responsible during the week of the simulation, which took place between August 26 and 29, 2019.

In order to send the messages, the Social Media Coordination team at SME/RJ carried out a number of actions prior to sending them:

- Collecting the telephone numbers of the guardians of students in the 5th and 9th grades;
- Formatting messages according to the WhatsApp application;
- Creation of three emails, from the Gmail service, to place the contact lists, since a cell phone with an Android system was used;
- Distribution of telephone numbers according to treatment groups in emails;
- Adding e-mail accounts to the handset and downloading contacts to it;
- Install the WhatsApp application;
- Creation of transmission lists on *WhatsApp*, according to the treatment groups sent by NudgeRio, with the units of each group, totaling 106 lists.

5° ANO

DISTRIBUIÇÃO DO ENVIO DE MENSAGENS PELOS GRUPOS DE TRATAMENTO

- **Treatment group 1 –** Parents/guardians of 5th-grade students: an audio message recorded by the Municipal Secretary of Education and sent the night before the SAEB Mock Test:

  Hello!

  This is Talma, Municipal Secretary of Education, teacher and mother of a public school student in the municipality of Rio de Janeiro.

  This week, your son or daughter, who is one of our students, will take the SAEB Mock Test. All 5th graders in Brazil will take the SAEB Exam.

  A good result in this test will be one more brick in building the confidence that is so important for a successful life.

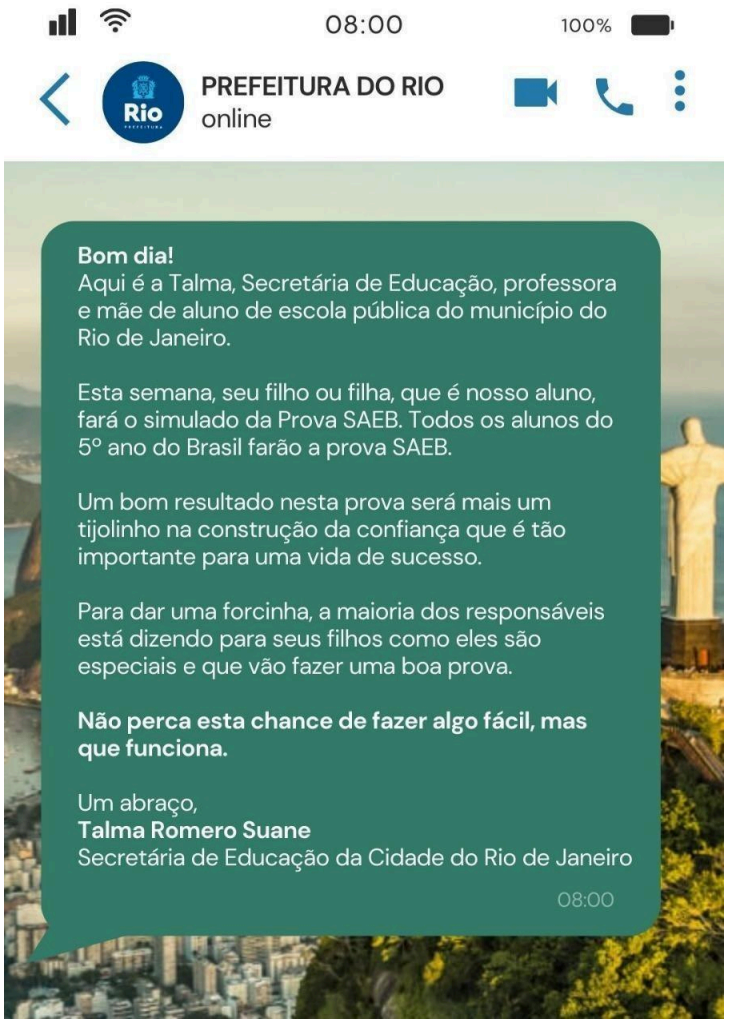
  To give their son or daughter a boost, the vast majority of parents are telling their children how special they are and that they're going to do well in the exam. Don't miss this chance to do something easy, but that works!

  Cheers! I'm counting on you!

Grupo de Tratamento 1 – 5º ano	
Dimensão Estratégica Governamental	IDEB, ensino público e comunidade escolar, participação das famílias, compromisso com simulado SAEB e melhoria na média das notas da avaliação.
Efeito Comportamental	Emoção como fator de decisão ou expectativa. Pais enviarem mensagens ou conversarem com os filhos a partir da predição de serem não participativos na vida acadêmica dos filhos, neste sentido têm-se o risco como sentimento. Pais estimulados a perguntarem aos seus filhos sobre o Simulado SAEB e aproveitarem a oportunidade para dizer ao filho o quanto é especial e capacitado.
Modelo de Comportamento	Motivação-Reflexivo
Estímulos comportamentais	Aversão à desigualdade, autoridade, norma social, facilidade e compromisso prévio.
Conduta a ser mudada	Alunos pouco atentos, desmotivados ou desinteressados na realização do Simulado SAEB.
Conduta esperada	Alunos mais atentos, motivados ou interessados na realização do Simulado SAEB.
Viés	Status quo
Heurística	Representatividade e disponibilidade
Função da Intervenção	Incentivo
Intervenção	Mensagem enviada aos pais/responsáveis, via aplicativo Whatsapp, para estimular os filhos/alunos.
Enquadramento	Ênfase: framing positivo - comparação social
Tema da Mensagem	Melhorar no futuro, melhorar de vida, mindset de crescimento
Formato da Mensagem	Áudio

- **Treatment group 2 -** Parents/Guardians of 5th-grade students: an audio message, sent the night before the SAEB Mock Test. It is important to highlight that the audio message was also sent in writing below to preserve the temporal dimension of the intervention, in case parents were unable to listen at that moment, minimizing any noise or losses associated with the timing of the message delivery.

  Text sent in writing along with the audio:



Audio text:

Hello!

This is Talma, Municipal Secretary of Education, teacher and mother of a public school student in the municipality of Rio de Janeiro.

This week, your son or daughter, who is one of our students, will take the SAEB Mock Test. All 5th graders in Brazil will take the SAEB Exam.

A good result in this test will be one more brick in building the confidence that is so important for a successful life.

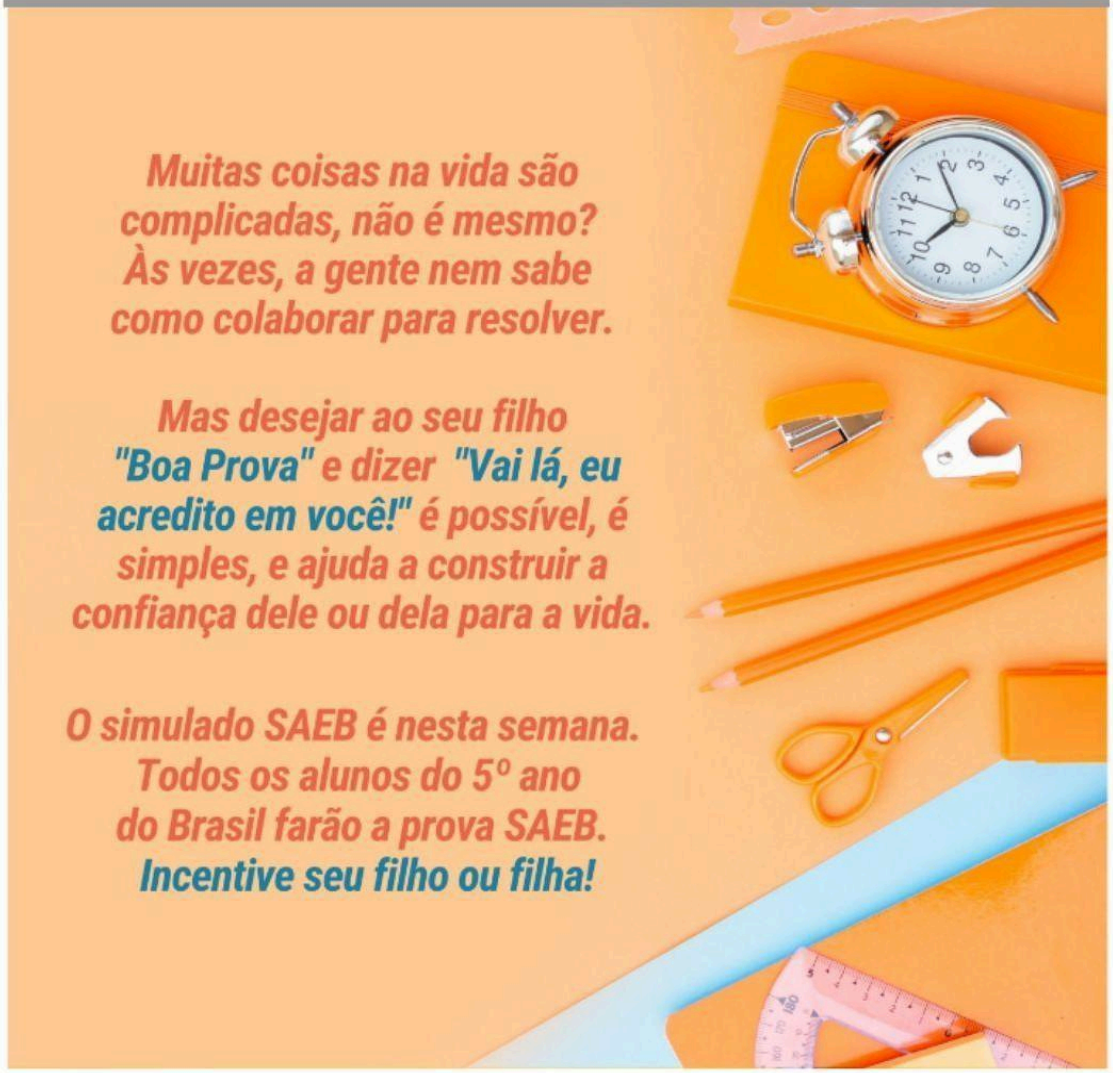
To give their son or daughter a boost, the vast majority of parents are telling their children how special they are and that they're going to do well in the exam. Don't miss this chance to do something easy, but that works!

Cheers! I'm counting on you!

Grupo de Tratamento 2 – 5º ano	
Dimensão Estratégica Governamental	IDEB, Ensino público e Comunidade Escolar, Participação das famílias, Compromisso com Simulado SAEB e melhoria na média das notas da avaliação.
Efeito Comportamental	Emoção como fator de decisão ou expectativa - Pais enviarem mensagens ou conversarem com os filhos a partir da predição de serem não participativos na vida acadêmica dos filhos, neste sentido têm-se o risco como sentimento. Pais estimulados a perguntarem aos seus filhos sobre o Simulado SAEB e aproveitarem a oportunidade para dizer ao filho o quanto é especial e capacitado.
Modelo de Comportamento	Motivação-Reflexivo
Estímulos comportamentais	Aversão à desigualdade, autoridade, norma social, facilidade e compromisso prévio.
Conduta a ser mudada	Alunos pouco atentos, desmotivados ou desinteressados na realização do Simulado SAEB.
Conduta esperada	Alunos mais atentos, motivados ou interessados na realização do Simulado SAEB.
Viés	Status Quo
Heurística	Representatividade e disponibilidade
Função da Intervenção	Incentivo
Intervenção	Mensagem enviada aos pais/responsáveis, via aplicativo Whatsapp, para estimular os filhos/alunos
Enquadramento	Ênfase: framing positivo - comparação social
Tema da Mensagem	Melhorar no futuro, melhorar de vida, modelo de pensamento de crescimento.
Formato da Mensagem	Áudio e Texto

- **Treatment group 3 -** Parents/Guardians of 5th-grade students: sending of two images, with the first one sent three days before the mock test and the second one sent the night before the test.

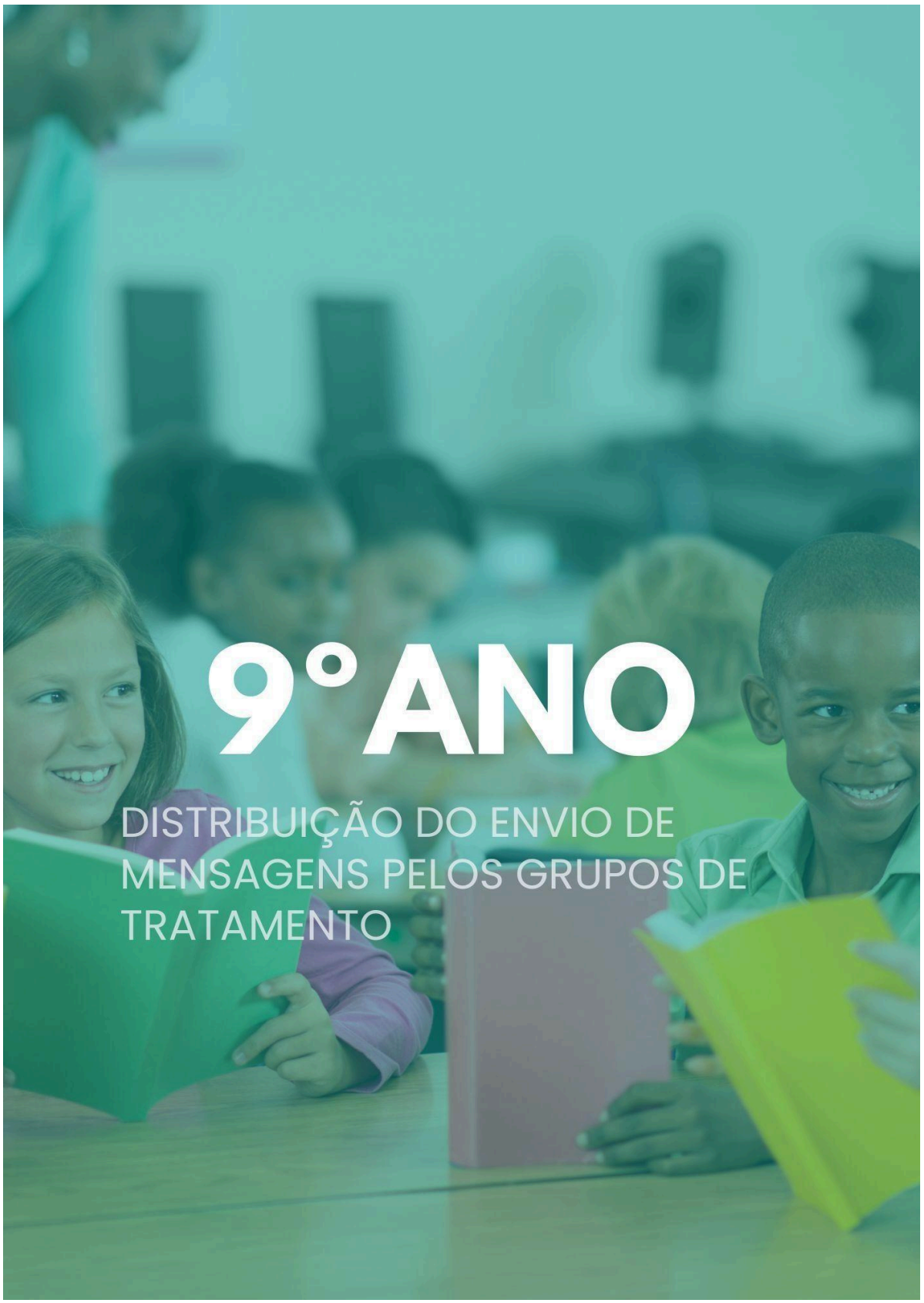
Grupo de Tratamento 3 – 5º ano: Imagem 1



Grupo de Tratamento 3 – 5º ano: Imagem 1	
Dimensão Estratégica Governamental	IDEB, Ensino público e Comunidade Escolar, Participação das famílias, Compromisso com Simulado SAEB e melhoria na média das notas da avaliação.
Efeito Comportamental	Emoção como fator de decisão ou expectativa - Pais enviarem mensagens ou conversarem com os filhos a partir da predição de serem não participativos na vida acadêmica dos filhos, neste sentido têm-se o risco como sentimento. Pais estimulados a perguntarem aos seus filhos sobre o Simulado SAEB e aproveitarem a oportunidade para dizer ao filho o quanto é especial e capacitado.
Modelo de Comportamento	Motivação-Reflexivo
Estímulos comportamentais	Aversão ao arrependimento, norma social, facilidade e compromisso prévio.
Conduta a ser mudada	Alunos pouco atentos, desmotivados ou desinteressados na realização do Simulado SAEB.
Conduta esperada	Alunos mais atentos, motivados ou interessados na realização do Simulado SAEB.
Viés	Status Quo
Heurística	Representatividade e disponibilidade
Função da Intervenção	Ativação – Incentivo, suporte cognitivo, comportamental com diminuição de barreira.
Intervenção	Mensagem enviada aos pais/responsáveis, via Aplicativo WhatsApp, para estimular os filhos/alunos na semana do Simulado SAEB.
Enquadramento	Ênfase: Framing Positivo - Responsabilização Pais
Tema da Mensagem	Acreditar no filho/aluno e modelo de pensamento de crescimento.
Formato da Mensagem	Foto com Texto

Grupo de Tratamento 3 – 5º ano: Imagem 2

Grupo de Tratamento 3 – 5º ano: Imagem 2	
Dimensão Estratégica Governamental	IDEB, Ensino público e Comunidade Escolar, Participação das famílias, Compromisso com Simulado SAEB e melhoria na média das notas da avaliação.
Efeito Comportamental	Emoção como fator de decisão ou expectativa - Pais enviarem mensagens ou conversarem com os filhos a partir da predição de serem não participativos na vida acadêmica dos filhos, neste sentido têm-se o risco como sentimento. Pais estimulados a demonstrarem afeto e interesse na vida escolar de seus filhos no período do Simulado SAEB e aproveitarem a oportunidade para os estimularem.
Modelo de Comportamento	Motivação-Reflexivo
Estímulos comportamentais	Aversão ao arrependimento, norma social e facilidade.
Conduta a ser mudada	Alunos pouco atentos, desmotivados ou desinteressados na realização do Simulado SAEB.
Conduta esperada	Alunos mais atentos, motivados ou interessados na realização do Simulado SAEB.
Viés	Status Quo
Heurística	Representatividade e disponibilidade
Função da Intervenção	Persuasão – uso da comunicação para induzir sentimentos positivos ou negativos ou estimular a ação.
Intervenção	Mensagem enviada aos pais/responsáveis, via aplicativo Whatsapp, para estimular os filhos/alunos na véspera do Simulado SAEB.
Enquadramento	Ênfase: Framing Positivo - Culpabilização Pais – Como você está fazendo a sua parte?
Tema da Mensagem	Estimular filho/aluno e modelo de pensamento de crescimento.
Formato da Mensagem	Foto com Texto



9° ANO

DISTRIBUIÇÃO DO ENVIO DE MENSAGENS PELOS GRUPOS DE TRATAMENTO

- **Treatment group 1 -** Parents/Guardians of 9th-grade students: sending of the image below the night before the SAEB Mock Test:

Grupo de Tratamento 1 – 9º ano: Imagem 1

Grupo de Tratamento 1 – 9º ano: Imagem 1	
Dimensão Estratégica Governamental	IDEB, Ensino público e Comunidade Escolar, Participação das famílias, Compromisso com Simulado SAEB e melhoria na média das notas da avaliação.
Efeito Comportamental	Emoção como fator de decisão ou expectativa - Pais enviarem mensagens ou conversarem com os filhos a partir da predição de serem não participativos na vida acadêmica dos filhos, neste sentido têm-se o risco como sentimento. Pais estimulados a perguntarem aos seus filhos sobre o Simulado SAEB e aproveitarem a oportunidade para dizer ao filho o quanto é especial e capacitado.
Modelo de Comportamento	Motivação-Reflexivo
Estímulos comportamentais	Aversão ao arrependimento, norma social e facilidade.
Conduta a ser mudada	Alunos pouco atentos, desmotivados ou desinteressados na realização do Simulado SAEB.
Conduta esperada	Alunos mais atentos, motivados ou interessados na realização do Simulado SAEB.
Viés	Status Quo
Heurística	Disponibilidade.
Função da Intervenção	Ativação – Incentivo, suporte cognitivo, comportamental com diminuição de barreira.
Intervenção	Mensagem enviada aos pais/responsáveis, via Aplicativo Whatsapp, para estimular os filhos/alunos na véspera do Simulado SAEB.
Enquadramento	Ênfase: Framing Positivo - Responsabilização Pais.
Tema da Mensagem	Acreditar no filho/aluno e modelo de pensamento de crescimento.
Formato da Mensagem	Foto com Texto

- **Treatment group 2 -** Parents/Guardians of 9th-grade students: an audio message immediately followed by an image file with text. Text of the audio message sent:

  Hello!

  This is Talma, Secretary of Education, teacher and mother of a public school student in the municipality of Rio de Janeiro.

  The SAEB Exam is this week. All 9th graders in Brazil will take the SAEB Exam.

  You can help your child a lot. Most guardians will send the image below to their children via WhatsApp today.

  Send this image too!

  Cheers! I'm counting on you!

Grupo de Tratamento 2 – 9º ano: Imagem 1

Grupo de Tratamento 2 – 9º ano: Imagem 1	
Dimensão Estratégica Governamental	IDEB, Ensino público e Comunidade Escolar, Participação das famílias, Compromisso com Simulado SAEB e melhoria na média das notas da avaliação.
Efeito Comportamental	Emoção como fator de decisão ou expectativa - Pais enviarem mensagens ou conversarem com os filhos a partir da predição de serem não participativos na vida acadêmica dos filhos, neste sentido têm-se o risco como sentimento. Pais estimulados a perguntarem aos seus filhos sobre o Simulado SAEB e aproveitarem a oportunidade para dizer ao filho o quanto é especial e capacitado.
Modelo de Comportamento	Motivação-Reflexivo
Estímulos comportamentais	Aversão à Desigualdade, Autoridade, norma social e facilidade.
Conduta a ser mudada	Alunos pouco atentos, desmotivados ou desinteressados na realização do Simulado SAEB.
Conduta esperada	Alunos mais atentos, motivados ou interessados na realização do Simulado SAEB.
Viés	Status Quo
Heurística	Disponibilidade.
Função da Intervenção	Ativação – Incentivo, suporte cognitivo, comportamental com diminuição de barreira.
Intervenção	Mensagem enviada aos pais/responsáveis, via Aplicativo Whatsapp, para estimular os filhos/alunos na véspera do Simulado SAEB.
Enquadramento	Ênfase: Framing Positivo - Comparação Social.
Tema da Mensagem	Acreditar no Filho/Filha, Melhorar de Vida, modelo de pensamento de crescimento.
Formato da Mensagem	Áudio e Imagem com Texto

5. DATA ANALYSIS AND RESULTS

The results of the SAEB Mock Test made it possible to answer whether there are differences between the average scores of the schools in the treatment groups and the schools in the control group, or whether the differences are just sample variation, what we might colloquially call chance.

5.1. STATISTICAL BASIS FOR CALCULATING RESULTS

This section will explain the calculations to determine whether the interventions were statistically significant.

For the SAEB Mock Test scores, we have that:

- The population variances are distinct and are given by $\sigma^2_{\bar{x}_t}$ and $\sigma^2_{\bar{x}_c}$, where *t* represents treatment and *c* represents control.
- The distribution for the difference in sample means (treatment and control - $\bar{x}_t - \bar{x}_c$) is a normal distribution;
- The mean of the difference in sample means is equal to the value of the difference in population means: $\mu_{\bar{x}_t - \bar{x}_c} = \mu_{\bar{x}_t} - \mu_{\bar{x}_c} = \mu_t - \mu_c$;
- The variance of the difference in sample means is equal to the sum of the population variances, divided by the number of school units in the population: $\sigma^2_{\bar{x}_t - \bar{x}_c} = \sigma^2_{\bar{x}_t} + \sigma^2_{\bar{x}_c} = \frac{\sigma_t^2}{n_t} + \frac{\sigma_c^2}{n_c}$.

Remember that the hypothesis is the statement: "It is possible to improve students' performance in the SAEB Mock Test when they are encouraged by their parents/guardians". To test it, the intervention indicated was to encourage family participation, in which parents receive WhatsApp messages from the SME/RJ with emotional stimuli for their children.

Statistically we have that:

$\mu_t - \mu_c = 0$	$\Rightarrow$	Hypothesis rejected
$\mu_t - \mu_c \neq 0$	$\Rightarrow$	Hypothesis confirmed

The z-value of the two-sided test to test the H_0 hypothesis is given by:

$$z = \frac{\left(\underline{x}_t - \underline{x}_c\right) - \left(\mu_t - \mu_c\right)}{\sqrt{\frac{\sigma_t^2}{n_t} + \frac{\sigma_c^2}{n_c}}} \sim N(0,1)$$

As the SAEB Mock Test samples are large, the population variance can be replaced by the sample variance:

$$Z_{calculado} = \frac{\left(\underline{x}_t - \underline{x}_c\right) - \left(\mu_t - \mu_c\right)}{\sqrt{\frac{S_t^2}{n_t} + \frac{S_c^2}{n_c}}} \sim N(0,1)$$

The null hypothesis will be rejected if $\left|Z_{calculado}\right| > Z_{\frac{\alpha}{2}}$.

The confidence level adopted in this study was 95%, which provides a value of 1.96 for $Z_{\frac{\alpha}{2}}$. What confirms that the positive percentage is the result of the nudge interventions is the $Z_{calculado}$ value being greater than $Z_{\frac{\alpha}{2}}$ = 1,96. If the $Z_{calculado}$ value is less than 1.96, nothing can be concluded about the superiority of the treatments over the control or vice versa, as the analysis would be subject to random fluctuations in the results.

5.2. ANALYSIS OF RESULTS

Table 10 shows the values of $Z_{calculado}$. It can be seen that for all the interventions in the treatment groups, there was an improvement in grades compared to the control groups, both in the 5th and 9th grades.

In the same table, the interventions with statistically significant results are highlighted in bold.

For the 5th grade, the average math score for treatment group 2 was significantly different from the average score for the control group. In other words, it can be stated that the intervention (audio and text message) had a positive impact on the Math scores that cannot be attributed to chance.

For the 9th grade, the interventions had positive results with statistical significance in all the averages of Treatment Groups 1 and 2, except only in the Portuguese Language and Literature average of Treatment Group 1.

Table 10: Values from $Z_{calculado}$ and percentage difference between the means of the treatments in relation to the control group

		TRATAMENTO 1		TRATAMENTO 2		TRATAMENTO 3	
		zc	%	zc	%	zc	%
5º ANO	MAT	1,37	2,80%	2,20	4,62%	1,29	2,87%
	LPL	0,21	0,37%	1,32	2,30%	1,59	3,04%
	GERAL	**0,93**	**1,60%**	**1,92**	**3,47%**	**1,50**	**2,95%**
9º ANO	MAT	2,18	4,47%	2,21	4,41%	-	-
	LPL	1,67	2,38%	2,68	3,80%	-	-
	GERAL	**2,07**	**3,39%**	**2,56**	**4,10%**	-	-

Caption:

zc= $z_{calculado}$

MAT= Values observed for the Mathematics Test

LPL= Values observed in the Portuguese Language and Literature Test

General= Values observed for the average of the Mathematics Test and the Portuguese Language and Literature Test

Prepared by Sérgio Bastos - Data Scientist

The results show the sample analysis of three different averages: Mathematics, Portuguese Language and Literature and General (average of the two previous averages). The presentation of the results of the

experiment was based on the overall average because it is a criterion related to the evaluation of school units for the IDEB.

Table 10 shows that treatments 1 and 2 for 9th graders were superior to the control, with treatment 2 (audio and image with text) performing more effectively.

All the treatment groups, regardless of school year, showed positive values for the percentage of difference between the means of the treatments, when compared to the mean of the control group. This shows that the average performance of the school units in the treatment groups was higher than the average performance of the UEs in the control group. Specifically, although this approach did not show statistical significance for all the treatment groups, the results were positive. It is important to emphasize the importance of this aspect as data to facilitate the testing new approaches, based on this experience, since it can reduce experimentation costs. This relevant factor may suggest an indication for replication in other experimental opportunities, and may present aspects to be calibrated and tested again.

The results of the experiment were analyzed for each treatment. In this approach, the average grades for the subjects assessed and the overall average grades for the 5th and 9th grades were taken into account.

6. EXPERIMENT LIMITATIONS

The constraints of the project were the time it would take to implement it and the ability of the SME/RJ team to devote itself exclusively to the demands required to involve the school community, since an

analysis was also made of the project's difficulties in relation to the possible experimental subjects: students, guardians, teachers and principals. In this sense, it was decided to carry out the intervention with the students, in terms of family participation.

The choice to work with parents/guardians was based on qualitative data that confirmed the importance of family participation in student performance in basic education and also specifically in the SAEB Exam, increasing the likelihood that the SAEB Mock Test would be relevant.

The choice to send messages directly to parents/guardians in order to motivate students is due to two factors: parents/guardians play an important role in the students' educational process, being the greatest encouragers in their academic journey; and Law No. 4.734 of January 4, 2008, which prohibits the use of cell phones and other equipment in the classroom.

7. CONCLUSION

The results obtained with this nudge experiment show that it is possible to develop other ways of tackling the problem of improving the Basic Education Development Index (IDEB) at low cost.

NudgeRio approached the problem as an Applied Behavioral Science project, with an emphasis on the Nudge methodology. To do this, it sought to answer the following experimental question: "Is it possible to improve students' performance in the SAEB Mock Test with encouragement from their parents/guardians?".

The UEs were divided into random samples, forming treatment and

control groups. Each sample received WhatsApp messages sent to parents/guardians before the simulation, asking and/or encouraging them to pass on the messages to their children or to encourage them about the importance of the assessment.

The result showed that the most effective intervention was Treatment Group 2 (audio and text message), which increased the overall average of 9th graders by 4.1%. As a result of this intervention, an adapted version of treatment 2 was implemented in the 2019 SAEB Exam, which took place a few weeks after the simulation.

It is through experimentation that the decision-making process of individuals and its impacts can be observed, generating results that reduce costs in access to public systems that provide services to citizens, but without losing their quality and considering their decision-making perspective. The study of emotional, cognitive and social influences allows us to model decision-making processes to change behavior, increasing individual satisfaction and bringing benefits themselves and society.

BIBLIOGRAPHICAL REFERENCES

BRYK, A.; RAUDENBUSH, S.W. Hierarchical linear models: applications and data analysis methods. Newbury Park: Sage, 1992.

CAMPBELL, D.T.; STANLEY, J.C. Experimental and quasi-experimental designs for research. Chicago: Rand McNally, 1996.

COCHRAN, W.G. Sampling techniques. 3. ed. New York: John Wiley & Sons, 1963.

COOK, T.D.; CAMPBELL, D.T. Quasi-experimentation: design and analysis issues for field settings. Chicago: Rand McNally, 1979.

FINNEY, D.J. Probit analysis. Cambridge: Cambridge University Press, 1971.

GUBA, E.G.; LINCOLN, Y.S. Fourth generation evaluation. California: Sage Publications, 1989. 296 p.

HUGHES, J. Philosophy of social research. London: Longmans Group Ltd., 1990.

ISAAC, S.; MICHAEL, W.B. Handbook in research and evaluation. California: San Diego Edits, 1971.

KUHN, T.S. The structure of scientific revolutions. Chicago: University of Chicago Press, 1962.

LEE, E.T.; WANG, J.W. Statistical methods for survival data analysis. Belmont: Wiley, 1980.

LOHR, S.L. Sampling: design and analysis. Duxbury Press, 1999.

OVERALL, J.E.; KLETT, C. Applied multivariate analysis. New York: McGraw-Hill, 1972.

THALER, R.H.; SUNSTEIN, C.R. Nudge: improving decisions about health, wealth and happiness. New Haven: Yale University Press, 2008. 293 p.

MOBERG, D.P.; PIPER, D.L.; SERLIN, R.C. When total randomization is impossible: nested randomized assignment. Evaluation Review, v. 17, n. 3, p. 271-291, 1993.

NEYMAN, J. On the two different aspects of the representative method: the method of stratified sampling and the method of purposive selection. Journal of the Royal Statistical Society, v. 97, n. 4, p. 558–625, 1934. Available at: <www.jstor.org/stable/2342192>. Accessed on: 27 mar. 2020.

OSGOOD, D.W.; SMITH, G.L. Applying hierarchical linear modelling to extended longitudinal evaluations: the Boys Town Follow-Up Study. Evaluation Review, v. 19, n. 1, p. 3-58, 1995.

SCHWARTZ, D.; FLAMANT, R.; LELLOUCH, J. Clinical trials. London: Academic Press, 1980.

SELTZER, M.H. Studying variation in program success: a multilevel modelling approach. Evaluation Review, v. 18, n. 3, p. 342-361, 1994.

SOLOMON, P.; DRAINE, J. One-year outcomes of a randomized trial of case management with seriously mentally ill clients leaving jail. Evaluation Review, v. 19, n. 3, p. 256-273, 1995.

FERNANDES, R. Experiência: Índice de Desenvolvimento da Educação Básica (IDEB). Available at: http://inovacao.enap.gov.br. Accessed on: Aug. 28,

2010.

HUIT, H.; HUMMEL, J.; KAEK, D. Internal and external validity: general issues, 1999. Available at: http://edpsycinteractive.org/topics/intro/valdgn.html. Accessed on: Apr. 18, 2020.

INSTITUTO NACIONAL DE ESTUDOS E PESQUISAS EDUCACIONAIS ANÍSIO TEIXEIRA. Saeb. Available at: http://portal.inep.gov.br/web/guest/educacao-basica/saeb. Accessed on: Jan. 14, 2020.

MINISTÉRIO DA EDUCAÇÃO. Índice de Desempenho da Educação Básica – IDEB. Resultados e metas alcançadas. 5º Ano do Ensino Fundamental. Available at: http://ideb.inep.gov.br/resultado/resultado/resultado.seam?cid=9883676. Accessed on: Jan. 23, 2020.

MINISTÉRIO DA EDUCAÇÃO. Índice de Desempenho da Educação Básica – IDEB. Resultados e metas alcançadas. 9º Ano do Ensino Fundamental. Available at: http://ideb.inep.gov.br/resultado/resultado/resultado.seam?cid=9884287. Accessed on: Jan. 23, 2020.

RIO DE JANEIRO (Município). Lei nº 4.734, de 04 de janeiro de 2008. Dispõe sobre a proibição da utilização de telefone celular e outros em sala de aula. Available at: https://cm-rio-de-janeiro.jusbrasil.com.br/legislacao/255337/lei-4734-08. Accessed on: Jan. 21, 2020.

SECRETARIA MUNICIPAL DE EDUCAÇÃO DA CIDADE DO RIO DE JANEIRO. Limites CRE. Available at: http://www.data.rio/datasets/limites-cre?geometry=-43.982%2C-23.167%2C-41.369%2C-22.724. Accessed on: Jan. 13, 2020.

INSTITUTIONAL

MAYOR

Eduardo Paes

PRESIDENT OF THE JOÃO GOULART FOUNDATION INSTITUTE

HEAD NUDGERIO | LABFAZ

Rafaela Bastos

ADVISOR

Liana Carvalho

COMMUNICATION AND BRANDING

Flávia Santos

TRAINING AND DEVELOPMENT COORDINATOR

Noemi Lustosa Baptista

ADVISORS

Rafael Costa

LEADERSHIP MANAGEMENT COORDINATOR

Bárbara do Nascimento

ADVISORS

Alessandra Teixeira
Amanda Oliveira
Marcos Pacheco

PROJECT DEVELOPMENT AND CROSS-CUTTING COORDINATOR

André Appariz

ADVISORS

George Alves

COORDINATOR OF DATA AND BEHAVIOR | NUDGERIO | LAB.FAZ

Pedro Arias Martins

ADVISORS

Marcela Lima
Jorge Marcelino
Pedro Zaidan

INTERNS

Daniel Levacov
Maria Clara Muniz

SAEB - THE IMPACT OF NUDGE ON EDUCATIONAL PERFORMANCE PROJECT TEAM

José Moulin Netto
Sergio Bastos
Rafaela Bastos

ORGANIZERS OF THIS PUBLICATION

Sergio Bastos
Rafaela Bastos
Alexandre Cherman

REVIEWERS OF THIS PUBLICATION

André Appariz
Jorge Marcelino
Marcela Lima
Maria Clara Muniz
Pedro Arias Martins
Pedro Zaidan
Rafaela Bastos