

**Impacts caused by COVID-19 on the Brazilian Education sector: An Application of
Exploratory Factorial Analysis**

**Impactos causados pelo COVID-19 no Setor de educacional brasileiro: Uma aplicação
de Análise Fatorial Exploratória**

**Impactos causados por COVID-19 en el Sector educativo brasileño: una aplicación de
Análisis factorial exploratorio**

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Abstract

The year 2020 was marked by the beginning of a pandemic caused by the new coronavirus (COVID-19). This virus of easy and rapid contagion has impacted several sectors around the

world, and like many countries Brazil seeks to minimize such impacts. Due to the ease of contamination, restrictive measures had to be adopted, such as social distancing, causing the closure of industries, businesses, universities, schools, among others, always seeking to reduce contact between individuals. The educational sector was severely affected, with the extremely necessary implementation of measures to allow the school year continuity. This work aims to measure the impacts caused by COVID-19 on the educational field, through factorial analysis. Data was collected via a virtual questionnaire, which made it possible to analyze the effects of this scenario on the lives of education professionals. The results were satisfactory, showing factors that influence directly on the performance of professionals during this challenging period.

Keywords: COVID-19; Education; Factorial analysis; Educational impact.

Resumo

O ano de 2020 foi marcado pelo início de uma pandemia ocasionada pelo novo coronavírus (COVID-19), este vírus de fácil e rápido contágio impactou diversos setores pelo mundo, e assim como inúmeros países o Brasil busca minimizar tais impactos. Devido a facilidade de contaminação, medidas restritivas precisaram ser adotadas, como o distanciamento social, ocasionando o fechamento das indústrias, comércios, universidades, escolas, dentre outros, buscando sempre reduzir o contato entre indivíduos. O setor educacional foi severamente afetado, sendo extremamente necessário a implementação de medidas que possibilitassem a continuidade do ano letivo. Isto posto, este trabalho objetiva mensurar através da análise fatorial os impactos ocasionados pela COVID-19 no âmbito educacional, os dados foram coletados através de um questionário virtual, que possibilitou analisar os efeitos deste cenário na vida dos profissionais da educação. Os resultados foram satisfatórios, mostrando fatores que influenciam diretamente no desempenho de profissionais neste período desafiador.

Palavras-chave: Covid19; Educação; Análise fatorial; Impacto educacional.

Resumen

El año 2020 estuvo marcado por el inicio de una pandemia provocada por el nuevo coronavirus (COVID-19), este virus de contagio fácil y rápido afectó a varios sectores alrededor del mundo, y como innumerables países, Brasil busca minimizar tales impactos. Debido a la facilidad de contaminación, se tuvieron que adoptar medidas restrictivas, como la distancia social, provocando el cierre de industrias, negocios, universidades, escuelas, entre otros, buscando siempre reducir el contacto entre individuos. El sector educativo se vio gravemente afectado y

es sumamente necesario implementar medidas que permitan continuar el año escolar. Dicho esto, este trabajo tiene como objetivo medir a través del análisis factorial los impactos ocasionados por el COVID-19 en el ámbito educativo, los datos fueron recolectados a través de un cuestionario virtual, que permitió analizar los efectos de este escenario en la vida de los profesionales de la educación. Los resultados fueron satisfactorios, mostrando factores que influyen directamente en el desempeño de los profesionales en este desafiante período.

Palabras clave: COVID-19; Educación; Análisis factorial; Impacto educativo.

1. Introduction

At the end of 2019, a new virus called Coronavirus (COVID-19) spreads through Wuhan (China) and a disease of fast and easy contagion becomes the most recent global threat (Souto, 2020). On December 31, the World Health Organization (WHO) was notified of an outbreak of pneumonia in the city of Wuhan caused by the new coronavirus (SARS-COV-2). A disease that challenges health professionals, researchers and government leaders, the unknown infection quickly impacted the Chinese population. Despite some restrictive measures, in 2020 it spread to many countries, and as early as February of the same year there were already approximately 80,000 cases and 2,838 deaths in 53 countries (Croda, 2020).

It did not take long for the disease to take on overwhelming proportions in the world and reach Brazil, where the first case was confirmed on February 26, 2020. It should be noted that at the beginning of March there were about 500 suspected cases notified, and at the end of the same month this number increased exponentially, reaching 2555 reported cases and 55 deaths (Croda, 2020). The country was on alert and measures needed to be taken to minimize contamination of the population, so it was necessary to implement social distancing, as well as the set of procedures known as "lockdown", leading to the closure of industries, businesses, schools, leisure areas and everything that was not considered essential, seeking to reduce contact between individuals and lower those numbers. Such restrictive measures directly impacted several sectors such as Economy and Education, among others, as pointed out by Aquino.

"Its implementation in Brazilian reality is without an irrefutable great challenge. The country's striking social inequalities, with large contingents in poverty and the growing portion of homeless people, combined with the large number of people deprived of their freedom, can facilitate the transmission, and hinder the implementation of social distance. In addition, the large proportion of informal workers requires that social

protection and support for vulnerable populations be established, in order to ensure the sustainability and effectiveness of the COVID-19 control policies." (Aquino 2020, p. 2443).

The educational sector was extremely affected, and it was necessary to implement a plan for the school year to continue, but time for planning was short and immediate actions had to be implemented. As an initial proposal, July vacation was anticipated, but long-term measures were also necessary, thus, after this recession period, education professionals together with government leaders proposed the use of remote learning technology already in use, as a tool to help students and teachers on the continuity of the school period.

The use of technology allowed the continuity of classes via the internet, becoming fundamental to mitigate the consequences of the pandemic in the educational field. The scenario is challenging for both students and teachers, and the professionals had more tasks added to their roles, as it was also necessary to rethink and innovate teaching methods, in order to guarantee a quality education that meets the academic demand.

The present work aims to measure the impact of the coronavirus pandemic on educators and students lives through of descriptive statistics and statistical methods such as factor analysis and chi-square testing, This study also allows the identification of factors which have most impacted the academic performance of students, and how these changes affects the teaching modes and professional lives of educators. For the collection of the analyzed data, a virtual questionnaire was distributed among education professionals (Figure 1). The data were collected from April to August 2020, being possible to identify which students and professionals are striving to maintain a good academic performance. However, factors such as the absence of technological resources and the increase in student workload is a further obstacle to the already complex and challenging scenario.

2. Coronavirus and its impact on the Brazilian Educational System

The new coronavirus causes a pathology of rapid contagion (COVID-19) because it is transmitted through droplets (aerosols) expelled by the breath of an already contaminated individual to a healthy individual.

This form of contagion is somewhat difficult to control, so measures were adopted to minimize the number of cases of the disease, based on similar pathologies, such as the Spanish flu of 1918. Social distancing is considered an effective measure (Fariza, 2020). With the negative effects of the pandemic taking on increasing proportions, reaching 215 countries,

approximately 7.5 million contaminated and 421,000 deaths by the middle of June 2020 (Jhu,2020), the concern involved more issues than the epidemiological problem: although restrictive measures are extremely necessary and effective, they cause a considerable impact on various human activities, affecting the country as a whole, in sectors of Public Health, Economy, Education, among others (Marques, 2020).

Seeking to preserve life, the Who has stressed that in order to combat COVID-19 countries should adhere to social isolation by avoiding crowds, and intensify hygiene habits (Who, 2020). With all these measures in place, the educational sector has suffered a great impact, but school education (basic or higher) and out-of-school training are indispensable for any society. Thus, after a short period of recess, it was decided to maintain educational activities remotely. However, Brazil is a country with a high rate of social inequality and educational professionals questioned how it would be possible to equally meet the demands of all students in a school term with minimum quality (Joye, 2020). In addition, the use of technology in the educational field divides opinions: for some, remote educational activities make it possible to maintain the academic year; for others, to use this tool without a structured project is harmful and selective, and in face of the country's social inequality, this measure can bring difficulties of access to education at this time of emergency. It is highlighted that even in face of extreme scenarios, the right to education is provided for in the Federal Constitution (Brazil, 1998) in Article 205:

"Being a right of everyone and a duty of the State and the family, Education will be promoted and encouraged with the collaboration of society, aiming at the full development of the individual, his or her preparation for the exercise of citizenship, and qualification for work".

However, it is essential to clarify that, although the face-to-face educational activities have been replaced indefinitely by remote activities, according to the Brazilian Association of Higher Education Providers (ABMES), remote classes do not fit into the Distance Learning modality as distance education can be presented in different ways: distance learning is a teaching modality that has its own mode of operation, with a specific methodological structure. In this modality the content is usually asynchronous, it has no predetermined schedule, and it can be conducted by tutors, whereas remote classes are applied synchronously, that is, with the presence of the teacher in real time. Thus, remote classes cannot be considered a teaching modality, despite being an immediate and affordable solution to maintain the school term (Vercelli, 2020).

This is an adverse period, when restructuring and adapting the teaching process was necessary. For students, the challenge is to maintain good performance, learn the content and innovate learning methods; for education professionals, the challenge presents the need to adopt alternative methodologies and teaching innovation, seeking to promote student autonomy; for both, the lack of resources (financial and technological) is a barrier, increasing the degree of difficulty in maintaining good quality education.

3. Theoretical Reference

3.1 Chis-square Test

Statistical tests are essential tools for data analysis and results validation. Thus, in this work, the Chi-square test was used to verify the existence of dependence between variables. According to Cramer (1946), this test consists in verifying the association between two observed variables, the row and column variables in a contingency table built from the sample data. The hypotheses to be tested in the test are:

$$\begin{cases} H_0: \text{Variables are independent} \\ H_1: \text{Variables are not independent} \end{cases}$$

The test statistics are provided by:

$$Q_{obs}^2 = \sum_{i=1}^r \sum_{j=1}^c \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad (1)$$

Where, $O_{ij} = (O_{11}, O_{12}, \dots, O_{rc})$ represents the vector of counts observed with multinomial distribution, E_{ij} represents the expected frequencies, being valid the hypothesis of independence the presented statistic has asymptotic distribution Chi-square with $(r - 1)(c - 1)$ degrees of freedom.

The decision rule for this test can be based on the descriptive level p , given a level of significance α , the p -value is determined by:

$$p - \text{value} = P[Q_{obs}^2 > \chi_{\alpha}^2; (r - 1)(c - 1) | H_0] \quad (2)$$

Therefore, if for α fixed, we get $p \leq \alpha$, we reject the null hypothesis H_0 of independence.

3.1 Shapiro-Wilk test of multivariate normality

The Shapiro-Wilk test multivariate normality was applied in order to verify if the data could be considered normal, the hypotheses to be tested are:

$$\begin{cases} H_0: \text{Data comes from a Normal distribution} \\ H_1: \text{Data does not come from a normal distribution} \end{cases}$$

Adopting a significance level of α , if the p-value of the test is lower than the default value of α , the null hypothesis H_0 is rejected, that is, the data have no Normal distribution.

The Shapiro-Wilk test of multivariate normality was proposed by Royston (1983, 1993) as an extension of the univariate case. A more detailed description of this extension can be found in Royston (1983, 1993).

3.2 Exploratory factorial Analysis - EFA

Factorial Analysis is a multivariate statistical method that consists of verifying the factorial structure of a correlated database. The EFA application aims to find the underlying structures in the analyzed database, thus being able to determine if and how many latent variables (factors) exist. According to Brown (2006) if these factors are found, they represent the observed set of variables. The implementation of EFA makes it possible to analyze the internal relationships between variables, thus defining which factors better explain their covariance. When factors are defined, the variables therein share a common variability (Damasio, 2012).

In order to verify if the factorial analysis is valid for the chosen data set, statistical techniques such as the Bartlett sphericity test are used. It consists in evaluating to what extent the covariance matrix is analogous to the identity matrix. Another purpose of the test is to analyze the degree of significance of the correlations between the observed data (Damasio, 2012). Hypotheses to be tested are:

$$\begin{cases} H_0: \text{The correlation matrix is the identity matrix} \\ H_1: \text{The correlation matrix is not the identity matrix} \end{cases}$$

After implementing the test, resulting p-value is observed: if it is lower than the pre-defined value of α , the null hypothesis H_0 is rejected; that is, the correlation matrix is not an identity matrix, therefore, there is correlation between the variables.

Other commonly used evaluation method is the Kaiser-Meyer-Olkin (KMO) criterion, a sample suitability index. This test consists in suggesting the variance proportion of observations that can be explained by a latent variable. To evaluate the adequacy of the sample size, the test result varies between 0 and 1, being acceptable for factor analysis results above 0.5. The KMO is calculated by means of the square of the 175 total correlations divided by the square of the partial correlations of the variables initially observed (Field, 2005), as it can be observed in the equation,

$$KMO = \frac{\sum_{i \neq j} R_{ij}^2}{\sum_{i \neq j} R_{ij}^2 + \sum_{i \neq j} Q_{ij}^2} \quad (3)$$

Where,

R_{ij} : It is the correlation between the variables (considering pair by pair);

Q_{ij} : It is the correlation between the variables (considering pair by pair) when all the others are considered constant.

After using these methods and observing the results, if these are favorable, factor analysis is applied. In the literature there are several methodologies involving criteria to obtain the factors and in this work we used the one developed by Kaiser-Guttman (Guttman, 1954; KAISER, 1960), known as the eigenvalue criterion, self-value greater than 1 ($\lambda_i > 1$). This consists of the rapid evaluation of the number of factors to be retained, each of these presenting an eigenvalue referring to the variability total explained by it (Damasio, 2012).

4. Analysis And Results

4.1 Data

This study is conducted by a total sample of 107 education professionals. The research was developed through a virtual questionnaire, aiming to obtain opinions on the impacts of the new coronavirus pandemic. The data collection period was from April to August 2020, and the main criterion for inclusion in the sample was to be a professional from the Education sector. For better analysis of the collected data, they were coded and categorized.

In Figure 1 we can read the questions contained in the virtually send survey.

Figure 1. Education Professionals – Survey.

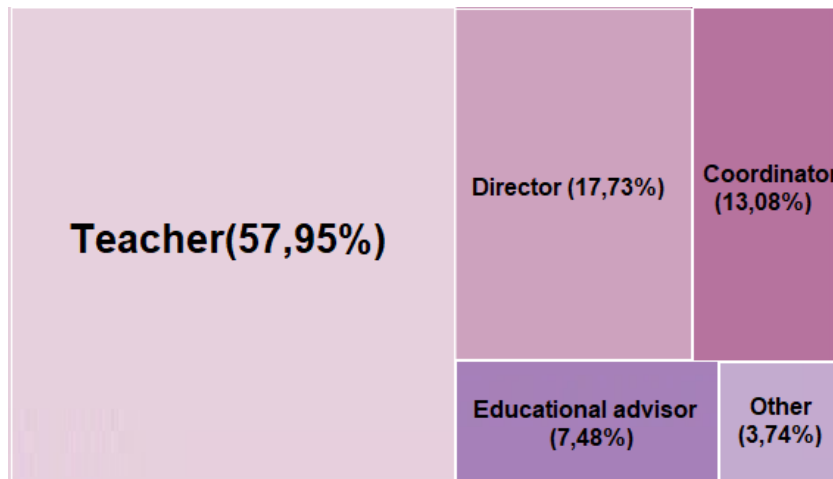
- | | |
|---|---|
| 1. If you are a professional in Education, specify your role: | 8. Which teaching modality are you applying? |
| 2. Which educational institution do you work for? | 9. How do you see the current moment for the school? |
| 3. What is your gender? Do you consider yourself Mixed, Black, White, or other? | 10. Consider the following sentences and give your opinion according to the grades. (Social distance is a good means to ensure people's health). |
| 4. In which city do you reside? | 11. Consider the following sentences and give your opinion according to the grades. (Preservation of people's lives and health is more important than the legal fulfilment of school days and mandatory hourly load). |
| 5. In which neighborhood? | 12. Consider the following sentences and give your opinion according to the grades. (Local authorities are taking the right measures to minimize the effects of the pandemic). |
| 6. Are you maintaining your teaching activity during the lockdown? | 13. Consider the following sentences and give your opinion according to the grades. (This is a difficult moment to normally maintain teaching/learning activities). |
| 7. Which teaching modality are you applying? | 14. Consider the following sentences and give your opinion according to the grades. (Mandatory hourly load will be met still during this year) |
| | 15. Consider the following sentences and give your opinion according to the grades. (The number of school days will be achieved with no difficulty). |
| | 16. Consider the following sentences and give your opinion according to the grades. (My teaching/learning process will be harmed by social distance). |
| | 17. Consider the following sentences and give your opinion according to the grades. (Remote Learning is the best option in this pandemic scenario). |
| | 18. Consider the following sentences and give your opinion according to the grades. (Distance learning can be developed in such a way to overcome students' educational deficiencies during social isolation). |
| | 19. From the following sentences, select the one corresponding to your current situation. (You can select as many as you like). |
| | 20. What is the current main challenge to ensure access of all students to Remote Learning System? |
| | 21. Now that professionals work from home, has the daily workload been altered? |
| | 22. In case of an affirmative answer to the previous question, select the best sentence to fit the current scenario. |
| | 23. Have the professional in your educational institution received any sort of training, no matter how short, to face the current crises? |
| | 24. In case of "yes", what sort of training? |
| | 25. How are the professionals helping/instructing students on Remote Learning? What are the resources used?? |
| | 26. What is the learning assessment criteria, in this moment of social distance? |
| | 27. In this moment of Remote Learning, do students show the same level of commitment? |
| | 28. Which measures were adopted by the Municipal Education Department in regard to students feeding, during this period when they are away from school? |
| | 29. What kind of support was offered by the Municipal Education Departments regarding Remote Learning? |

Source: Created by the authors.

4.2 Data Statistics

After the codification and categorization of the data, the frequency of the data can be observed. Figure 2 shows that most of the respondents of the questionnaire are teachers, reaching the mark of 57.95%, followed by the academic directors, being these 17.73% of the sample.

Figure 2. Proportion of Education Professionals by their roles.



Source: Created by the authors.

Teachers: 57,95%, School Principals: 17,73%, Coordinators 13,08%, Educational Advisor 7,48%, Others 3,74%

Aiming to observe the dependency between some variables in the database, the Chi-square test was applied. This method makes it possible to verify if there is a dependency between two variables of interest. First, we observed the crossing of questions Q1 that indicates the educational position the of the participant and Q10 where the respondent expresses his / her opinion regarding social isolation as a good measure to ensure people's health. The Chi-square test presented a p-value of 0.5948, therefore, at a 5% significance level, we have no evidence to reject H₀, which indicates independence of the variables, that is, the opinion regarding the effectiveness of the preventive measure does not depend on the position the professional holds.

To verify if there is a dependence between the place of residence of the responding professional with his/her opinion regarding the preservation of lives and health being more important than the legal compliance of the school days and the mandatory workload, it has been noticed, after applying the test and obtaining p-value equal to 0.0003434, that at the level of significance of 5%, there is evidence to reject the null hypothesis. Thus, the observed

dependent variables, i.e., the evidence of dependence between the place of residence and the respondent's opinion.

Crossing question Q2, which indicates whether the professional holds positions in public or private institutions or both, with question Q17 in which the respondent expresses his / her opinion about the mandatory workload to be fulfilled still this year, the result was a p-value of 0.02326. So, at the 5% significance level, there is evidence to reject H₀, pointing to a dependence between these variables, i.e., there is dependence between the institution where the professional works and his opinion on the workload to be fulfilled or not this year.

4.3 Factorial Analysis

In order to assess the impacts of OVID-19 on the lives of education professionals, the method of exploratory factorial analysis was applied in order to verify the existence of latent variables. For this study, questions 10 to 18 were used, in which respondents express their opinion about the pandemic and its impacts. Table 1 shows the frequency of variables used in factorial analysis, with a total of 107 respondents.

Table 1. Frequency.

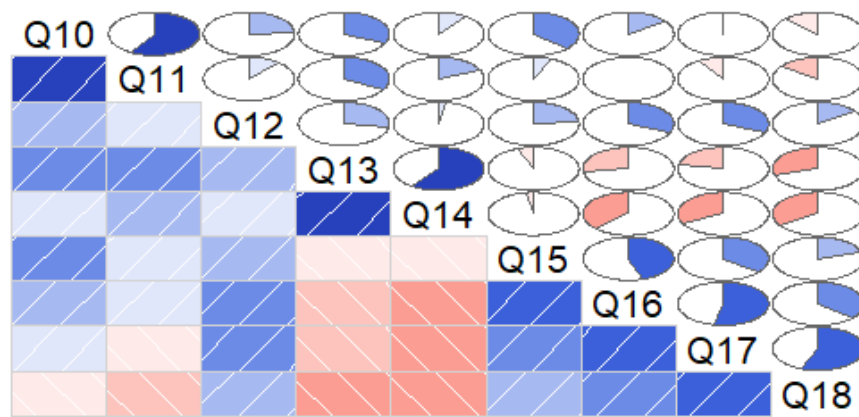
	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
Totally disagree	1	0	9	2	5	8	25	39	62
Partially disagree	3	2	24	11	9	11	20	14	13
Indifferent	0	0	5	0	7	9	7	21	13
Partially agree	15	11	46	29	44	29	40	23	12
Totally agree	88	94	23	65	42	50	15	10	7

Source: Created by the authors.

In order to verify the normality of the data, the Shapirp-Wilk multivariate test was applied, obtaining a very small p-value close to zero, so, at the 5% significance level we have evidence to reject H₀, that is, the data are not normally distributed.

To measure the correlation between the variables we used the method of polychoric correlation. This technique consists in analyzing items from self-reporting instruments, i.e., those that frequently use evaluation scales. In figure 3 we can observe the correlations between the variables. The blue shades indicate positive correlations, while those in pink indicate negative correlations. It can be seen that most questions are positively correlated, and that some have stronger correlations.

Figure 3. Correlation – Education Professionals Survey.



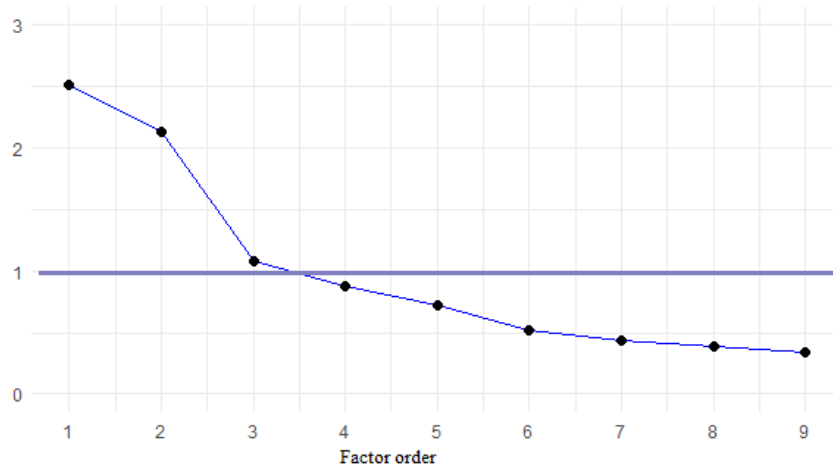
Source: Created by the authors.

The Bartlett Sphericity test was applied to check if the correlation matrix is an identity matrix. The p-value obtained was very small, close to zero, so at the 5% significance level there is evidence to reject H_0 and with that, it can be said that there are relationships between the variables.

To check the adequacy of the sample the KMO method was applied and the result obtained was 0.71, i.e., factor analysis is acceptable for this sample.

For the extraction and determination of factors numbers, the method of the main components was applied, with the matrix of sample correlations. The objective of factor extraction is to find a set of factors that form a linear combination of the original variables or the matrix of correlations. In this work the method of estimation for maximum likelihood was not used, because the data do not follow a normal distribution, as seen above. To determine the number of initial factors, it is observed in figure 4 that the screeplot graph points 3 factors as the ideal number for this sample.

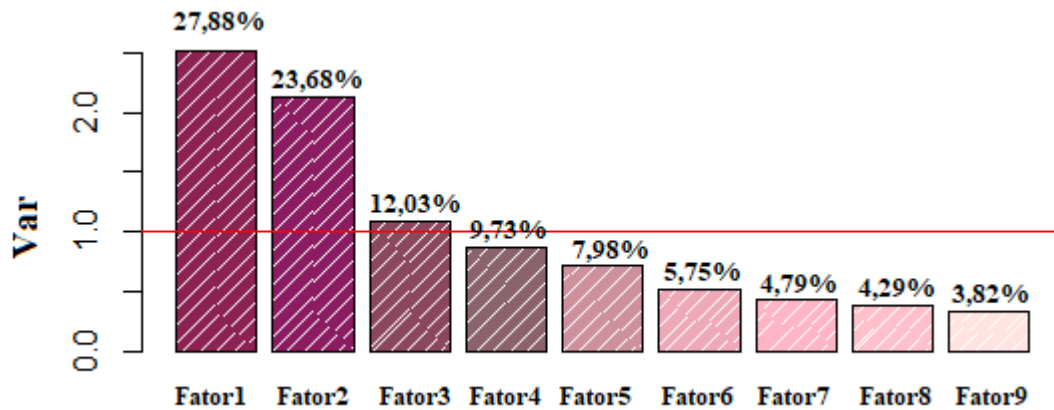
Figure 4. Screeplot - Number of factors.



Source: Created by the authors.

Analyzing the data after the application of the principal components' method, we have that the factor 1 answers for 27.8% of the total variance. Likewise, the second factor responds for 23.6%, and the third for 12%. Thus, the first three factors together account for 63.6% of the total variance (Figure 5).

Figure 5. Factors proportion.



Source: Created by the authors.

After determining the number of factors in Table 2, it is possible to observe the factor loads of the variables. The factorial analysis will be based on three factors

Table 2. Factorial Loads.

Variables	Factor 1	Factor 2	Factor 3
Q10	0.17005347	0.77894741	0.38099695
Q11	-0.05928059	0.63844425	0.59473652
Q12	0.38709185	0.50313605	-0.55690116
Q13	-0.23383561	0.75637032	-0.36964222
Q14	-0.41879401	0.50658096	-0.29540911
Q15	0.64187507	0.18558878	0.18169927
Q16	0.78359162	-0.02804031	-0.01556101
Q17	0.79281933	0.01591968	-0.12184766
Q18	0.66511573	-0.01523032	-0.04802814

Source: Created by the authors.

After presenting the factor loads, the communalities and specific variances are estimated. The communality is calculated to check how much of the variability of each variable is explained by the model. As presented in the theoretical reference session, the communality varies between 0 and 1, that is, the higher the result observed the more the variance is explained by the variable. The specific variance is the portion of the data variance that cannot be explained by the factor. The greater the specificity, the less relevant the variable is in the factorial model. In Table 3 it is possible to verify the communalities, variance and specific variance of the data. It can be observed that questions 15 and 18 present low communalities, however, they have a correlation with the other variables. Therefore, we have opted to keep them in the sample.

Table 3. Estimates.

Variables	Communality	Specific Variance	Variance
Q10	0.7808359	0.2191641	1
Q11	0.7648368	0.2351632	1
Q12	0.7131249	0.2868751	1
Q13	0.7634105	0.2365895	1
Q14	0.5192792	0.4807208	1
Q15	0.4794614	0.5205386	1
Q16	0.6150442	0.3849558	1
Q17	0.6436628	0.3563372	1
Q18	0.4449176	0.5550824	1

Source: Created by the authors.

The residual matrix analysis makes it possible to check whether the model is appropriate when the elements of this matrix are close to zero. In the following Table 4 it is possible to observe the results of the residual matrix. Note that the values are close to zero, indicating that the model is appropriate, and the sum of the square of the residuals presents a value of

0.8973471, which is also close to zero, strengthening the evidence that the model is appropriate.

Table 4. Residual matrix values.

	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
Q10	0.00	-0.13	0.00	-0.09	-0.11	0.05	0.04	-0.10	0.21
Q11	-0.13	0.00	0.14	0.05	0.00	-0.12	0.07	0.02	-0.07
Q12	0.00	0.14	0.00	-0.22	-0.23	0.00	0.02	-0.07	-0.13
Q13	-0.09	0.05	-0.22	0.00	0.01	0.02	-0.07	-0.09	-0.15
Q14	-0.11	0.00	-0.23	0.01	0.00	-0.07	0.03	-0.04	-0.07
Q15	0.05	-0.12	0.00	0.02	0.20	-0.03	-0.05	-0.13	-0.22
Q16	0.04	0.07	0.02	-0.07	-0.03	-0.05	0.00	-0.09	-0.16
Q17	-0.10	0.02	-0.07	-0.09	-0.04	-0.13	-0.09	0.00	0.02
Q18	-0.21	-0.07	-0.13	-0.15	-0.07	-0.22	-0.16	0.02	0.00

Source: Created by the authors.

Aiming to facilitate the interpretation of factors, they were rotated using the Varimax method. Table 5 presents the rotated factor loads.

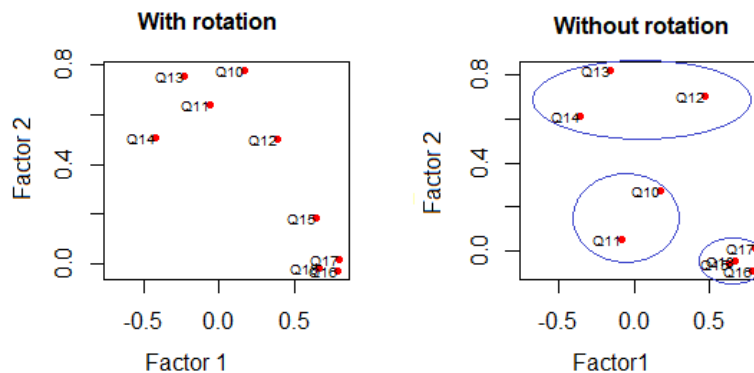
Table 5. Rotating Factorial Loads – Varimax.

Variables	Factor 1	Factor 2	Factor 3
Q10	0.176	0.276	0.821
Q11			0.869
Q12	0.464	0.704	0.255
Q13	-0.157	0.821	0.129
Q14	-0.361	0.610	0.278
Q15	0.631		
Q16	0.779		
Q17	0.800		
Q18	0.665		

Source: Created by the authors.

In Figure 6, it is possible to observe the estimates of the variables factor loads without and with rotation by the varimax method, respectively. It can be noticed that after the varimax method rotation there is a clearer separation of the variables in relation to the factors.

Figure 6. Factorial loads.



Source: Created by the authors.

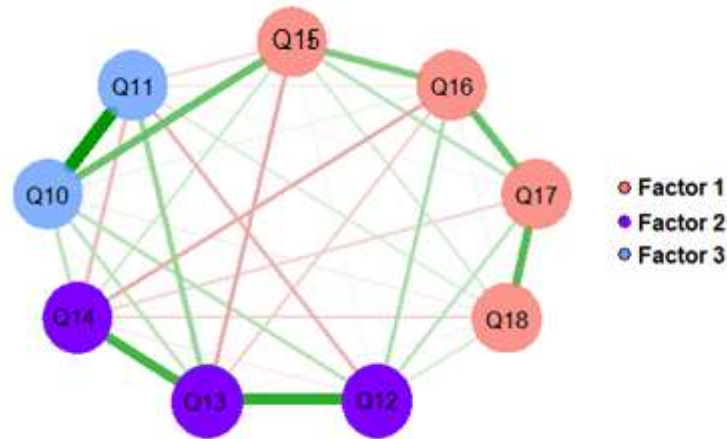
After observing the matrix of the rotated factor loads, together with figure 5, it is possible to highlight which variables are present in each factor. Factor 1 presents high coefficients for the variables Q15, Q16, Q17 and Q18. Factor 2 has a strong relationship with Q12, Q13 and Q14, whereas Factor 3 has higher coefficients for the variables Q10 and Q11.

- **Factor 1:** Pandemic reflex in the school year
- **Factor 2:** Impacts of social isolation on the teaching and learning process
- **Factor 3:** Effectiveness of restrictive measures

Factor 1 shows which variables directly affected the school year, whether the implementation of distance learning is the best alternative to the pandemic scenario, and whether it can address students' educational deficiencies during social isolation. Another concern of education professionals has to do with the fulfillment of the mandatory workload. In factor 2, the impacts of social isolation on the lives of professionals can be observed, where the need for innovation in the teaching method is highlighted, causing an increase in the workload. Factor 3 points out the opinion of educators about how effective the restrictive measures are, even though they directly impact the educational sector.

Figure 7 makes it possible to observe the separation of the factors and the correlation between them. Among the variables, it can be noted that some correlations are stronger than others: those within the factors are positive, represented by the straight lines in green and there are few negative correlations, these being more evident among the variables Q13 with Q15 and Q16 with Q14.

Figure 7. Factors.



Source: Created by the authors.

That said, the implementation of factor analysis has enabled the extraction of three factors showing latent variables.

5 Conclusion

This work aimed to verify the impacts of the pandemic caused by COVID-19 in the Brazilian educational sector. The data were collected through a virtual questionnaire answered by education professionals and it was possible to implement statistical methods for the analysis of such data in order to extract significant information. After crossing the variables and implementing the Chi-square test, it was possible to observe the dependence among some variables. That said, it has been identified the dependence between the place of residence and the respondent's opinion regarding the preservation of lives and health as more important than the fulfillment of the school year. There is also a dependence between the institution where the professional works and his/her opinion about the legal number of school days being fulfilled or not, for this year.

With the factor analysis, it was possible to extract three factors, where factor 1 points out the pandemic effect upon the school year. In this factor, the respondents express their opinion on remote classes, and their concern regarding the fulfillment of the mandatory workload. 50% of the respondents totally agree that distance learning is the best alternative in this pandemic scenario, only 8% totally disagree. Another question contained in this factor is whether distance learning can be developed in a way that addresses students' educational deficiencies during social isolation: only 15% of professionals fully agree that remote learning will be enough to address such deficiencies. This factor alone accounts for 27.8% of total variance.

Factor 2 highlights the impacts of social isolation on the teaching and learning process, and accounts for approximately 23.6% of the total variance in the sample. In this factor, 46% partly agree that local authorities are taking appropriate measures to mitigate the effects of the pandemic. As for maintaining academic activities, 65% said it was a very difficult time to maintain them. Factor 3 represents 12% of the sample variability and with this factor we can observe the effectiveness of the restrictive measures, where 88% of the education professionals totally agree that the social isolation is a good measure to assure the public health. Together, the 3 factors represent 63.6% of the total sample variance.

With this study it was possible to verify how much the pandemic impacted the educational sector and the lives of professionals. The increase in workload, lack of technological resources, a need for innovation, and an uncertainty regarding compliance with the academic year were evident in the analysis.

Thinking about future work, a form was virtually distributed to students, aiming to collect data that would make it possible to verify the impacts of COVID-19 on theirs. With these data collected, the objective is to make an exploratory and confirmatory factor analysis.

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