# ACCEPTANCE OF INFORMATION SYSTEMS DURING COVID-19: A COMPARATIVE STUDY BETWEEN FEDERAL AND PRIVATE EDUCATIONAL INSTITUTIONS

*ACEITAÇÃO DE SISTEMAS DE INFORMAÇÃO DURANTE A COVID-19: ESTUDO COMPARATIVO ENTRE INSTITUIÇÕES DE ENSINO FEDERAL E PARTICULAR*

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## Abstract

The COVID-19 pandemic has compelled Higher Education Institutions (HEIs) to adopt social distancing measures, which had a significant impact on the teaching-learning model. To ensure effective use of technology in the teaching-learning process, it is crucial to understand the contexts in which these technologies are applied and how they are perceived by teachers and students. This study aims to analyze the perception of students and teachers from federal and private Brazilian HEIs regarding the usefulness and ease of use of the main Information System used in remote teaching/learning during the COVID-19 pandemic. A quantitative approach with hypothetic-deductive logic was adopted, and 806 valid responses were collected. Data analysis was conducted using descriptive statistics, clustering, correlation, analysis of variance, and regression. The study found that the attitude toward IS use during the pandemic period was influenced by Perceived Usefulness and Perceived Ease of Use, but the influence was different for students and teachers. The modality of teaching before the pandemic did not impact the perception of usefulness or ease of use of the IS, regardless of whether the HEI was public or private. However, this observation varied for students.

**Keywords:** TAM Model. Technology Acceptance. Higher Education Institution. COVID-19. Pandemic. Teaching. Learning.

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**Resumo**

A pandemia da COVID-19 obrigou as instituições de ensino superior (IES) a adotar medidas de distanciamento social, o que teve um impacto significativo no modelo de ensino-aprendizagem. Para garantir o uso eficaz da tecnologia no processo de ensino-aprendizagem, é fundamental entender os contextos em que essas tecnologias são aplicadas e como elas são percebidas por professores e alunos. Este estudo tem como objetivo analisar a percepção de alunos e professores de IES brasileiras federais e privadas sobre a utilidade e a facilidade de uso do principal Sistema de Informação utilizado no ensino-aprendizagem remoto durante a pandemia da COVID-19. Foi adotada uma abordagem quantitativa com lógica hipotético-dedutiva e epistemologia interpretativista, e foram coletadas 806 respostas válidas. A análise dos dados foi realizada por meio de estatísticas descritivas, agrupamento, correlação, análise de variância e regressão. O estudo constatou que a atitude em relação ao uso do SI durante o período da pandemia foi influenciada pela utilidade percebida e pela facilidade de uso percebida, mas a influência foi diferente para alunos e professores. O modo de ensino antes da pandemia não afetou a percepção de utilidade ou facilidade de uso do SI, independentemente de a IES ser pública ou privada. Entretanto, essa observação variou para os alunos.

**Palavras-chave:** Modelo TAM. Aceitação de tecnologia. Instituição de Ensino Superior. COVID-19. Pandemia. Ensino. Aprendizado.

## 1 INTRODUCTION

The school constitutes an environment where individuals have the opportunity to learn, experience, and refine socialization (Müller, 2008). However, the need for social distancing triggered by the COVID-19 pandemic impacted the teaching-learning model practiced and established in Higher Education Institutions - HEIs (Alyoussef, 2021). In an attempt to ensure the continuity of the educational process, faculty and students from the traditional teaching model (face-to-face) transitioned to remote learning without adequate technical, social, and technological adaptations being made (Adedoyin & Soykan, 2020).

The COVID-19 pandemic altered how socialization occurs in school environments, and the teaching and learning process itself had to adapt to a new reality mediated by social medias (Lopes et al., 2023), computers and Information Systems (IS) that facilitate remote learning (Adedoyin & Soykan, 2020; Daniel, 2020; O'Leary, 2020). Computer and smartphone screens have become the primary means of interaction between teachers and students and IS is the medium through which these interactions take place in the digital environment (Adedoyin & Soykan, 2020; Daniel, 2020; O'Leary, 2020). In the face of this heavily technology-mediated scenario compelled by the COVID-19 pandemic, it is necessary to observe the different contexts in which these technologies are applied, and especially, how information systems used in mediating the teaching-learning process were accepted by teachers and students.

Therefore, to guide the research, the following question was established: What is the perception of students and faculty from Brazilian Federal and Private Higher Education Institutions (HEIs) regarding the usefulness and ease of use of the main Information System used in remote teaching/learning during the COVID-19 pandemic? The study's objective is to analyze the perception of students and faculty from Brazilian Federal and Private HEIs regarding the usefulness and ease of use of the main Information System used by them in remote teaching/learning during the COVID-19 pandemic.

To achieve the study's objective, a quantitative approach and hypothetical-deductive logic were adopted. A total of 806 valid responses were collected. Data were analyzed using descriptive statistics, clustering, correlation, analysis of variance, and regression techniques.

## 2 THEORETICAL BACKGROUND

### 2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) has been used to understand behaviors related to the acceptance (e.g., Banking Apps - Feliciano et al., 2018) and use of computer technology and information systems (Maria, Frogeri, Piurcosky, & Prado, 2021). Davis (1989) proposed a theoretical model of technology acceptance based on the pillars of perceived usefulness and perceived ease of use as prerequisites for an individual's behavior in accepting or rejecting a technology.

The model suggested by Davis (1989) utilizes the constructs of perceived usefulness (PU - the degree to which users believe that the technology will enhance their job performance) and perceived ease of use (PEU - the degree of ease with which the technology can be used) to predict not only the user's acceptance of technology but also the benefits of that technology in relation to the effort required to employ it. Originally conceived to evaluate the professional use of a word processor, TAM, after the inclusion of external variables (Davis, Bagozzi, & Warshaw, 1989), has been adapted to assess the intention and usage of various technologies (e.g., Remotely Piloted Aircraft System - Maria et al., 2021).

Davis (1989) proposes that individuals tend to use technologies to enhance their job performance (Perceived Usefulness). However, this perception of usefulness may be compromised by its complexity (disproportionate effort to usefulness) (Perceived Ease of Use).

The TAM model uses the Perceived Usefulness (UP) and Perceived Ease of Use (FUP) constructs as its central structure to assess whether or not a technology is accepted by a user. Table 1 below shows the variables associated with each of these constructs.

**Table 1**

UP and FUP construct variables

| Perceived Usefulness (PU) | Perceived Ease of Use (FUP) |
|---|---|
| Works faster | Easy to learn |
| Increased productivity | Controllable |
| Enhances job performance | Easy to use |
| Effectiveness | Rigid and inflexible |
| Provides easier work | Easy to remember (functions) |
| Utility | Requires mental effort |
| Quality of work | Annoying |
| Control over the work | Understandable |
| Technology is critical for work | Effort needed to become qualified |
| Completing more tasks | Frustrating |

Note. The table represents constructs associated with the Technology Acceptance Model (TAM) proposed by Davis et al. (1989), specifically Perceived Usefulness (PU) and Perceived Ease of Use (FUP) constructs. These constructs encapsulate users' perceptions regarding the adoption of a technological system.

The Technology Acceptance Model (TAM) constructs UP and FUP suggest users' perceptions are intricately shaped by various factors, each contributing to the overall evaluation of a system's utility and ease of use (Venkatesh, Morris, Davis, & Davis, 2003). Operational speed emerges as a pivotal aspect, with users deeming a system more useful when it facilitates quicker operations. The correlation extends to increased productivity, where the perceived usefulness is intertwined with the system's ability to enhance overall work output. Additionally, users appreciate systems that contribute to improved individual job performance, highlighting the significance of a system's impact on professional efficacy. However, the effectiveness of a system, measured by its capability to deliver desired outcomes, can be impeded by rigidity, potentially hindering its perceived usefulness.

Furthermore, ease of use is gauged by how effortlessly users can navigate tasks, particularly when functions are easy to remember. Users also factor in the utility of the system, carefully weighing it against the mental effort required for operation. The overall quality of work is influenced by users' perceptions of system annoyance, emphasizing the nuanced interplay between satisfaction and performance. A system's ease of understanding contributes to perceived ease of use, influencing users' sense of control over their work environment. While users may acknowledge technology's critical role, achieving proficiency may demand considerable effort. Lastly, the completion of tasks enhances perceived usefulness, but frustration may arise if the system proves challenging to use, underscoring the delicate balance between functionality and user experience.

## 2.2. Online learning during COVID-19 pandemic

During the COVID-19 pandemic, various studies were conducted to understand the teaching/learning process in that context. Kharma et al. (2021) sought to comprehend the factors affecting students' acceptance of online learning. Rizun and Strzelecki (2020) aimed to understand how students at the University of Economics in Katowice (Poland) perceived the shift to distance learning and the IT communication tools applied by the university for remote education. Rizun et al. (2020) aimed to identify the factors influencing the acceptance of Vietnamese students regarding the use of video conferencing tools (VCTs) in distance learning during the COVID-19 pandemic. Meanwhile, Cicha et al. (2021) investigated the first-year students' expectations regarding the transition to distance learning during the COVID-19 pandemic, the impact of the pandemic on people's daily lives, and whether this impact would be permanent.

Kharma et al.'s (2021) study presented a conceptual model based on 15 variables to investigate the factors affecting students' acceptance of online learning, testing 29 hypotheses, confirming 15 and rejecting 14. Four variables (Perceived Usefulness, Social Influence, Quality of Life, and Habit) had positive effects on the Behavioral Intention to use online courses, while the study found that course design and ease of course use influenced online collaborative learning. Three relationships had negative effects on the model.

Rizun and Strzelecki (2020) observed that pleasure and self-efficacy are the best indicators of students' acceptance of the shift from traditional face-to-face teaching to distance learning. Perceived usefulness has a strong effect on the attitude toward use, and usage intention has a strong effect on actual use. The model explains a relatively high percentage of the variation in perceived usefulness and perceived ease of use.

The main conclusions of Rizun et al. (2020) include the significant impact of external factors on TAM constructs, the positive influence of result quality on perceived usefulness and acceptance of VCTs, and support for eleven hypotheses tested in the study.

Lastly, Cicha et al. (2021) found that the most important factors influencing students' feelings and willingness to switch from face-to-face to distance learning are the sense of pleasure in this form of education and a sense of self-efficacy, similar to Rizun and Strzelecki (2020). Cicha et al. (2021) noted that students were not entirely convinced of the effectiveness of distance learning and were unsure about its efficacy.

Thus, based on previous discussions and TAM model, we have defined two hypotheses:

> H1: Students and teachers at a private educational institution in the south of Minas Gerais consider the main Information System used for remote teaching/learning during the COVID-19 pandemic to be useful and easy to use.

> H2: Students and teachers at a federal educational institution in the south of Minas Gerais consider the main Information System used for remote teaching/learning during the COVID-19 pandemic to be useful and easy to use.

The first hypothesis posits that individuals, both students and teachers, affiliated with a private educational institution in the southern region of Minas Gerais, perceive the principal Information System employed for remote teaching and learning during the COVID-19 pandemic as both useful and user-friendly.

The second hypothesis contends that students and educators associated with a federal educational institution in the southern region of Minas Gerais similarly evaluate the primary Information System utilized for remote teaching and learning during the COVID-19 pandemic as being both useful and easy to navigate.

## 3 METHODOLOGY

Methodologically, the study is characterized by a quantitative approach and employ a hypothetical-deductive logic (Popper, 2013). The study aims to test the hypotheses H1 and H2 for falsifiability. Between April and June 2021, students and teachers from two educational institutions in the city of Varginha, located in the south of Minas Gerais, Brazil, were invited to participate in the survey.

The first Higher Education Institution (HEI) is private, boasting over 20 years of existence and hosting approximately 7.000 students enrolled in both on-site and distance learning undergraduate courses. The second HEI is federal, providing technical and higher education courses, with an enrollment of approximately 800 students exclusively in on-site modalities.

The study employed a non-probabilistic sample. An electronic questionnaire, distributed via email, was used to collect data. The study received approval from the Brazilian Research Ethics Committee (CEP) and is registered under Certificate of Submission for Ethical Appraisal (CAAE) number 44802921.0.0000.5111. The questionnaire was organized according to the constructs and variables suggested in the TAM model (Table 2). Using a five-point Likert scale, as recommended by Dalmoro and Vieira (2013), the survey questionnaire's relationship between the constructs and variables of the TAM model is presented in Table 2 below.

**Table 2**

Relationship between the constructs and variables of the TAM model and the survey questionnaire

| Construct | Variables | Descritpion | Assertive |
|---|---|---|---|
| **External variables** | Previous experience or use of the system | A form of wisdom or specific skills acquired through systematic learning, improving over time; practice. | 1) I had previous experience when I started using the information systems I use today. |
| | Documentation | The use of books or documents to acquire knowledge on a particular topic. | 2. The use of the Information System(s) I use today is facilitated by the availability of manuals, tutorials or similar resources. |
| | Training/skills | Preparation, ability to develop techniques. | 3. I have received adequate training to use the Information System(s) I use today. |
| **Perceived usefulness** | | **Descritpion** | **Assertive** |
| Work faster | | The Information System allows me to do my job more quickly. | 4. The information system(s) I use on a daily basis allows me to do my job more quickly. |
| Increased productivity | | The Information System allows me to be more productive. | 5. The Information System(s) I use on a daily basis allows me to be more productive. |
| Improving work performance | | The Information System allows me to improve my overall performance. | 6. The Information System(s) I use on a daily basis allows me to improve my overall work performance. |
| Efficiency | | The Information System is simple and objective. | 7. The information system(s) I use every day is simple and objective. |
| Provides easier work | | The Information System makes my job easier. | 8. The information system(s) I use on a daily basis makes my job easier. |
| Utility | | The Information System is useful. | 9. The information system(s) I use every day is useful. |

| Quality of work | The Information System provides quality for my work. | 10. The information system(s) I use every day provides quality for my work. |
| Control over work | The Information System gives me greater control over my work. | 11. The information system(s) I use every day gives me greater control over my work. |
| Technology is fundamental to the job | The technology used in the Information System is essential for my work. | 12. The technology used in the information system I use every day is essential for my work. |
| Completion of more work | The Information System allows me to complete more work. | 13. The information system(s) I use on a daily basis allows me to complete more work (productivity). |
| **Perceived ease of use** | **Description** | **Assertive** |
| Easy to learn | The information system is easy to learn. | 14. The information system(s) I use on a daily basis is easy to learn. |
| Controllable | The information system provides some kind of control. | 15. The information system(s) I use on a daily basis allow me to control data and actions. |
| Easy to use | The information system is easy to use. | 16. The information system(s) I use on a daily basis is easy to use. |
| Rigid and inflexible | The information system does not allow modifications. | 17. The information system(s) I use on a daily basis does not allow modifications. |
| Easy to remember (functions) | The information system has functions that are easy to memorize. | 18. The information system(s) I use every day has functions that are easy to remember. |
| Requires mental effort | The information system requires more effort from the brain. | 19. The information system(s) I use every day requires more effort from my brain. |
| Disturbing | The information system causes discomfort or disruption. | 20. The Information System(s) I use every day causes me discomfort or upset. |
| Understandable | The information system is understandable. | 21. The Information System(s) I use every day is comprehensible (easy to understand). |
| Effort required to be skilled | The Information System requires training and dedication to master. | 22. The Information System(s) I use on a daily basis requires training and dedication to master. |
| Frustrating | The Information System has flaws that make it frustrating. | 23. The Information System(s) I use every day has flaws that make it frustrating. |

| Construct | Variables | Description | Assertives |
| --- | --- | --- | --- |
| **Attitude towards Use** | First impressions | The impression the system makes directly affects the user's behavior in relation to using the system. | 24. My first impression of the Information System(s) I use today was positive. |
| **Intention to Use** | Attitude + perceived usefulness | Attitude towards using the technology; considers the usefulness of the technology. | 25. I consider the information system(s) I use today to be fundamental to my work. |

Note. The table presents constructs, variables, descriptions, and related assertive statements for the Technology Acceptance Model (TAM). External variables include previous experience, documentation, and training/skills. Perceived usefulness encompasses aspects like working faster, increased productivity, and control over work. Utility, quality of work, and completion of more tasks are also explored. Perceived ease of use involves

characteristics such as being easy to learn, controllable, and understandable. Attitude towards use covers first impressions and the intention to use, emphasizing positive initial impressions and the perceived importance of the information system for daily work tasks. Created by the authors.

## 4 ANALYSES and DISCUSSIONS

A total of 806 responses were considered valid, with 701 (86.97%) associated with private institutions of higher education (IES) and 105 (13.03%) with federal IES. The significant difference in the number of participants between the IES types is linked to the fact that the private IES has a substantially larger number of students and faculty compared to the federal IES unit under investigation. Table 3 provides a breakdown of the research sample by gender, type of IES, and type of respondent.

**Table 3**

Gender, role of the respondent and HEI of the research sample

| Gender/ Role of the respondent | Private | | Public | | Overall |
|---|---|---|---|---|---|
| | Amount | % | Amount | % | |
| **Female** | **393** | **48.76** | **55** | **6.82** | **448** |
| Student | 331 | 41.07 | 39 | 4.84 | 370 |
| Teacher | 62 | 7.69 | 16 | 1.99 | 78 |
| **Male** | **308** | **38.21** | **50** | **6.20** | **358** |
| Student | 238 | 29.53 | 46 | 5.71 | 284 |
| Teacher | 70 | 8.68 | 4 | 0.50 | 74 |
| **Overall** | **701** | **86.97** | **105** | **13.03** | **806** |

Note. The table presents a comprehensive breakdown of survey respondents based on gender and role, with a distinction between private and public institutions as well as an overall summary. The structure includes three main categories: "Private," "Public," and "Overall," with subcategories for "Female," "Student," and "Teacher." Each category and subcategory includes columns for the quantity of respondents, expressed as both a numerical count and a percentage of the total responses in that respective category. The data is organized to facilitate a clear comparison between private and public institutions, allowing for an analysis of the distribution of respondents by gender and role across the different institutional types and overall. Created by the authors.

In Table 3, there is a clear prevalence of responses from students in Higher Education Institutions (HEIs), accounting for 654 responses (81.14%), while only 152 responses (18.86%) come from faculty members. Concerning the gender of the respondents, there is a certain balance, with 448 (55.58%) identifying as female and 358 (44.42%) as male. Regarding the age distribution of the sample, the majority (366 or 45.41%) fall within the 21 to 34 years age range. Those aged between 35 and 54 years constitute 34.12% (275), and individuals under 20 years old account for 124 respondents (15.38%). A small proportion, only 41 (5.09%) of the survey participants, are above 54 years old. Given the context of the COVID-19 pandemic, it is crucial to examine the changes that have occurred in the teaching and learning processes of both students and educators. In this regard, we present Table 4.

**Table 4**

Gender, role of the respondent and HEI of the research sample

| Type of teaching-learning that was conducted before the pandemic | Private | | Public | | Overall | |
|---|---|---|---|---|---|---|
| | Amount | % | Amount | % | Amount | % |

| | | | | | | |
|---|---|---|---|---|---|---|
| I exclusively conducted distance learning classes and continue in this mode. | 12 | 7.89 | | | 12 | 7.89 |
| I exclusively conducted in-person classes and now teach remotely. | 82 | 53.95 | 20 | 13.16 | 102 | 67.11 |
| I conducted classes in both distance learning and in-person teaching. Currently, for in-person teaching, I conduct classes remotely. | 38 | 25.00 | | | 38 | 25.00 |
| **Overall** | **132** | **86.84** | **20** | **13.16** | **152** | **100** |

Note. The table provides a breakdown of respondents based on the type of teaching-learning they conducted before the pandemic, categorized by private and public institutions, and an overall perspective. The structure includes three main categories: "Private," "Public," and "Overall." Subcategories detail the percentage and amount of respondents who exclusively conducted distance learning classes and continue in this mode, exclusively conducted in-person classes and now teach remotely, and those who conducted classes in both distance learning and in-person teaching. Notably, the "Overall" row sums up the total respondents, offering a comprehensive view of the distribution across different teaching modalities. Created by the authors.

According to the data from Table 4, the majority of educators (102 – 67.11%) exclusively conducted in-person classes, and during the pandemic, they shifted to remote instruction. Another group of educators (38 – 25%) delivered classes in a hybrid format (online and in-person) and, during the pandemic, transitioned to remote instruction for students enrolled in in-person courses. Only 12 (7.89%) educators exclusively taught in the online format and continued in this mode during the pandemic. There is a significant majority of educators from private higher education institutions (132 – 86.84%) compared to those from public institutions (20 – 13.16%).

It is noteworthy that, at the observed public institution, there were no Distance Education courses when the research was conducted in mid-2021. Considering the earlier analyses, it is interesting to observe whether the transition of educators from in-person to remote teaching has any influence on the perceived usefulness or ease of use of the Information System employed by the institution during remote instruction. As suggested by Hair Jr et al. (2010), it is recommended that the constructs of a model, even if already validated in the literature, be analyzed in correlation with their factor loadings. In this context, conducting an Exploratory Factor Analysis (EFA) and the Sample Adequacy Test (KMO) is recommended. A KMO value above 0.70 suggests a suitable sample for EFA (Hair Jr et al., 2010). The KMO result for the UP construct was 0.941, and for the FUP construct, it was 0.873. Thus, an EFA was performed to assess the suitability of the variables for the construct in the studied scenario. Table 5 presents the EFA for the UP construct with a number of factors equal to one.

**Table 5**

EFA of the Perceived Usefulness (PU) construct

| Perceived Usefulness (UP) | Factor | Uniqueness |
|---|---|---|
| | 1 | |
| UP_workFaster | 0.801 | 0.358 |
| UP_increaseProductivity | 0.846 | 0.284 |
| UP_performanceJob | 0.847 | 0.283 |
| UP_efficiency | 0.706 | 0.501 |
| UP_makesworkEasier | 0.895 | 0.199 |
| UP_useful | 0.742 | 0.449 |
| UP_qualityWork | 0.849 | 0.280 |
| UP_controlJob | 0.785 | 0.384 |
| UP_technologyFundamental | 0.626 | 0.608 |
| UP_finishMoreWork | 0.745 | 0.446 |

Note. The table presents data related to the Perceived Usefulness (UP) construct, including factor loadings and uniqueness values for various associated factors. Each factor is denoted by a specific attribute, such as "UP_workFaster" and "UP_increaseProductivity," with corresponding factor loadings representing the strength of the relationship between the observed variables and the underlying construct. Additionally, uniqueness values

indicate the proportion of variance in each factor that is unique and not shared with other factors. The 'minimum residual' extraction method was used in combination with an 'oblimin' rotation. Created by the authors.

Hair Jr et al. (2010) propose that factor loadings exceeding 0.50 possess greater practical significance, while loadings between 0.30 and 0.40 are considered acceptable. In the context of the UP construct, the data presented in Table 5 indicates that all variables within the construct exhibit notable factor loadings, suggesting no need for exclusions. Subsequently, a reliability analysis for the construct was performed, yielding a Cronbach's alpha of 0.940, a value significantly surpassing the 0.70 threshold recommended by Hair Jr et al. (2010). Following this analysis, Table 6 provides the results of the Exploratory Factor Analysis (EFA) for the FUP construct.

**Table 6**

EFA of the Perceived Ease of Use construct (FUP)

| Perceived Ease of Use (FUP) | Factor | Uniqueness |
|---|---|---|
| | 1 | |
| FUP_ easyLearning | 0.810 | 0.344 |
| FUP_controllable | 0.666 | 0.557 |
| FUP_user-friendliness | 0.806 | 0.350 |
| FUP_difficultyChange | 0.337 | 0.886 |
| FUP_easyMemorization | 0.767 | 0.412 |
| FUP_effortCerebral | | 0.926 |
| FUP_desconfortoPertubacao | -0.424 | 0.820 |
| FUP_easyUnderstanding | 0.801 | 0.359 |
| FUP_training | | 0.976 |
| FUP_faultsFrustrating | -0.366 | 0.866 |

Note. The table presents data related to the Perceived Ease of Use (FUP) construct, featuring factor loadings and uniqueness values for various associated factors. Each factor is denoted by a specific attribute, such as "FUP_easyLearning" and "FUP_controllable," accompanied by factor loadings indicating the strength of the relationship between the observed variables and the underlying construct. Additionally, uniqueness values convey the proportion of variance in each factor that is unique and not shared with other factors. The structure provides insights into the perceived ease of use regarding different aspects, including learning, controllability, user-friendliness, and memorization. . The 'minimum residual' extraction method was used in combination with an 'oblimin' rotation. Created by the authors.

The data from Table 6 suggests that the variables "difficulty of change," "cerebral effort," "discomfort or disturbance," "training," and "failures making the IS frustrating" of the FUP construct can be excluded. Negative factor loadings suggest contrary associations, and the low loading (0.337) of the "difficulty of change" variable may be omitted based on the analysis of the "Uniqueness" column, indicating a variance sharing of 0.114. After excluding the suggested variables, a reliability analysis of the construct was conducted, resulting in a Cronbach's alpha of 0.885.

With the validated constructs and variables of the model, we continued the analyses through the One-Way ANOVA test to verify if there are significant differences between the means of the analyzed groups and if the factors influence any dependent variable (Hair Jr et al., 2010). In this case, the dependent variables are the means of the variables that compose the Perceived Usefulness (UP) and Perceived Ease of Use (FUP) constructs according to the EFA results (Tables 5 and 6).

The analyses reveal an F value of 0.415 for the UP construct and a p-value of 0.664. The FUP construct has an F value of 0.472 and a p-value of 0.629, suggesting no statistical significance between the analyzed groups. In other words, the analyses suggest that whether educators exclusively taught in-person, exclusively in Distance Learning, or both before the pandemic does not influence the perception of usefulness or ease of use of the IS adopted for remote teaching. As a confirmation of the previous data, a Tukey Post-Hoc test was conducted, analyzing significances separately for each of the groups. In this regard, no valid significance was

observed for the UP (Table 7) and FUP (Table 8) constructs, confirming the lack of influence of the teaching modality before the pandemic on the perception of usefulness or ease of use of the IS adopted for remote teaching.

**Table 7**

Tukey Post-Hoc test for the UP construct - teachers

| | | I used to teach only distance learning classes and I continue to do so | I used to teach face-to-face classes and now I teach remotely | I used to teach in distance learning and face-to-face classes. At the moment, in face-to-face teaching, I teach remotely |
|---|---|---|---|---|
| I used to teach only distance learning classes and I continue to do so | Mean difference | — | 0.207 | 0.106 |
| | p-value | — | 0.685 | 0.918 |
| I used to teach face-to-face classes and now I teach remotely | Mean difference | | — | -0.101 |
| | p-value | | — | 0.793 |
| I used to teach in distance learning and face-to-face classes. At the moment, in face-to-face teaching, I teach remotely | Mean difference | | | — |
| | p-value | | | — |

Note. The table presents a comparison of mean differences and p-values among three groups of educators based on their teaching modalities before the pandemic and during the remote teaching period. The three groups consist of educators who exclusively taught distance learning classes before and during the pandemic, those who initially taught face-to-face classes and shifted to remote teaching, and those who conducted both distance learning and face-to-face classes, with a current practice of remote teaching during in-person sessions. The mean differences and p-values provide insights into the statistical significance of any observed variations in the perceptions of the perceived usefulness of the Information System employed for remote teaching among these different teaching modalities. Created by the authors.

**Table 8**

Tukey Post-Hoc test for the FUP construct - teachers

| | | I used to teach only distance learning classes and I continue to do so | I used to teach face-to-face classes and now I teach remotely | I used to teach in distance learning and face-to-face classes. At the moment, in face-to-face teaching, I teach remotely |
|---|---|---|---|---|
| I used to teach only distance learning classes and I continue to do so | Mean difference | — | 0.162 | 0.2254 |
| | p-value | — | 0.736 | 0.604 |
| I used to teach face-to-face classes and now I teach remotely | Mean difference | | — | 0.0637 |
| | p-value | | — | 0.884 |

| | | I used to teach only distance learning classes and I continue to do so | I used to teach face-to-face classes and now I teach remotely | I used to teach in distance learning and face-to-face classes. At the moment, in face-to-face teaching, I teach remotely |
|---|---|---|---|---|
| I used to teach in distance learning and face-to-face classes. At the moment, in face-to-face teaching, I teach remotely | Mean difference | | | — |
| | p-value | | | — |

Note. The table presents a comparison of mean differences and p-values among three groups of educators based on their teaching modalities before the pandemic and during the remote teaching period. The three groups consist of educators who exclusively taught distance learning classes before and during the pandemic, those who initially taught face-to-face classes and shifted to remote teaching, and those who conducted both distance learning and face-to-face classes, with a current practice of remote teaching during in-person sessions. The mean differences and p-values provide insights into the statistical significance of any observed variations in the perceptions of perceived ease of use of the Information System employed for remote teaching among these different teaching modalities. Created by the authors.

Similarly to the previous analysis, we looked at how students studied before the COVID-19 pandemic. The majority (375 - 57.34%) reported that they studied in person before the pandemic and during the pandemic they started studying remotely. Another group of students (279 - 42.66%) studied via distance learning before the pandemic and continued to do so during the pandemic.

Thus, we carried out the One-Way ANOVA analysis of variance test (Table 9) considering the means of the variables of the UP and FUP constructs after the EFA with the dependent variable type of study modality of the student before the pandemic (face-to-face or distance learning).

**Table 9**

One-Way ANOVA of the constructs UP, FUP and the independent variable "student's mode of study"

| Construct | F | df1 | df2 | p |
|---|---|---|---|---|
| UP | 97.1 | 1 | 631 | < .001 |
| FUP | 34.3 | 1 | 652 | < .001 |

Note. The table presents a comparison of mean differences and p-values among three groups of educators based on their teaching modalities before the pandemic and during the remote teaching period. The three groups consist of educators who exclusively taught distance learning classes before and during the pandemic, those who initially taught face-to-face classes and shifted to remote teaching, and those who conducted both distance learning and face-to-face classes, with a current practice of remote teaching during in-person sessions. The mean differences and p-values provide insights into the statistical significance of any observed variations in the perceptions of perceived ease of use of the Information System employed for remote teaching among these different teaching modalities. Created by the authors.

The results of the One-Way ANOVA analysis suggest a significant difference among the analyzed groups for both constructs. The Tukey Post-Hoc test for the UP construct indicates a mean difference between the groups of 0.563 with a significance of p < .001, and for the FUP construct, a mean difference of 0.337 with a significance of p < .001. Therefore, it can be considered that the shift from in-person to remote teaching has a distinct influence on the perceived usefulness or ease of use of the Information System adopted for remote teaching when compared to those students who were already in the Distance Learning modality. This outcome was expected, given that Distance Learning students experience the use of technologies adopted by many Higher Education Institutions (HEIs) for remote teaching (Adedoyin & Soykan, 2020).

It is worthwhile to explore if the previous results exhibit variations between the federal public and private institutions. In this regard, we conducted the One-Way ANOVA test again for samples stratified by the type

of institution. The results for both constructs (UP and FUP) from the HEIs showed a significance level of p < .001. For the federal public institution, the significance level remained at p < .001 for the UP construct, while for the FUP construct, it did not show valid significance at the 95% level (p < 0.150). Thus, it is suggested that there are significant differences between students from a private or federal public institution in the perception of ease of use of the IS adopted for remote teaching.

At this point, it is relevant to highlight those institutions utilized different Information Systems for remote teaching. According to students from the private institution, the main Information Systems used during the COVID-19 pandemic for remote teaching/learning were Google Classroom (476 – 67.90%) and Google Meet (182 – 25.96%). For the federal public institution, the main Information Systems used were SIGAA (Integrated System for Academic Activities Management – a system developed by the Federal University of Rio Grande do Norte (UFRN) and widely used in federal HEIs in Brazil – 34 – 32.38%), Microsoft Teams (23 – 21.90%), and Google Classroom (23 – 21.90%).

The difference in perception of ease of use for public institution students compared to private institution students may be associated with the fact that the public institution used a greater number of Information Systems. A higher number of technologies being used simultaneously may hinder the complete mastery of the tool and its functionalities. This observation aligns with the validated variables via EFA for the FUP construct: easy learning, controllable, user-friendliness, ease of memorization, and easy understanding.

Finally, to verify hypotheses H1 and H2, we initially conducted a correlation analysis between the UP and FUP constructs and the attitude variable towards the use of the TAM model, segregated by the type of institution. Subsequently, in Table 10, the correlation analysis for the federal public HEI is presented.

**Table 10**

Correlation analysis of federal public HEI

| Constrcuts | | UP | FUP | Attitude towards Use |
|---|---|---|---|---|
| UP | Pearson's r | — | | |
| | p-value | — | | |
| FUP | Pearson's r | 0.687 | — | |
| | p-value | < .001 | — | |
| Attitude towards Use | Pearson's r | 0.534 | 0.518 | — |
| | p-value | < .001 | < .001 | — |

Note. The table depicts correlation analyses among three constructs: Perceived Usefulness (UP), Perceived Ease of Use (FUP), and Attitude towards Use. For the UP construct, the Pearson's r and p-value are presented, indicating the correlation and significance level between UP and itself. Similarly, for the FUP construct, the Pearson's r and p-value demonstrate the correlation and significance level with FUP. Lastly, the table includes the correlation coefficients and p-values for the relationship between Attitude towards Use and both UP and FUP constructs. Created by the authors.

The data in Table 10 suggests a moderate and significant positive correlation between the FUP and UP constructs (0.687 and p < .001). The correlation between Perceived Usefulness (UP) and Attitude towards use was also moderate and significant (0.534 and p < .001). A similar analysis was observed between the FUP construct and the Attitude towards use variable - moderate correlation (0.518) and significance p < .001. According to the analysis, it is suggested that students and lecturers at the public HEI have a positive attitude towards the use of the ISs adopted during the remote teaching period. Table 11 shows the correlation analysis for the private HEI.

**Table 11**

Correlation analysis of private HEI

| Constrcuts | | UP | FUP | Attitude towards Use |
|---|---|---|---|---|
| UP | Pearson's r | — | | |
| | p-value | — | | |
| FUP | Pearson's r | 0.740 | — | |
| | p-value | < .001 | — | |
| Attitude towards Use | Pearson's r | 0.494 | 0.578 | — |
| | p-value | < .001 | < .001 | — |

Note. The table depicts correlation analyses among three constructs: Perceived Usefulness (UP), Perceived Ease of Use (FUP), and Attitude towards Use. For the UP construct, the Pearson's r and p-value are presented, indicating the correlation and significance level between UP and itself. Similarly, for the FUP construct, the Pearson's r and p-value demonstrate the correlation and significance level with FUP. Lastly, the table includes the correlation coefficients and p-values for the relationship between Attitude towards Use and both UP and FUP constructs. Created by the authors.

The results presented in Table 11 are similar to those observed for the public institution, with the exception of the higher correlation value between the UP and FUP constructs, suggesting a strong positive correlation (Hair Jr et al., 2010).

To conclude the analyses and identify the influence of the UP and FUP constructs on the Attitude variable towards the use of the Information System adopted by the institution during the pandemic, a linear regression analysis was conducted, as shown in Table 12. Prior to the linear regression analysis, Hair et al. (2009) recommended examining the collinearity between the independent variables of the model (UP and FUP). In this regard, the VIF for the public institution data was 1.89, and for the private institution, it was 2.22, suggesting no collinearity between the independent variables. Additionally, autocorrelation between the residuals was analyzed, identifying a value of 1.87 for the private institution data and 1.99 for the public institution. Hair Jr et al. (2010) propose a value between 1.5 and 2.5 for the Durbin-Watson test statistic for the absence of autocorrelation between the residuals. Therefore, the model and study data are suitable for linear regression analysis and are presented in Table 12.

**Table 12**

Regression analysis for the research hypotheses

| Hypotheses | Result of regression analysis |
|---|---|
| H1: students and teachers at a private educational institution in the south of Minas Gerais consider the main information system used for remote teaching/learning during the COVID-19 pandemic to be useful and easy to use. | R2 = 0.344 and significance of UP of 0.001, FUP < .001. Estimated value of 0.206 for UP and 0.711 for FUP. |
| H2: students and teachers at a federal public educational institution in the south of Minas Gerais consider the main Information System used for remote teaching/learning during the COVID-19 pandemic to be useful and easy to use. | R2 = 0.329 and significance of UP of 0.003, FUP < 0.012. Estimated value of 0.476 for UP and 0.437 for FUP. |

Note. The table outlines the results of the regression analysis for hypotheses H1 and H2, which investigate the perceptions of students and teachers at a private educational institution and a federal public educational institution in the south of Minas Gerais, respectively. For H1, the R2 value is provided along with the significance levels for Perceived Usefulness (UP) and Perceived Ease of Use (FUP), with estimated values of 0.206 for UP and 0.711 for FUP. Similarly, for H2, the R2 value is presented alongside the significance levels for UP and FUP, with estimated values of 0.476 for UP and 0.437 for FUP. Created by the authors.

The data from Table 12 suggests that both hypotheses (H1 and H2) can be confirmed. It is observed that for the private educational institution (IES), the Perceived Ease of Use (FUP) construct (estimated value of 0.711)

has a greater influence on the attitude variable toward usage, whereas in the federal public educational institution, the Perceived Usefulness (UP) and FUP constructs exhibit similar influences (UP at 0.437 and FUP at 0.476), indicating that both constructs are important in determining the attitude toward the use of the Information System (SI) for this group. The results of our study align with various works in the literature.

Alyoussef (2021) examined the influence of key constructs of the Technology Acceptance Model (TAM) on the actual use of an e-learning system at a university in Saudi Arabia during the COVID-19 pandemic. Alyoussef's (2021) results suggest that students' intention to use e-learning had positive effects on student learning during the COVID-19 pandemic. Similarly, Quadir and Zhou (2021) made a comparable observation to Alyoussef (2021) while investigating how Chinese students perceived the impact of Tencent Meeting system resources under the two main determinants of the TAM model (UP and FUP). The study also analyzed the effects of these determinants on learning performance, noting that both UP and FUP are significant contributors to learning performance.

Khan, Ashraf, Seinen, Khan, and Laar (2021) in Pakistan observed collaborative learning during the COVID-19 pandemic and sought to enhance the understanding of social media adoption among higher education students. The results suggest that the Perceived Usefulness (PU) and FUP constructs have a positive relationship with social media adoption. Social media tools facilitate resource-sharing, as students perceive this medium as easy to use and useful because it helps them share information more effectively and efficiently.

Sharma, Aggarwal, and Saxena (2021) studied the adoption of ICT tools by students in higher education institutions in the Delhi capital region, India. The results suggest that the UP and FUP constructs have a significant positive relationship with the attitude and behavioral intention of higher education students to use ICT tools. Alfadda and Mahdi (2021) analyzed the correlation between TAM variables in the use of the Zoom software application in language learning. The study's results reveal a strong positive correlation between the actual use of Zoom and students' attitudes and behavioral intentions.

Although our study did not observe the influence of Information Systems (IS) used during remote teaching on students' learning, it can be suggested, inductively and empirically, that students' perception of the ease and usefulness of IS during remote teaching influences their learning, as this is the main mediating element in the teaching-learning interaction. Similarly, the same perception by teachers may have a similar influence.


## 5 CONCLUSION

At this juncture, it is crucial to revisit the question that guided the study: What is the perception of students and faculty from Brazilian Federal and Private Higher Education Institutions (HEIs) regarding the usefulness and ease of use of the main Information System used in remote teaching/learning during the COVID-19 pandemic? We observed that attitudes toward the use of the IS adopted by HEIs during the COVID-19 pandemic are influenced by Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), but in distinct ways for students and faculty.

The fact that faculty members were exclusively involved in face-to-face teaching, solely in Distance Learning, or both before the pandemic did not influence the perception of the usefulness or ease of use of the IS adopted for remote teaching, whether they belonged to a private or public HEI. However, this observation differed for students. We found that students transitioning from face-to-face to remote learning had a distinct influence on the perception of usefulness or ease of use of the IS compared to those already in Distance Learning. Additionally, there were significant differences between students from private and federal public HEIs in the perception of the ease of use of the IS for remote teaching. Private HEI students showed a greater influence of the PEOU construct on the intention to use the IS, suggesting that IS adopted by private HEIs may be more user-friendly for students, consequently facilitating learning, as suggested by Quadir and Zhou (2021) and Alyoussef (2021).

It is noteworthy that the public HEI's use of a greater number of IS during remote teaching may have influenced students' Perceived Ease of Use of the different IS adopted. In this regard, it is recommended to moderate the use of technologies that mediate the teaching-learning process during remote teaching (our study suggests up to two, e.g., Google Classroom and Google Meet, IS adopted by the private HEI).

Lastly, we accept both research hypotheses (H1): students and faculty at a private educational institution in the South of Minas Gerais consider the main Information System used for remote teaching/learning during the COVID-19 pandemic useful and easy to use; and H2: students and faculty at a federal public educational institution in the South of Minas Gerais consider the main Information System used for remote teaching/learning during the COVID-19 pandemic useful and easy to use.

We believe that the study contributes to the technology acceptance literature by addressing a current theme aligned with the main challenges faced by Brazilian Higher Education Institutions during the COVID-19 pandemic. In the field of management, the study's results suggest practices that can facilitate the use of information systems in the transition from face-to-face to remote teaching.

## *ACKNOWLEDGMENT*

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