

# Teacher Stress During Educational Processes with Physical and Remote Attendance Regarding the Covid-19 Pandemic – A Secondary Publication

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**Abstract:** The integration of new technologies and the increase in workload have influenced teaching performance, thereby affecting the development of teaching-learning activities. The balance between time dedicated to professional practice and time available for physical and psychological rest is analyzed based on the definition of stress as a collection of daily situations that impact the personal and professional development of an individual, which escalated during the COVID-19 pandemic with the rise of virtual educational practices. The study, conducted in two educational units in Quito, Ecuador, involved administering the Maslach Burnout Inventory questionnaire to 155 participants, alongside collecting data on sociodemographic variables. Statistical analysis was performed using the JASP 0.15 program. The results indicate the level of work stress experienced by teachers, depending on various sociodemographic variables including rural or urban setting, gender, age, level of education, marital status, and cohabitation arrangements. A statistically significant correlation ( $< 0.001$ ) was observed, particularly regarding the challenge faced by over half of the participants (0.51) in finding time for postgraduate studies. Additionally, a moderate correlation was found between inattention and various symptoms: frustration (0.46), guilt (0.36), weariness (0.26), tiredness (0.51), lack of attention (0.26), and the importance of work (0.43). These findings prompt a discussion on the allocation of time and workload for teachers, irrespective of their location in rural or urban areas.

**Keywords:** Teaching stress; Burnout; Teaching professional development; Work stress; Teaching learning

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## 1. Introduction

Due to the pandemic context of COVID-19, in most countries around the world, including Ecuador, an educational model that leveraged the use of virtual learning environments incorporating other resources and virtual platforms was implemented massively <sup>[1]</sup>. However, the majority of the population was not prepared for such abrupt changes, prompting urgent and relevant reflection on virtual educational processes and the acquisition of new technological competencies within the social and educational discourse.

Educational processes were directly affected due to the disruption of non-working hours, which were

intervened by training and other updates related to virtuality. These changes began in early 2020 when in-person activities involving large human groups were restricted. In the Ecuadorian context, this reached its critical point upon confirmation of the first COVID-19 case.

Educational institutions and all involved parties were compelled to shift from a traditional, in-person educational system to one incorporating the use of technological resources for teaching and learning processes <sup>[2]</sup>, as it falls among the activities of primary necessity according to constitutional guidelines in Ecuador. To better facilitate teaching and learning processes, the delegation and assignment of new roles from delegations were recommended as a pedagogical strategy, which has been regularly implemented since 2017.

These roles aimed to alleviate the workload on teachers; however, the delegation of new roles and, consequently, their demands placed an additional burden on teachers who found themselves trapped by being unable to balance or resolve the issues they encountered, with these demands exceeding their capabilities and maintaining a connection beyond their regular hours of responsibility.

The excess workload made communication an indispensable strategy for improving the educational environment and also the working environment, aiming to ensure that the role of generating good social relationships is not neglected. Organizational justice goes hand in hand with communication as it enables the achievement of the goals of stakeholders.

The dialogue used appropriately within institutions will foster respect for the ethical and moral norms of their members. Managers must have developed channels for emotional connection to communicate with their staff, where they will truly get to know who they are. The tones of voice used by leaders when addressing their staff are important because they allow them to perceive their closeness and affection in necessary conversations to apply organizational justice.

According to Palacios and Pernas <sup>[3]</sup>, stress in teachers can be caused by internal or external factors that can complicate work processes or relationships with family. This must be added to the perception of ways of thinking, values, beliefs, or the way of perceiving the world, which influences the particularity of individuals, each with their own appreciation of the things around them and different ways of facing problems or situations that may arise.

Cifuentes-Faura <sup>[4]</sup>, regarding the effects of teacher stress, recommends making use of all types of evaluation available to the teacher to avoid confusion and additional information overload while a course is being developed. In a reality where self-teaching and education through virtual platforms prevail, “analytical evaluation seems to be a more suitable option to avoid receiving work overload outside the determined time for work or academic follow-up,” an action of vital importance because it allows timely intervention by the teacher with reinforcements in those aspects where the student faces greater difficulties.

Within this same premise, the exercise of teaching in the educational environment has been characterized as one of the most demanding professions in terms of the work environment. Teaching implies intense emotional commitment because the work situation corresponds to the diversity of institutions where particularities of relationship and communication styles are also reflected <sup>[4]</sup>. Additionally, being a teacher implies a context and the classroom as a physical or virtual space where it is necessary to understand each of the individual demands of students, parents, and authorities; all expectant of the teacher’s attitudes and responses, with their successes and mistakes <sup>[5]</sup>.

Considering the Ecuadorian context, it is important to remember that within the teaching role, it is not only necessary to carry out intellectual activities but also certain adjustments in the content of their subject (curricular adaptations) that take into account the different interests and abilities of their students. This “demands a greater investment of their time; what is really sought is for teachers to develop psychological well-being and satisfaction in their work environment” <sup>[6]</sup>.

The person-to-person approach was intervened and forced to change interaction, as reflected by García Aretio <sup>[1]</sup>, who pointed out an access gap to communicative, educational, and virtual resources. This gap widened due to the pandemic, reducing the access possibilities to education for many students in vulnerable populations with limited economic and social resources, thereby impacting teachers who had to address this situation <sup>[1]</sup>.

In the two educational units where this study was conducted, teachers unanimously agreed that the COVID-19 pandemic has increased their perception of work-related stress. Teachers have attributed this to a lack of knowledge about technological tools, which contrasts with one of the most demanding teaching activities: engaging for many hours a day in conflicts, difficulties, and other concerns and potential needs that arise from students, where they may not always receive favorable contributions.

The absence of updating programs and spaces for teacher breaks within curricular planning has left teaching as one of the most vulnerable professional activities, and one of the most affected by the level of stress produced by pedagogical activities, as this profession involves personal beliefs and emotional situations of various kinds <sup>[7]</sup>.

On the other hand, and according to the current context in which this research was conducted, amidst an environment of isolation due to the COVID-19 pandemic, the work of teachers was notably altered, highlighting the lack of updates regarding the use of Information and Communication Technologies (ICT), especially in incorporating teleworking. For these reasons, it is considered necessary to evaluate the level of work-related stress in teachers in the context of the COVID-19 pandemic.

Teaching practice and exercise require a balance between time devoted to the activity and time available for physical and mental rest, which involves interaction among large groups of people. Henríquez pointed out that the concept of stress has been used to define situations that cause discomfort and identify it as a stimulus or relationship in the face of a threatening state <sup>[8]</sup>.

### **1.1. Effects of innovation in times of COVID-19**

To maintain the world in regular operation, a series of methodological strategies were proposed to address how education is approached in our context, one in which the lack of preparation in educational innovation linked to virtual tools was noticeable. New trends in learning design suggest that the teacher or designer should produce programs and materials that are much more facilitating than prescriptive in nature.

Due to the need to sustain the trend and the lack of preparation, strategies such as gamification, aimed at promoting learning and problem-solving through playful thinking, are linked to the use of game mechanics and aesthetics, promoting aspects such as creativity and perseverance, gained momentum and began to promote the use of resources such as Quizizz, which allows the teacher to create and customize, in a playful and fun way, a variety of questions for knowledge reinforcement. It will be the teacher who provides the students with the web questionnaire link with their respective access codes, which can be viewed from a computer or mobile device.

Resources like this allowed for the technological incorporation of:

- (1) Question and answer contests created by the teacher, which will allow the evaluation of the participant's knowledge, as well as being a motivational component to give more dynamism to the class.
- (2) Individual evaluations, whose level of difficulty will increase depending on the topics to be assessed.
- (3) Feedback from contests and evaluations through the verification of their results will enable students to improve their successes in future exercises.
- (4) Additional exercises, which can be worked on asynchronously from home, to further improve the student's proficiency in the foreign language.

Each of these sections allows for the evaluation of students through team presentations, research projects,

written assessments, rubrics, and self-assessment targets. Additionally, for the teaching staff, the option of generating reports provides a better understanding of student learning and even helps define reinforcement stages through their own resources or external ones that align with the detected needs.

The growth of this innovative tool enabled tutors to harness the participants' skills, allowing them to develop abilities when creating strategies to complete exercises efficiently. It also provides greater development of logical thinking. From this, and considering evaluative needs, the study began on how to determine learning values, especially within virtual environments. Precisely because it follows other dynamics such as those listed in the Quizizz resource.

Among the advantages of these educational technology tools (open source) is the ability to implement activities from regular classroom settings, such as creating concept maps, and learning activities for course planning and design. These activities generally rely on tools that accept the embedded inclusion of HTML code generated in the Moodle platform or any other e-learning platform. These embedded resources facilitate the design and customization of learning paths for each student. Learning paths include activities that allow students to carry out adaptive self-learning.

Educational units proposed an understanding regarding assessments as one of the most relevant aspects of the educational process, as it allows determining to what extent students have effectively developed the planned competencies. In a time when education through virtual means has become a necessity, the role of assessment may be considered even more important than before. This is because this modality does not allow the student to be physically present in a space where they can approach the teacher and ask about their doubts; and, although it is possible to do so through one of the many communication platforms available, the distance may cause students to face greater difficulties with the learning process compared to what happens in a regular classroom.

Thus, to ensure that class objectives are being achieved and students are acquiring the necessary skills, assessments must be continuously conducted to determine student progress and provide necessary reinforcement in problem areas. For this, assessment rubrics must be developed timely and be clearly and thoroughly communicated. Students need to know not only what product they must deliver to be evaluated but also “on what parameters they will be evaluated, for which it must be established and communicated which achievement indicators will be managed.”

## 2. Methodology

The study was descriptive in nature. The sample consisted of 155 teachers from two educational units in the city of Quito, Ecuador. The ages of the teachers ranged from 43 to 51 years old.

Data collection was conducted through an online questionnaire, resulting in  $n = 155$  respondents. The data were subjected to correlation analysis. The selection process began with an empirical recognition, based on experimentation or observation of evidence, in this case, the responses collected from teachers in the instrument, which were accepted through a confidentiality agreement disseminated with the authorities for the development of this document.

The sociodemographic questionnaire is designed to be completed during the first five questions, which investigates aspects of education and job stability. The questionnaire is complemented by the application of twenty-one questions that allow verifying the existence or non-existence of a degree of stress regarding teaching practice.

For the development of the investigative survey, informed consents were consolidated, contact was made with institutions with teachers, information was collected via Google Forms, and data analysis was conducted using JASP 0.15.

The questions were adapted linguistically and contextually to fit the communicative use of local jargon. The questions were systematized based on the framework presented by Santamaría *et al.* [9], and their data selection allows for obtaining new results according to the scenario where the present study has been applied.

Data tabulation followed correlation using Pearson’s coefficient. For inputting the information obtained from Microsoft Forms, data verification and format conversion were carried out for loading into the statistical program JASP 0.15, from which the following sampling results were obtained (**Table 1**). The survey results revealed a higher number of responses from the female gender (57%), with 12% opting not to disclose, leaving the remaining 31% for the male gender. Standard deviation variables considered gender, level of education, marital status, and job stability for interpreting their responses.

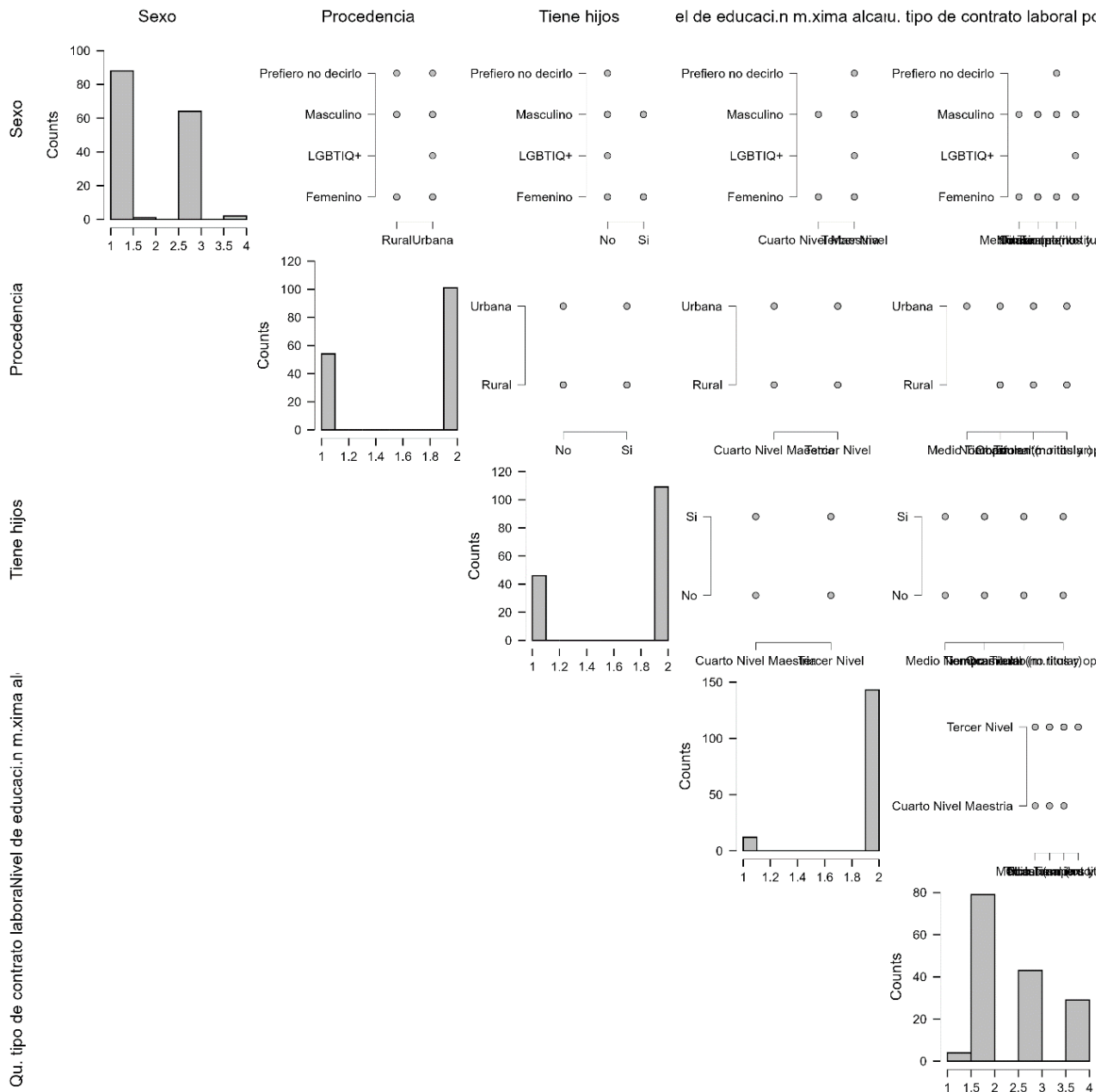
**Table 1.** Binomial correlation test in JASP 0.15

Variable	Level	Counting	Total	Proportion
Sex	Female	88	155	0.56
	LGBTIQ+	1	155	0.06
	Male	64	155	0.41
	Prefer not to disclose	2	155	0.13
Marital status	Married	80	155	0.51
	Divorced	15	155	0.09
	Single	49	155	0.31
	Free union	8	155	0.05
	Widowed	3	155	0.01
Source	Rural	54	155	0.34
	Urban	101	155	0.56
Living status	Family	99	155	0.63
	Couple	29	155	0.18
	Alone	17	155	0.11
	Shared house	10	155	0.06
Children	No	46	155	0.29
	Yes	109	155	0.70
Highest education level attainment	Fourth level mastery	12	155	0.07
	Third level	143	155	0.92
Type of contract labor	Part-time	4	155	0.02
	Appointment	79	155	0.51
	Occasional (non-tenured)	43	155	0.27
	Holder (merits and opposition)	29	155	0.18

Proportions tested against value: 0.5.

From the obtained data, it is evident that 65% of respondents live with their families, and additionally, 70% claimed to have children, which does influence their work perception and can be verified in the data presented in **Table 2** and is also contrasted with the level of education attained. Only 15% of respondents hold a fourth-level degree, highlighting the limited availability of time for teachers to enhance their education due to their

workload – despite the job stability most of them confirm having – as well as their family habitat relationship.



**Figure 1.** Correlation generated in JASP 0.15

Description of variables such as the number of participants, mean age, and standard deviation. Then, in the correlation analysis between sociodemographic variables and their different levels (**Figure 1**), an approximate proportion of  $< 0.50$  was obtained for the gender variable. For the variable “marital status,” the variance proportion was mostly divided among respondents who identified as married, with  $> 0.51$  of the sample having a relationship of  $< 0.74$  for single individuals. The study’s origin, while initially intended for predominantly rural study, when obtaining the data, revealed that the self-identification of respondents corresponds to  $> 0.65$  urbanities, leaving  $< 0.34$  for those identifying with rural settings.

Regarding respondents’ family environment, the results reflect that  $> 0.61$  of the sample defines their family cohabitation as a group, with the minimum  $< 0.06$  living alone. This variable is consistent with the  $> 0.70$

obtained from the population claiming to have children but also reflects the challenges of accessing a fourth-level degree, as only < 0.07 possess a fourth-level degree. Finally, contract stability shows that only < 0.18 of the proportion hold a merit-based appointment, while > 0.51 are distributed with appointments that may be subject to removal.

The correlation of sociodemographic variables allows for observing the details of the 155 valid samples. The statistical test presented a value of 13.21, with percentiles of 90, 95, and 99 of its distribution with 1 degree of freedom between 2.71; 3.84, and 6.63 respectively, as can be seen in **Table 2**; it is worth mentioning that according to JASP 0.15, the value of *n* was established at 155 for the sample size.

**Table 2.** Description of variables based on *n* = 155 in JASP 0.15

	Validated surveys	Mean	Standard deviation	Minimum	Maximum
Age	155	38.00	9.18	22.00	65.00
Exhaustion	155	4.00	1.87	0.00	6.00
Emptiness	155	1.00	2.13	0.00	6.00
Fatigue	155	2.00	2.03	0.00	6.00
Understanding	155	6.00	1.65	0.00	6.00
Impersonal objects	155	0.00	1.50	0.00	6.00
Weariness	155	1.00	2.13	0.00	6.00
Problems	155	5.00	1.92	0.00	6.00
Strain	155	3.00	2.05	0.00	6.00
Influence	154	5.00	2.03	0.00	6.00
Toughness	154	2.00	2.22	0.00	6.00
Emotional hardening	154	1.50	2.33	0.00	6.00
Energy	154	5.50	1.78	0.00	7.00
Frustration	154	2.00	2.31	0.00	6.00
Time	154	5.00	2.33	0.00	6.00
Importance	154	0.00	1.86	0.00	6.00
Contact	154	2.00	2.22	0.00	6.00
Climate	154	6.00	1.78	0.00	6.00
Estimation	153	5.00	2.06	0.00	6.00
Value	153	6.00	1.82	0.00	9.00
Limit	154	1.00	2.17	0.00	6.00
Emotional problems	154	5.00	2.17	0.00	6.00
Guilt	154	0.00	1.78	0.00	6.00

From the data presented in the table, it can be seen that a high percentage of the sample has had their ability to conduct classes affected and even consider that their time is no longer sufficient, nor is their influence positive with the students.

Due to the standard deviation results generated by the statistical resource, it was taken advantage of that JASP 0.15 allows for the diagramming of correlation processes. These data were placed following the Maslach Burnout Inventory base, where the results show a strong and direct correlation of 0.86, statistically significant

< 0.01 between the sociodemographic variable and the variable of activities carried out in teaching practice, which demonstrates a curve of effect on the respondents' responses and the results of the battery applied (and edited by context) regarding how their workspace affects their emotional health.

The *t* value is equivalent to the inferential value used to determine whether there are differences between the groups, in this case, with each of the collected questions. The data frame range contrasts the quantity of validated and statistically significant surveys with the *P*-value < 0.001, moderate with the mean difference that establishes an average of 38.91 years for those who are mostly exhausted by their work, but with a decrease of 1.15 for those who feel that their work is not important or influential on their students.

**Table 3.** Percentage of participation-correlation from the adapted Maslach Burnout Inventory (MBI) questionnaire in *t*-test

	Student's <i>t</i> -test	<i>P</i> value	VS-MPR*	Mean difference	Cohen's <i>d</i>
Age	52.73	< 0.01	8.85e+96	38.91	4.23
I feel emotionally drained from my work	24.14	< 0.01	9.36e+50	3.62	1.93
When I finish my workday, I feel empty	12.89	< 0.01	2.10e+23	2.20	1.03
When I wake up in the morning and face another workday, I feel fatigued	15.97	< 0.01	2.75e+31	2.61	1.28
I feel I can easily understand my students	36.98	< 0.01	1.20e+75	4.91	2.97
I feel I am treating some of my students as if they were impersonal objects	5.99	< 0.01	1.44e+6	0.72	0.48
I feel that working with people all day tires me out	12.04	< 0.01	1.17e+21	2.06	0.96
I feel I deal effectively with my students' problems	28.55	< 0.01	1.21e+60	4.41	2.29
I feel my job is wearing me out	18.15	< 0.01	9.50e+36	3.00	1.45
I feel I am positively influencing the lives of others through my work	25.76	< 0.01	1.73e+54	4.22	2.07
I feel I have become tougher on those around me.	14.97	< 0.01	6.05e+28	2.68	1.20
I worry that this job is toughening me emotionally	13.68	< 0.01	2.43e+25	2.57	1.10
I feel very energetic in my job	32.54	< 0.01	1.90e+67	4.68	2.62
I feel frustrated in my job	13.22	< 0.01	1.45e+24	2.46	1.06
I feel I spend too much time in my job	19.85	< 0.01	1.00e+41	3.73	1.59
I feel I don't really care what happens to my students	7.69	< 0.01	8.14e+9	1.15	0.62
I feel working in direct contact with people tires me out	13.11	< 0.01	7.40e+23	2.35	1.05
I feel I can easily create a pleasant atmosphere with my students	33.65	< 0.01	1.67e+69	4.83	2.71
I feel valued after working closely with my students	26.66	< 0.01	7.92e+55	4.45	2.15
I believe I achieved many valuable things in this job	33.11	< 0.01	1.02e+68	4.88	2.67
I feel like I'm at the limit of my capabilities	13.08	< 0.01	5.94e+23	2.29	1.05
I feel emotional problems are handled properly in my job	22.71	< 0.01	4.48e+47	3.98	1.83
I feel students blame me for some of their problems	7.22	< 0.01	6.62e+8	1.03	0.58

For the Student's *t*-test study, the effect size estimation refers to Cohen's *d*, the determination of the difference location is estimated based on the sample size and the difference between *d*, and the alternative of specific hypotheses differs from zero according to the variables. \*Vovk-Sellke Maximum *P*-Ratio is based on the comparison between the "two-sided *P*-value" validates the maximum possible value between the variables and its favoring factor of  $H_1$  over  $H_0$  equal to  $1/(-e P \log(P))$  for  $P \leq 0.37$  (Sellke, Bayarri, & Berger, 2001).



Based on the collected data (**Table 3**), Cohen's d variance allows standardizing a mean to measure the effect size. The effect size has revealed that job burnout is present in 9.36 subjects of the sample with an equivalent of 1.93, thus determining its effect. This is contrasted with the distribution mean of the variables.

According to the percentage distribution of the tables, a general balance is established for the total distribution of these over one hundred percent of three basic units of interpretation. The content shows a medium general emotional exhaustion, a balanced depersonalization (distancing from values), and a personal accomplishment as intentionality with a high degree of acceptability, from which it can be concluded within the correlation of the variables that the factors affecting teaching performance do refer to levels of stress reached during professional practice.

The data obtained through JASP 0.15 allows identifying the correlation by association of the variables from the Maslach Burnout Inventory base where the results show a strong and direct correlation of 0.59 and statistically significant  $< 0.001$  between the exhaustion variable and the feeling of emptiness. A strong and indirect correlation between fatigue and understanding of 0.26 is also found. Additionally, statistically significant correlations  $< 0.001$ , moderate and inverse, are found between concern for work and class hours -0.53 and student esteem -0.15.

Similarly, statistically significant correlations  $< 0.001$ , moderate and inverse, are found between guilt and work climate -0.15. Also, statistically significant correlations  $< 0.001$ , moderate, are found between the depression variable and symptoms of anxiety 0.55 and symptoms of aggression 0.49. On the other hand, statistically significant correlations  $< 0.001$ , moderate, are found between the emotional environment variable and symptoms of frustration 0.33; symptoms of guilt 0.42 and symptoms of emotional hardening 0.47.

Moreover, statistically significant correlations  $< 0.001$ , moderate, are found between the exhaustion variable and symptoms of fatigue 0.57; symptoms of impersonality 0.27; symptoms of burnout 0.37 and esteem 0.43. Additionally, statistically significant correlations  $< .001$ , moderate, are found between the frustration variable and symptoms of emotional instability 0.36; symptoms of limitation 0.43; symptoms of depression 0.62; influence 0.68 and toughness 0.66. Similarly, statistically significant correlations  $< 0.001$ , moderate, are found between the inattention variable and symptoms of frustration 0.46; symptoms of guilt 0.36; symptoms of burnout 0.26; tiredness 0.51; lack of attention 0.26 and work importance 0.43.

### 3. Discussion

One of the main elements influencing the development of Burnout syndrome is the lack of familiarity and direct relationship regarding empathy and communication among those who interact in a workplace or even in a family nucleus, while also interacting with external or publicly available information. On this matter, Younes *et al.* argued that interaction processes through electronic devices, which have exceeded 2.5 million continuous activities, imply in themselves a new form of almost Burnout stress within modern society<sup>[10]</sup>.

This data was doubled during the first quarter of the pandemic only in Ecuador according to data from the INEC 2021, which exceeds the institute's own statistics in 2016 where it was estimated that 9 out of 10 families have at least one cell phone, 36% of families nationally have an Internet connection, of which 24.5% have wireless internet and 54.1% have fixed Internet<sup>[11]</sup>, leading by necessity to double that figure. The significant participation of teachers from urban backgrounds highlights that problems regarding job stress do not discriminate based on the location where the work activity is being carried out.

As observed in **Table 3**, teacher stress influences fatigue, which is why the data obtained throughout the study allows exploring how technology, electronic devices, and internet-based communication resources have

taken a prominent role in society. The generational gap and the handling of these utilities represented one of the main barriers when working on pedagogical processes, which show how sociodemographic conditions, age, and gender affect emotional stability for work performance.

The survey results helped establish a quantitative scale of the number of teachers who have been involved or affected by some degree or level of teaching stress, as it generates physicochemical changes, activating the secretion of hormones (catecholamines and adrenaline). The use of electronic devices over time, according to Fung *et al.* <sup>[12]</sup>, drives teachers to health conditions linked to routine, obesity, poor diet, low-quality sleep, and psychological problems that can lead to various disorders, which can negatively influence the family environment and hence organizational performance, reaffirming the activation of catecholamine and adrenaline hormones.

It was also found that virtual environments may not necessarily be dedicated to learning. Despite representing an apparent deficiency in educational development, it has also represented a way to advance through structured learning resources from flipped classrooms and gamification. Therefore, the cycle of training or continuous updating becomes one of the vital elements for educational practice and also one of the least promoted due to its impact on daily and academic activities <sup>[13]</sup>.

Burnout as a disorder develops parallel to work activities due to intrafamily interaction processes. Often within the teaching role, virtual activities tend to interact with everyday life. In that sense, due to the usual use of devices, according to Vogel <sup>[14]</sup>, it has been confirmed that children, young people, and even adults feel bored or unhappy when they are not using an electronic device. This leads to repetitive series of distractions during mandatory access to topics related to learning, which is why Burnout would develop due to external factors linked to the habits of participants in an educational cycle.

These reflections allow us to consider that based on the collected and investigated data – from the questionnaires and their results – it was possible to identify not only the issues that teachers faced during the development of their classes through remote (synchronous and asynchronous) modality from different platforms, which were at the time poorly known and imply a commitment from both teachers and authorities to training regarding the use of technological resources that were little or not used in face-to-face education. This, in some way, generated traces of work stress that were gradually increasing.

This finally drives an investigative approach, where out of an innovative need due to COVID-19, it proposes redesigning the methodological aspect with which students are introduced to the learning of fractions and their arithmetic derivatives. In this context, recent research such as that carried out by Gutiérrez <sup>[15]</sup> and Marchant <sup>[16]</sup> proposed the application of changes that mainly must arise from the attitude of the teacher, referring, for example, to “the interrelation in the class, management of space and therefore the mathematical vocabulary used” <sup>[15]</sup>; these types of strategies can be used for reflection rather than learning or memorizing certain processes, enabling in the learning exercise a reflection on the incorrect arguments that may arise and that would allow them to learn in any subject.

## Disclosure statement

The author declares no conflict of interest.

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