



# Evaluation of stress and anxiety levels on science and engineering undergraduate students in Spain when facing written assessments guides for positive interventions

Clara Simón de Blas<sup>a,\*</sup>, Karina Rojas<sup>a</sup>, Ana E. García Sipols<sup>b</sup>,  
Sonia Hernández Alonso<sup>a</sup>, María Eugenia Castellanos<sup>a</sup>, Javier Cano<sup>a,d</sup>,  
Claudia Córdoba<sup>c</sup>

<sup>a</sup> Department of Computer Science and Statistics, Rey Juan Carlos University, Spain

<sup>b</sup> Department of Applied Mathematics, Materials Science and Engineering and Electronic Technology, Rey Juan Carlos University, Spain

<sup>c</sup> Department of Education, University of Santiago, Chile

<sup>d</sup> Department of Statistics, University of Auckland, New Zealand

## ARTICLE INFO

### Keywords:

Anxiety  
Stress  
Online teaching  
Undergraduate students  
COVID-19  
Prediction model  
Positive guidelines  
Motivation

## ABSTRACT

Anxiety and stress disorders are increasingly common, especially among undergraduate students, significantly affecting their family, social, and academic lives. The isolation from restrictive measures during the COVID-19 pandemic in Spain has further exacerbated mental health issues. The disruption of in-person teaching has also impacted traditional learning and evaluation processes, increasing stress and anxiety levels in students. Based on this background, this study aims to analyze the incidence of these disorders among undergraduates and their relationship with various academic, demographic, and family factors, considering the influence of COVID-19. Our results were obtained from a survey conducted among first- and second-year URJC students who are enrolled in an experimental degree program. The statistical analysis provides guidelines for positive interventions to increase student motivation, which further leads to academic success. Results show that women exhibit higher levels of stress and a greater prevalence of anxiety compared to men. The study highlights the influence of specific factors on anxiety levels among students, proposing direct lines of action that enhance positive feelings concerning academic tasks.

## 1. Introduction

According to the World Health Organization (WHO, 2024), stress can be defined as “the set of physiological reactions that prepare the body for action”. Stress is experienced in the short term and its symptoms are varied and include irritability, feelings of overwhelm, anxious thoughts, dizziness, and nausea, among others. This conception can be applied to various aspects of human life, including day-to-day circumstances where stress is more likely to occur. For instance, Marco-Ahulló et al. (2022) characterized “academic stress” as “a physiological, emotional, cognitive, and behavioral reaction to stimuli and events related to the academic environment”, which enables us to apply existing knowledge about stress to a specific area.

Although stress is a biopsychological function in humans that activates a physiological response (Schneiderman et al., 2005), its

\* Corresponding author.

constant overactivation can lead to maladaptive responses that negatively impact psychological well-being. This can result in the emergence of unpleasant emotions such as distress and anxiety, as supported by (Marco-Ahulló et al., 2022; Marcén-Román et al., 2021; Vivanco Vidal et al., 2020). Anxiety is defined by the American Psychiatric Association (2000) as the apprehensive anticipation of future harm or misfortune, accompanied by a feeling of dysphoria or somatic symptoms of tension. It can be understood as a normal strategy for coping with a stressful situation (Chacón et al., 2021). Unlike stress, which is experienced in the short term, anxiety can persist over time and may not be triggered by an identifiable event. The individual's inability to control this worry can lead to the development of anxious crises or an anxiety disorder, presenting various somatic symptoms and experiencing an exaggerated startle response. Both of these emotions are associated with a sense of being unable to manage or cope with certain conditions or situations that an individual is experiencing, as discussed in (Cabezas-Heredia et al., 2021b). This inability can manifest in symptoms such as difficulty falling asleep, irritability, fatigue, and muscle tension, as noted by Ramón-Arbués et al. (2020). These symptoms can contribute to a recurring fear of not being able to handle specific tasks or responsibilities, which is a common experience in everyone's life.

On the other hand, the outbreak of the infectious disease caused by the SARS-CoV-2 virus, which prompted the WHO to declare a global pandemic on March 11, 2020, had a profound impact on the lives of entire populations. It affected more than 760 million people worldwide and resulted in the death of at least 6.87 million people globally, as reported in *Our world in data* (2024). As noted by Rodríguez-Besteiro et al. (2021), the measures taken by different governments created a social climate characterized by uncertainty, powerlessness, and inequity, further amplified by the extraordinary measures implemented by authorities, such as lockdowns, teleworking, and remote learning.

In a pre-pandemic paper, Sanford (2017) had already examined the differences in learning success between undergraduate students learning online and face-to-face. The study found that students in face-to-face classes demonstrated better learning outcomes compared to those in online courses. Furthermore, the study suggested that students with lower academic performance may face additional learning risks when enrolled in online courses. In another study, King and Kabat-Farr (2022) examined the contextual and personal stressors encountered by business school students and offered recommendations for long-term changes, particularly in response to the challenges posed by the COVID-19 pandemic.

This unprecedented situation had a profound effect on our stress levels and our ability to respond and adapt to such significant changes. As highlighted by (Díaz-Jiménez et al., 2020; Odriozola-González et al., 2020; Rodríguez-Rey et al., 2020), this constant emotional and social strain created an environment conducive to a notable increase in the prevalence of distress and anxiety, greatly impacting people's well-being. The impact of the pandemic on university students was not uniform. Factors such as age, sex, socio-economic status, and the presence of preexisting risk factors influenced students' vulnerability to mental health issues, as discussed in González-Sanguino et al. (2020).

In the case of Spain, all these changes that constrained our social and academic lives from 2019 to 2021 are still relatively fresh in our memories, as mentioned by Cabezas-Heredia et al. (2021a) and Díaz-Jiménez et al. (2020). However, since the lifting of all mobility restrictions, lockdowns, and social isolation are no longer the norm. Consequently, there has been a gradual return to normalcy, marked by the reopening of public spaces, workplaces, universities, and other educational institutions. This means that those who have adjusted their daily routines to remote work and social distancing need to find ways to readjust to the pre-pandemic reality of face-to-face interactions. Previous studies in this area Saunders (2014) has shown that analyzing feedback indicates a positive correlation between an increase in formative feedback and improved academic performance, which is largely driven by greater student engagement. Similarly, Kang and Park (2022) evaluated students' satisfaction with online courses during the COVID-19 pandemic and found that students' positive perception of instructors' useful interaction (feedback) and their preference for online courses positively influenced their satisfaction. Other relevant studies on emotion regulation, such as those found in (Derakhshan et al., 2023; Li et al., 2024; Pan et al., 2023; Wang et al., 2023a,2021; Wang & Xu, 2023; Wang et al., 2024; Wu et al., 2024), explore emotional factors aimed at enhancing the quality of language teaching and learning.

Numerous studies have sought to assess the impact of these disruptions on undergraduate students in Spain (Marques et al., 2021; Morales-Rodríguez, 2021; Morales-Rodríguez & Pérez-Mármol, 2019). They underscored the importance of providing psychological support to those affected by the pandemic and the need for public health policies to address the mental health implications of the outbreak. Ozamiz-Etxebarria et al. (2020a) utilized the Depression Anxiety and Stress Scale (DASS) to examine the prevalence of these disorders in the Basque Country, analyzing 976 adults from various age groups, including university students. While symptomatology was generally low at the beginning of the alert, younger individuals with chronic illnesses reported more symptoms compared to the rest of the population. In a related study, Ozamiz-Etxebarria et al. (2020b) employed remote techniques to help voluntary university participants reduce their anxiety levels. Anxiety measurements were taken using the Generalized Anxiety Disorder-7 (GAD-7) scale before and after the workshop. The results demonstrated the effectiveness of several relaxation techniques in reducing anxiety levels as an alternative to pharmacotherapy.

In their study, Morales-Rodríguez and Pérez-Mármol (2019) examined the relationship between self-efficacy levels, anxiety, coping strategies, and emotional intelligence among 258 Spanish university students. The findings revealed significant associations between trait anxiety, problem-solving, emotional expression, social withdrawal, emotional clarity, and perceived self-efficacy. Another study by Morales-Rodríguez (2021) explored the correlation between fear of COVID-19, COVID-19-related stress, technological stress, resilience, self-esteem, and coping strategies in a sample of 180 Spanish university students. The results demonstrated significant associations among these variables, providing valuable insights for the development of educational interventions. Additionally, Marques et al. (2021) aimed to investigate the impact of COVID-19 on the mental health of Spanish university students. The study revealed that students experienced anxiety, depression, and social dysfunction, which could, in some cases, be alleviated through the use of mobile mental health apps. Other research studies the impact of academic performance and home environment on student

well-being (Brougham et al., 2009; Stallman, 2010), gender anxiety prevalence (Eisenberg et al., 2007), and remote learning impact on engagement and stress (Adedoyin & Soykan, 2020; Garbe et al., 2020).

In these studies, although the topic of students' anxiety and stress in the classroom and regarding their interaction with technology is addressed, the pressure of exams and assessment tests is not evaluated. In fact, evaluation through digital means continues to be an additional stressor among students, with the fear of losing information, accidental deletion, or other issues when being assessed through digital platforms instead of more traditional written in-person exams. Moreover, exams in technical disciplines, such as those in the field of mathematics, add stressors regarding digital platforms, as they often consider only the final result and not the entire development and reasoning of the item being evaluated.

With this objective in mind, we aim to evaluate the anxiety and stress levels experienced by undergraduate students at URJC when faced with various forms of written tests, with the ultimate purpose of providing positive guidelines to increase student motivation. The participants selected for this study were enrolled in Science, Technology, Engineering, and Mathematics (STEM) degree programs and were taking courses taught by the authors. To measure stress and anxiety levels, we surveyed to assess the level of stress and the presence or absence of anxiety among students, as measured by the Goldberg Anxiety and Depression Scale (GADS), developed by Goldberg et al. (1988). Through our analysis, we will evaluate the prevalence of anxiety in the university population and explore their association with academic, demographic, and family factors that students encountered during the pandemic. Additionally, our goal is to identify potential factors contributing to stress and anxiety among university students, aiming to propose useful measures to teachers, so that they can create a more positive environment within the classroom.

The paper is organized as follows. Section 2 presents the methodology employed in this study. Section 3 discuss the obtained results, while Section 4 examines potential factors associated with the student's stress and/or anxiety levels. Finally, we conclude with a discussion and guidelines to enhance the class atmosphere.

## 2. Methodology

This study is purely quantitative research conducted using primary data collected through a structured questionnaire with closed-ended questions.

### 2.1. Research design

We selected five professors from the Computer Science and Statistics department at Rey Juan Carlos University, each with a minimum of six years of professional experience at the university and having taught in multiple undergraduate or graduate degrees. Out of the twenty subjects assigned to these professors, we focused on six specific subjects for monitoring and analysis of the impact of changes introduced in teaching and examination procedures during the year 2022. The professors' academic qualifications were in Mathematical Science or Statistics. They were randomly chosen from a pool of 23 teachers from the Statistics and Operations Research area, based on specific inclusion criteria: a minimum of five years of teaching experience, a positive evaluation from Docencia (the Spanish Quality Assurance System for University Teaching), and at least three different undergraduate or graduate teaching experiences.

The target audience of this study comprises students enrolled in an experimental degree program at Rey Juan Carlos University during the year 2022, encompassing different grades ranging from the first to the fourth year. The survey instrument was administered a few days after the students had completed an evaluation for a subject, therefore ensuring proximity to the experience of facing an assessment, which is typically a stress-inducing situation for students.

The measurement instrument consists of four sections. The first section includes demographic questions, while the second section gathers information about their academic life, such as their current grade, year of study, subject repetitions, and self-perceived academic achievement. The third section focuses on their experience during the period of confinement, specifically addressing aspects related to the continuation of their studies under these conditions, including online education and evaluation, as well as the availability of resources at home for this purpose. Finally, the fourth section comprises two sets of questions. The first set pertains to seven

**Table 1**  
Distribution of students across academic degrees ( $\mu$ : average;  $\sigma$ : standard deviation).

Academic Degree (Lecture interviewed)	Count	%	%Females	$\mu \pm \sigma$ age
Experimental Sciences (Mathematics III)	30	12.0	63.3	20.6 $\pm$ 2.0
Video Game Design and Development (Statistics, Discrete mathematics)	33	13.2	15.2	19.5 $\pm$ 1.1
Computer Systems Engineering (Statistics)	32	12.8	12.5	18.8 $\pm$ 1.4
Mechanical Engineering (Statistics)	25	10.0	12.0	19.1 $\pm$ 0.5
Industrial Organisation Engineering	24	9.6	37.5	18.9 $\pm$ 0.9
Mathematics (Statistical mathematics, Computational geometry)	48	19.2	43.8	18.9 $\pm$ 1.2
Mathematics and Computer Science (Statistical mathematics, Computational geometry)	10	4.0	10.0	19.8 $\pm$ 1.0
Mathematics and Software Engineering (Statistical mathematics, Computational geometry)	13	5.2	30.8	19.7 $\pm$ 1.1
Mathematics and Economics (Statistical mathematics, Computational geometry)	14	5.6	57.1	19.9 $\pm$ 1.2
Mathematics and Primary Education (Statistical mathematics, Computational geometry)	10	4.0	100.0	19.8 $\pm$ 1.0
Water Resources (Statistics)	11	4.4	45.5	20.0 $\pm$ 2.4
Total	250	100.0	35.6	19.4 $\pm$ 1.4

indicators associated with a state of stress, while the second set contains the nine items of the Goldberg scale.

The survey was conducted face-to-face, with students self-administering the questionnaire under the guidance of a teacher. Participant privacy was ensured by the informed consent added to the survey, excluding data regarding student ID, and the collection of any data that could identify students or reveal sensitive or personal information about them. Data was stored in OneDrive university account, to take advantage of cryptographic tools and algorithms to avoid cyberattacks from the Rey Juan Carlos University.

## 2.2. Participants

The sample design employed in this study is a cluster sample, where each cluster represents a course within an experimental degree program at Rey Juan Carlos University that is currently being evaluated in one or more subjects.

The sample consists of 250 students who were enrolled in Mathematics (30 %) and Statistics (70 %) courses during the academic year 2021–22. Regarding their academic year, 41 % of the students are in their first year, 41 % are in their second year, and the remaining 18 % are in their third and fourth years. These students are distributed across various degree programs, as detailed in Table 1.

In terms of their demographic characteristics, 36 % of the participants in this study were female, while 64 % were male. The average age of the participants was 19.42 with a standard deviation of 1.42, ranging from 17 to 27 years. Among the participants, 94 % were of Spanish nationality, 3 % identified as Latino, 3 % were from non-EU European countries, and one student was from Israel. Additionally, 18 % of the participants indicated that their homes were located outside of Madrid.

Regarding their living arrangements, 86 % of the surveyed students reported living with at least one parent, 5 % resided with other family members, 3 % lived alone, and 6 % shared their living space with other individuals, such as friends or partners.

## 2.3. Data collection

The collected information was entered into a database and underwent a thorough cleaning process to ensure data quality. The cleaning process consisted of text mining, coding verification, i.e. values out of range detection, and outlier data detection considering boxplot techniques. The survey included indicators related to the level of stress and the presence or absence of anxiety among students, as measured by the Goldberg scale. This scale was specifically developed to assess the likelihood of experiencing anxiety or depression. It consists of 18 psychiatric symptoms, with nine symptoms contributing to the anxiety indicator and the remaining symptoms contributing to the depression indicator. The items considered were:

1. Have you felt very excited, nervous, or tense?
2. Have you been very worried about anything?
3. Have you felt very irritable?
4. Have you had difficulty relaxing?
5. Have you slept badly, have you had difficulty sleeping?
6. Have you had headaches or neck pain?
7. Have you had any of the following symptoms: tremors, tingling, dizziness, sweating, diarrhea?
8. Have you been worried about your health?
9. Have you had any difficulty falling asleep or staying asleep?

Participants were asked to respond with either “yes” or “no” to each item on the scale. According to Goldberg et al. (1988), individuals with anxiety scores of five or more or depression scores of two or more were considered to have a 50 % chance of experiencing clinically significant disturbances. For this study, only the items corresponding to the anxiety scale were included in the questionnaire. Participants were classified as having a significant probability of clinically important disturbances if their aggregated score exceeded five or more points, following the criteria established by Goldberg et al. (1988).

## 2.4. Data analysis

The stress level was assessed using an aggregated indicator specifically created for this purpose. The proposed items are related to the symptoms of stress noted above. In this study, we computed the sum of scores based on the responses to the following questions (1 = Never; 2 = Several times; 3 = Half times; 4 = Almost always), as proposed by Holmes and Rahe (1967) in the American Institute of Stress:

1. I feel nervous, that makes my hair stand on end.
2. I am not able to control my concerns.
3. I worry about several things.
4. I have difficulties relaxing.
5. I find it challenging to remain still.
6. I often get irritable or upset.
7. I experience fear as if something terrible is about to occur.

By summing the scores obtained for each of these items, we derived an overall measure of the participants’ stress levels.

We calculated an overall measure of participants’ stress levels by summing the scores obtained for each of these selected items. The questionnaire was designed to be completed in less than 20 min on average, so we chose the most relevant items adapted for the university context. It is important to note that not all suggested items were included, which limits our ability to determine the threshold beyond which participants may be at risk of developing an illness in the next two years. However, the results, with a Cronbach’s alpha of 0.819, exceed the minimum recommended score for research questionnaires (Cronbach’s alpha higher than 0.7) as indicated by Nunnally and Bernstein (1994).

Furthermore, to summarise the information regarding the living conditions of the evaluated students at home, we constructed an indicator called “Home Resources.” This indicator provides a scale in which higher values indicate better conditions, including access to a quiet and comfortable space for studying, availability of technological tools, and an internet connection. Conversely, lower scores reflect a more precarious situation with limited resources for creating an adequate study environment. The minimum possible score was 9 points, which corresponds to the response “Strongly disagree” for the 9 questions involved. On the other hand, the maximum possible score was 45 points, corresponding to the response “Strongly agree” (the wording of the questions was previously reversed). The reliability analysis resulted in a Cronbach’s alpha of 0.7, meeting the minimum reference score for research questionnaires.

To evaluate the environment and learning context environment, a descriptive analysis was conducted. The anxiety prevalence and stress indicators were analyzed, exploring possible significant factors. 1000 bootstrap samples were computed to ensure the statistics’ robustness and the confidence intervals generated.

To assess the learning environment and context, a descriptive analysis was performed. The prevalence of anxiety and stress indicators was examined, and potential significant factors were explored. To ensure the reliability of the statistics and generate confidence intervals, 1000 bootstrap samples were computed.

The chi-squared independence test and its extension through the Fisher test were used, to test the frequency homogeneity related to different factors. Finally, logistic regression was considered to determine the significant factors that discriminate the presence or absence of anxiety, and, therefore, help to assist professionals in attending to students with a significant probability chance of having clinically important disturbances.

The analysis was conducted at a significance level of  $\alpha = 0.05$ . The computations were performed using SPSS IBM 18 and R version 4.1.2, R Core Team (2021). Fig. 1 illustrates the data management and statistical analysis conducted.

### 3. Results

#### 3.1. Student’s academic and environmental conditions

The following is a summary of the descriptive and inferential analyses conducted on the family environment and the student’s academic status.

Self-perceived academic achievement was rated by students on a Likert scale with 5 items, where 1 represented “Excellent” and 5 represented “Very bad”. Slightly over half of the students indicated that they were performing well in their studies (56 %, scores below 2), while 11 % felt that they were not performing well (aggregation of scores 4 and 5). Additionally, approximately half of the students failed no more than one subject in the previous year (53.2 %), and 91.9 % had to retake no more than two subjects.

House student conditions were assessed using a Likert scale. In general, the participants regarded their home as a comfortable place

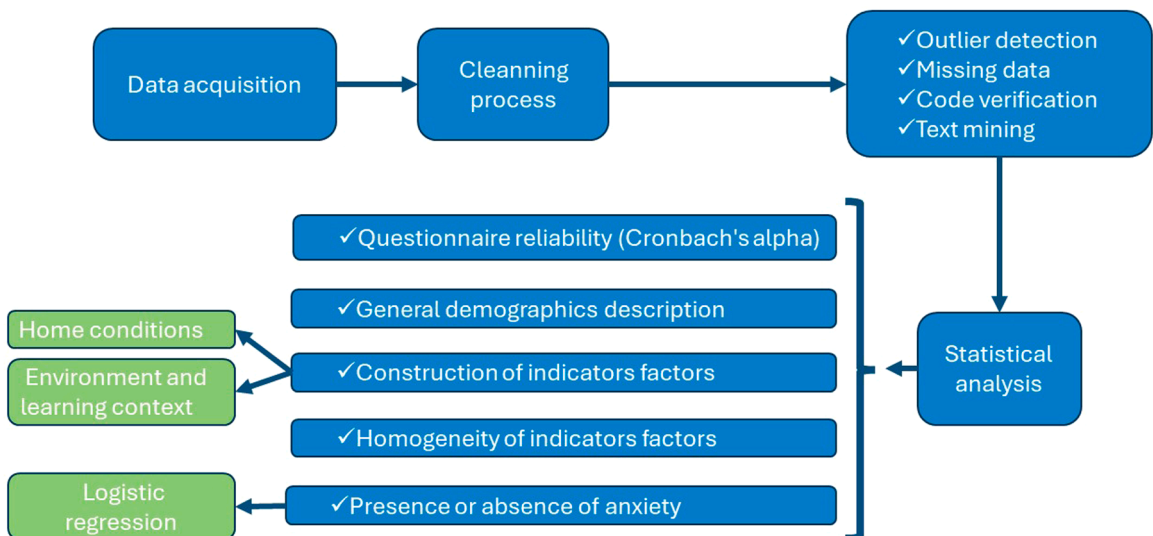


Fig. 1. Data management and statistical analysis description.



(87.6 % reported scores above 4), with sufficient space to study (88.8 % reported scores above 4), their laptop (90 % reported scores above 4), and a good Internet connection (77.5 % reported scores above 4). However, greater variability was observed concerning tempestuous conditions in their house (32.4 % agreed, scores below 2), living with too many people (22.4 % agreed, scores above 4), and using their study location for other purposes (46.2 % agreed, scores above 4) See Fig. 2 for more details.

During the Covid-19 pandemic lockdown period from 16th March 2020 to the end of the 2020/2021 Spanish academic year, students' experiences were assessed. Regarding their families, 7 % reported the loss of a family member due to COVID-19, 66 % had a family member who had to isolate because of the virus, and 20 % were infected and had to undergo isolation during the pandemic. In terms of their learning experiences, the majority of participants indicated that classes were conducted remotely (72.2 %), they had the necessary tools to participate (74.4 %), and they were able to attend most of the classes (64.9 %) while being able to share their opinions, ask questions, listen, and respond (75.6 %). However, 60.6 % of the students reported not liking to actively participate while 55.3 % only used the chat function.

### 3.2. Exam format type

When asked about their preferred type of exam format, the majority of students expressed a preference for the traditional format of a face-to-face exam, conducted in the classroom, where they can write their answers on paper and hand them in directly to the teacher (63 %). This was followed by a preference for an online format where they could answer the exam at home (22 %). The least preferred formats were online questionnaires to be completed in person in a computer lab and non-face-to-face exams where they have to upload their work to a virtual platform in the classroom, with both options receiving a preference of only (9 %). See Fig. 3 for more details.

Therefore, these results indicate that, overall, students have a positive perception of their academic performance, with the majority of students not having repeated any subjects and only a small number having failed more than one subject in the previous year. See Fig. 4 for more details. Furthermore, while most students expressed feeling comfortable studying at home, some mentioned challenges such as having too many people around and their study space being used for other purposes. Throughout the pandemic, a significant portion of students actively participated in online classes and possessed the necessary tools to do so. However, a few students either expressed a dislike for participation or solely relied on the chat feature. It is worth noting that students without a dedicated study space at home exhibited slightly lower levels of participation in online classes.

### 3.3. Prevalence of stress and anxiety among students

To identify potential factors influencing students' stress levels and anxiety states, nonparametric statistical analyses were conducted on the stress and anxiety indicators along with each of the variables gathered in the survey.

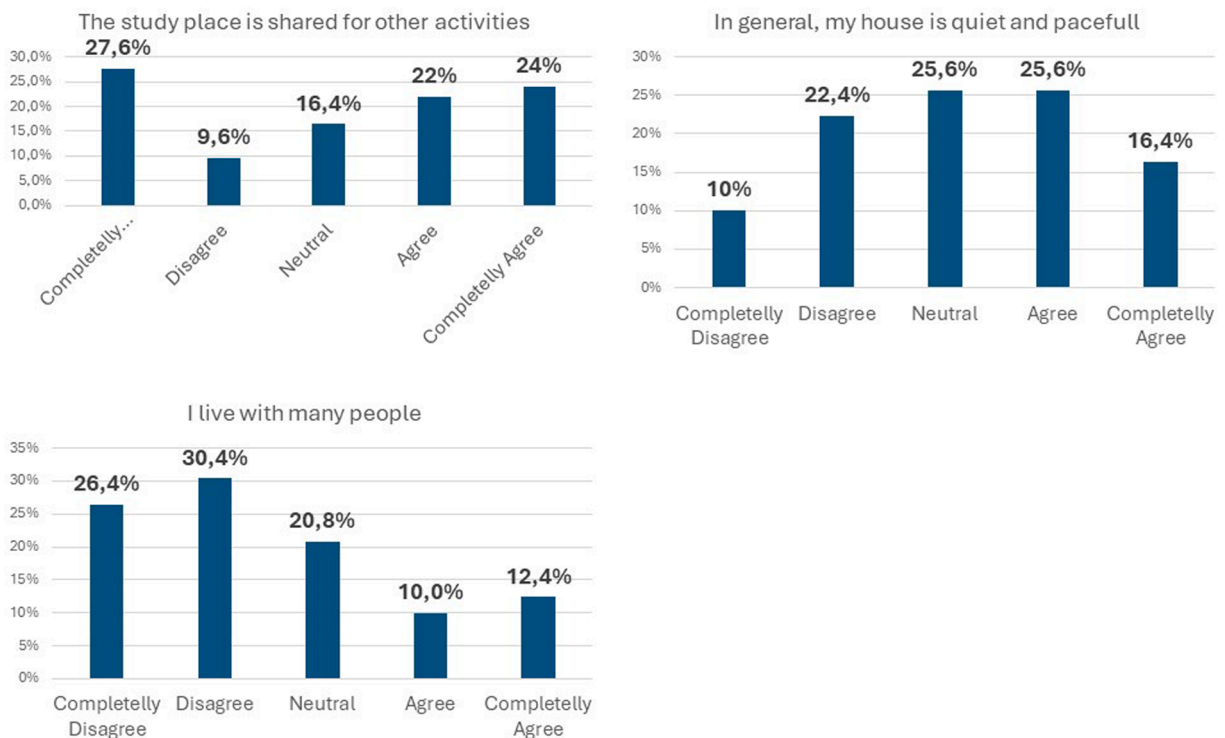


Fig. 2. Percentage of responses related to house conditions.

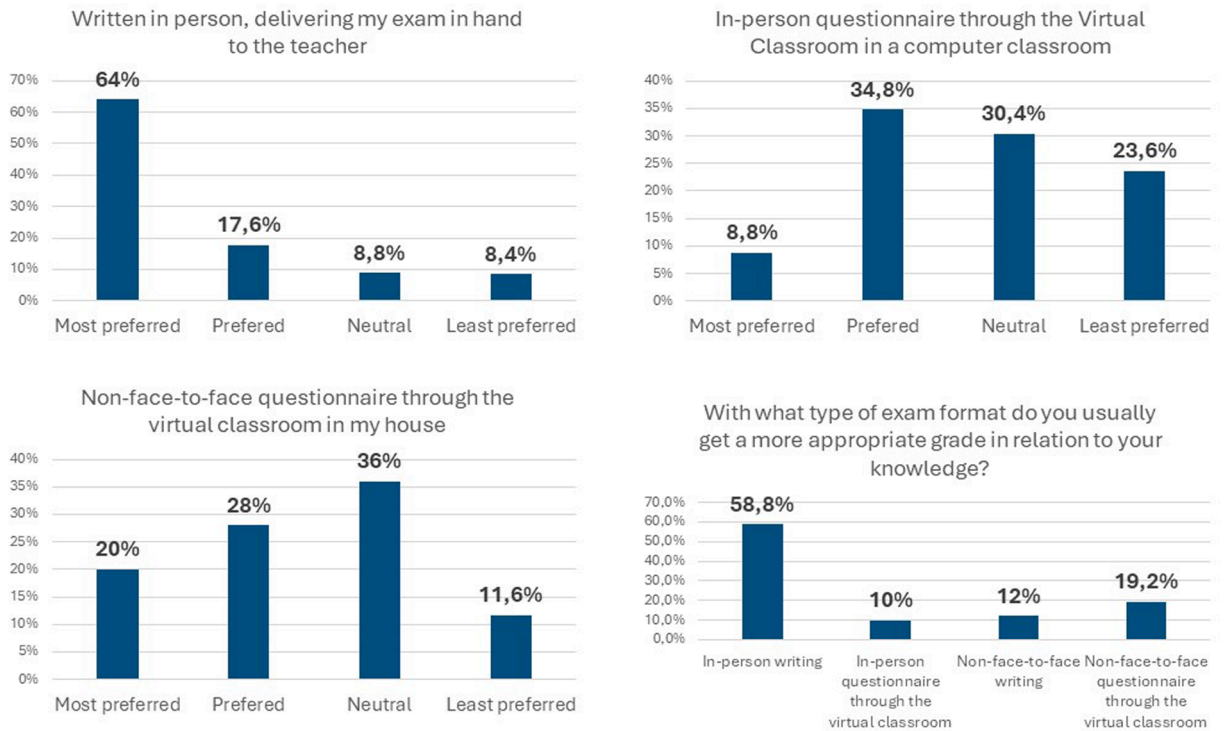


Fig. 3. Percentage of responses to exam type preferences.

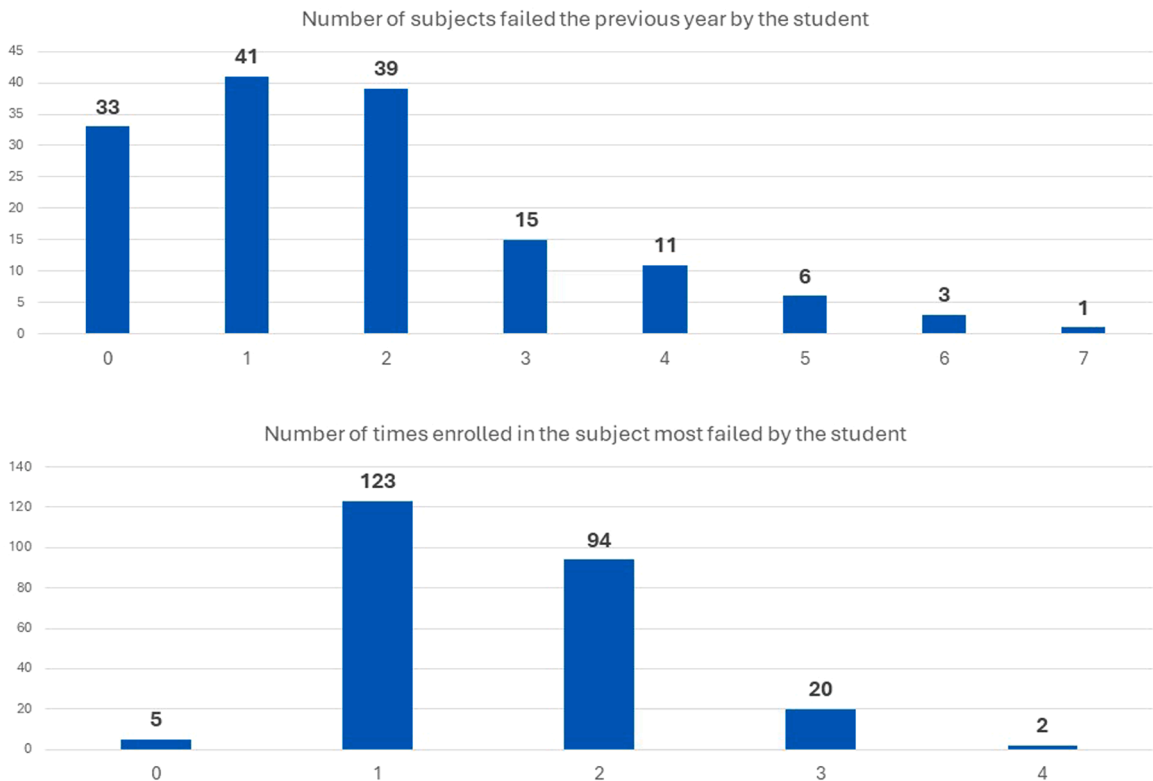


Fig. 4. Number of subjects failed the previous year and times enrolled in the subject most failed by the student.

### 3.3.1. Demographic anxiety prevalence

Among the participants, 64 % exhibited significant impairment based on the Goldberg scale. This prevalence was significantly higher in females compared to males, with 80.9 % versus 64.4 % respectively ( $p$ -value = 0.019,  $\chi^2_2 = 7.915$ ), see Fig. 5. Other demographic variables measured in the participating students did not have an impact on this anxious state.

### 3.3.2. Academic success anxiety prevalence

Significant differences were observed concerning the number of times students have had to retake the same subject and its association with the anxiety indicator ( $p$ -value = 0.046,  $\chi^2_8 = 9.684$ ). As the number of subject repetitions increased, a higher proportion of students exhibited significant alterations according to the Goldberg scale, see Fig. 6. Weird results are obtained when the number of times repetitions is four, but this is due to the lack of the number of students in this case, as only two students reported this situation.

No significant differences were found concerning the number of years enrolled in the degree courses ( $p$ -value = 0.614,  $\chi^2_8 = 2.672$ ) or self-perceived academic achievement ( $p$ -value = 0.426,  $\chi^2_8 = 3.854$ ).

### 3.3.3. Home conditions anxiety prevalence

Regarding home conditions, no significant differences were found in terms of home location within or outside the region of Madrid ( $p$ -value = 0.723,  $\chi^2_8 = 0.126$ ), home cohabitants ( $p$ -value = 0.266,  $\chi^2_8 = 8.83$ ), home cohabitants during the pandemic closure ( $p$ -value = 0.239,  $\chi^2_8 = 7.986$ ), house comfort perception ( $p$ -value = 0.077,  $\chi^2_8 = 8.423$ ), although these last results are close to the confidence boundary and should be interpreted cautiously. While the  $p$ -value suggests some evidence against the null hypothesis, it does not reach the conventional threshold of statistical significance (typically set at  $p < 0.05$ ). Therefore, we cannot confidently conclude that there is a true difference in house comfort perception among the participants based on the data analyzed. However, it's important to interpret these results with caution, considering that the  $p$ -value is close to the confidence boundary. Despite the lack of statistical significance, the observed trend towards differences in house comfort perception may still be meaningful in understanding students' living conditions and potential factors influencing their well-being. Further investigation or larger sample sizes may be warranted to confirm or refute this trend. Furthermore, no significant differences were found in terms of having a proper space for studying ( $p$ -value = 0.181,  $\chi^2_8 = 6.258$ ), using the studying place for different purposes ( $p$ -value = 0.563,  $\chi^2_8 = 2.69$ ), sharing the studying place ( $p$ -value = 0.385,  $\chi^2_8 = 4.161$ ), owning a laptop ( $p$ -value = 0.886,  $\chi^2_8 = 1.15$ ), and having a good internet connection ( $p$ -value = 0.403,  $\chi^2_8 = 4.02$ ).

However, significant differences were found concerning the home environment ( $p$ -value = 0.021,  $\chi^2_8 = 1.44$ ), indicating that a higher percentage of students exhibited significant disturbances according to the Goldberg scale when their home conditions were less peaceful, see Fig. 7.

### 3.3.4. Demographic stress prevalence

The stress indicator used in this study is based on a scale where higher values indicate a higher likelihood of experiencing illness within the next two years. The scale ranges from a minimum score of 7 points, corresponding to the response "Never" for the 7 questions involved, to a maximum score of 28 points, corresponding to the response "Almost always." In this study, we consider values above 14 points as indicating a moderate presence of potential stress symptoms and a significant probability of illness within the next two years, while scores above 21 points indicate a severe presence. Analysis revealed significant sex differences ( $p$ -value = 0.003,  $\chi^2_2 = 16.171$ ), with a higher percentage of females exhibiting severe stress levels compared to males, see Fig. 8.

### 3.3.5. Academic success stress prevalence

Significant differences were found in self-perceived academic achievement ( $p$ -value = 0.021,  $\chi^2_8 = 18.01$ ), with a higher percentage of students experiencing moderate or severe stress reporting a negative perception of their performance compared to students with more positive perceptions, see Fig. 9.

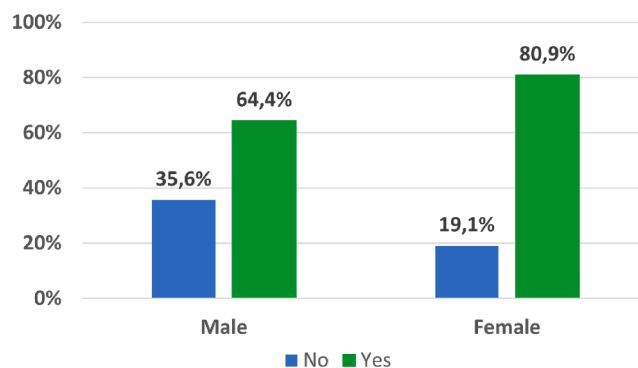


Fig. 5. Sex-based anxiety responses by Goldberg scale.



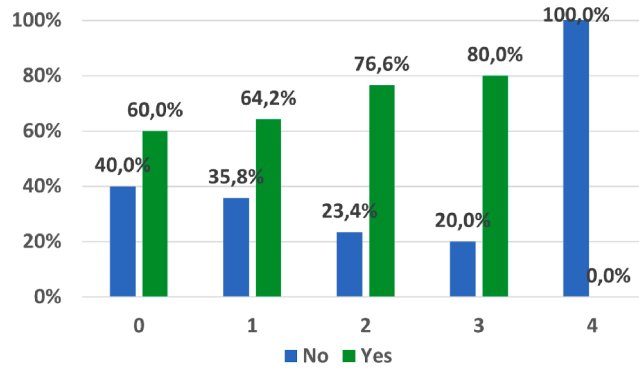


Fig. 6. Anxiety indicator based on the number of subject retakes.

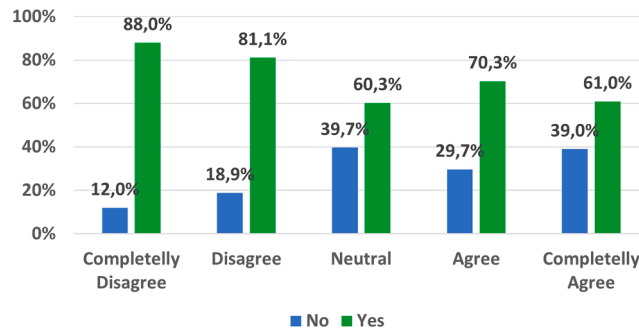


Fig. 7. Anxiety indicator by agreement level with “My house is very quiet and peaceful.”.

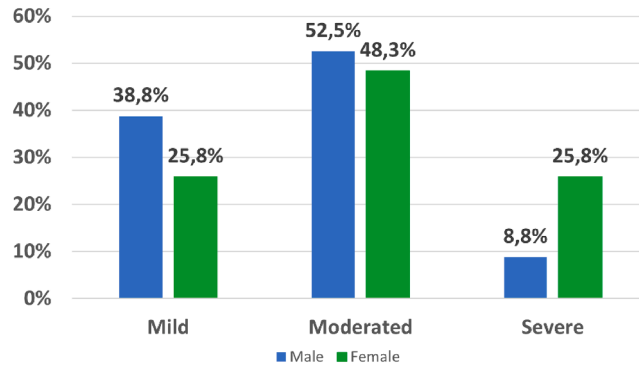


Fig. 8. Students' stress responses categorized by sex.

No significant differences were found concerning the maximum number of enrolled courses in relation to the stress indicator (p-value = 0.214,  $\chi^2_8 = 10.795$ ).

3.3.6. Home conditions stress prevalence

No significant differences were found concerning the home location either within or outside the region of Madrid (p-value = 0.672,  $\chi^2_8 = 0.795$ ), the presence of home cohabitants (p-value = 0.543,  $\chi^2_8 = 12.79$ ), the presence of home cohabitants during the pandemic closure (p-value = 0.68,  $\chi^2_8 = 9.27$ ) or the perception of house comfortableness (p-value = 0.109,  $\chi^2_8 = 13.086$ ). Additionally, no significant differences were found regarding the use of the studying place for different purposes (p-value = 0.383,  $\chi^2_8 = 8.53$ ), the sharing of the studying place (p-value = 0.773,  $\chi^2_8 = 4.856$ ), the possession of a personal laptop (p-value = 0.713,  $\chi^2_8 = 5.407$ ), and the availability of a good internet connection (p-value = 0.713,  $\chi^2_8 = 5.410$ ).

However, significant differences were found concerning the availability of proper space for studying (p-value = 0.018,  $\chi^2_8 = 18.457$ ), with a higher percentage of students experiencing severe stress who disagreed or strongly disagreed about having their own

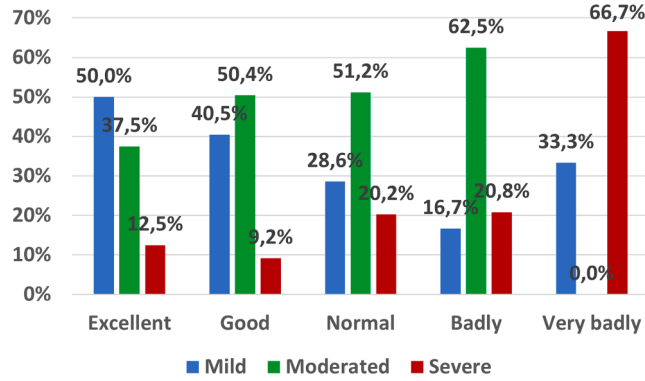


Fig. 9. Student stress responses by self-perceived academic achievement.

dedicated space. Additionally, significant differences were observed regarding the home environment ( $p$ -value  $\approx 0, \chi^2_8 = 38.316$ ), with a larger percentage of students experiencing severe stress when their home conditions were less peaceful, see Fig. 10.

3.3.7. Relationship between stress and anxiety indicators

A significant Spearman’s rank correlation, with a point estimate  $\rho = 0.33$ , and a 95 % confidence interval (0.223, 0.431), was observed between the anxiety and stress indicators.

House conditions seem to be a factor in anxiety and stress prevalence among students. Improving library accessibility to offer an alternative place for studying could be an option to reduce emotional pressure when facing written assessments. The face-to-face presence of the teacher during the written assessments also seemed to be an anxiety reductive, therefore is desirable the presence of the professor during the examination. Special attention must be given to repeater students, offering face-to-face tutorial classes, and contributing in such a way as to reduce their anxiety when facing written assessments. Negative perceptions of studying performance also affected the stress and anxiety levels, activities during the classroom, and additional tasks in difficult areas of the subject could positively favor this perception, engaging the students in more positive sensing related to the subject performance.

4. Prediction model

A generalized linear regression model, specifically within the binomial family (in particular the Bernoulli one, because the response variable is 0/1), was employed to assess the collective influence of various factors and covariates on students’ anxiety levels. This nonlinear equation can take diverse forms, contingent on the chosen family and link function Dobson and Barnett (2018). While the flexibility to specify various expectation functions is advantageous, it also necessitates considerable effort to determine the function that best fits the data. This requires additional research, familiarity with the subject area, and trial and error analysis. Furthermore, for nonlinear equations, understanding the impact of each predictor on the response can be less straightforward compared to linear equations.

After trying different models and links, and using the Akaike information criterion (AIC) as the model comparison statistic, the complementary log-log function (also known as ‘cloglog’) was selected as the link function, within the Bernoulli distribution. It is crucial to consider suitable random variables in the fitted models, given that the response variable indicates whether each student has anxiety or not, resulting in a binary variable taking values of either 0 or 1. In this model, the explanatory variables can be both quantitative and qualitative. Although the equation does not have an initial linear function, it can be transformed to resemble a linear one.

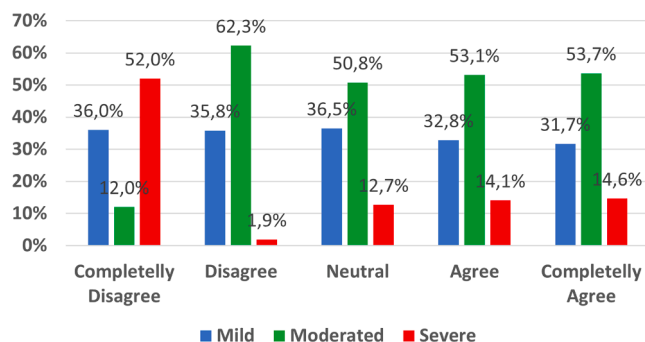


Fig. 10. Student stress responses based on home conditions.

Transforming the equation to appear as a linear one, despite its initial lack of a linear function, offers the advantage of simplifying the interpretation of the model and facilitating predictions based on the explanatory variables. The linear form of the equation makes it easier to understand the contribution of each explanatory variable to the response variable and to make predictions for new observations based on the values of the explanatory variables.

Several models were considered and compared using the AIC criterion. Starting with the full model and using a stepwise backward search, the selected model has an AIC of 244.24. The fitted model was also evaluated taking into account the overall test of the observed deviance of that model, which, if the model is correct, must be compatible with a  $\chi$  square distribution with the observed degrees of freedom, in this case, 231. The associated  $p$  value is 0.26, which means that the observed deviance is compatible with the theoretical  $\chi$  square distribution, indicating that the model appears to be compatible with the observed data. Also, the deviance residuals are in a reasonable range, between  $-2.26$  and  $1.99$ . Since the response variable is 0/1, it is not true that these residuals must have an approximately normal distribution, and then it may be necessary to rely on the aggregated goodness of fit statistics deviance or chi-squared.

The final fitted model (1) incorporated individual factors such as age, sex, and level of stress, as well as household factors including household resources, and academic factors such as the subject taken. This model aimed to predict the probability of a student experiencing an anxious state

$$\Pr(\text{Student } i \text{ anxious} = 1) = 1 - \exp(-\exp(2.602 + 0.132 \cdot SI_i + 0.339 \cdot G_i - 0.168 \cdot Age - 0.034 \cdot HR_i + 0.891 \cdot L_{1,i} - 0.524 \cdot L_{2,i} - 0.748 \cdot L_{3,i} - 0.734 \cdot L_{4,i} + 0.066 \cdot L_{5,i})) \tag{1}$$

The variables considered for each subject are as follows:  $SI$  (stress indicator), which ranges from 7 to 28;  $G$  (sex), taking the value 1 if the student is female and 0 otherwise;  $Age$  (age of the student in years), ranging from 17 to 27;  $HR$  (home resources), ranging from 16 to 43; and  $L_1$  (Mathematical Statistics),  $L_2$  (Affine Geometry),  $L_3$  (Discrete Mathematics),  $L_4$  (Mathematics II), and  $L_5$  (Mathematics III), the last five taking the value 1 if the student is enrolled in the corresponding subject and 0, otherwise.

The results indicate that stress level and sex have a significant positive impact on the probability of experiencing an anxious state. Higher scores on these variables are associated with a higher likelihood of anxiety. On the other hand, age and home resources have a negative influence, reducing the probability of anxiety in students. This suggests that better home conditions and older age act as protective factors against the manifestation of anxiety.

Furthermore, the subject in which the student is enrolled appears to be associated with anxiety levels. Specifically, students enrolled in Mathematical Statistics for the Mathematics degree show higher anxiety levels compared to the baseline level, which is represented by the subject of Statistics for engineering degrees. Additionally, Discrete Mathematics, Mathematics II, and Affine Geometry also contribute negatively to the probability of anxiety compared to the baseline level of the subject of Statistics for engineering degrees.

Table 2 shows the classification results obtained using the proposed model, with an overall accuracy of 71.4 % in correctly classifying the cases. It provides a means to evaluate the model’s performance by comparing the predicted values with the actual observed values. The analysis includes 241 classified students, while the remaining 9 students have missing values in some covariates.

For classification purposes, a default cut-off point of 0.5 has been applied to the predicted probabilities. Individuals with a calculated probability below 0.5 are classified as “Not anxious,” while those with a probability above 0.5 are classified as “Anxious.”

Table 3 displays the average probability of experiencing anxiety for selected values of the covariates. The first row represents the mean values of the quantitative variables, while the factors are set to the default level specified in the fitted model (i.e.,  $Sex = Male$  and  $Subject = Statistics$ ). Subsequent rows examine the effect of individual covariate changes while keeping the remaining variables at their default values from the first row. The quantitative variables ( $SI$ ,  $Age$ ,  $HR$ ) have been set to the third quartile, while each possible value has been considered for the factors. Notably, increasing from the mean to the third quartile in stress exhibits a similar impact as switching from male to female. The choice of subject significantly influences the predicted probability of anxiety, with Mathematical Statistics yielding the highest probability and Discrete Mathematics the lowest. Moreover, increasing household resources to the third quartile leads to a slightly greater reduction in the predicted probability of anxiety compared to increasing age.

In order to further enhance the understanding of the findings, Table 4 presents the influential factors affecting the likelihood of anxiety among undergraduate students. By highlighting variables including stress, sex, subject of study, age, and household resources, this study provides valuable insights for designing targeted interventions and support systems for students who are at higher risk of experiencing anxiety and depression disorders. Moreover, these findings call for a more comprehensive approach to education and mental health in universities, urging policymakers to consider the diverse social, academic, and demographic factors that impact student well-being.

Overall, the study indicates that there are specific factors that can contribute to anxiety levels among students, emphasizing the

**Table 2**  
Anxiety state classification with proposed model.

Anxiety	Predicted Anxiety		Correct percentage
	No	Yes	
No	30	42	41.6 %
Yes	27	142	84 %
Total	57	184	71.4 %

**Table 3**  
Variable contributions to anxiety probability.

Variables changing	SI	Sex	Age	HR	Subject	Pr(Anxiety = 1)
Initial typical values	15.89	Male	19.43	32.83	Statistics	0.747
SI → Q <sub>3</sub> (SI)	19	Male	19.43	32.83	Statistics	0.875
Sex → female	15.89	Female	19.43	32.83	Statistics	0.855
Age → Q <sub>3</sub> (Age)	15.89	Male	20	32.83	Statistics	0.714
HR → Q <sub>3</sub> (HR)	15.89	Male	19.43	37	Statistics	0.696
Subject → Math. Stat.	15.89	Male	19.43	32.83	Mathematical Statistics	0.965
Subject → Disc. Math.	15.89	Male	19.43	32.83	Discrete Mathematics	0.479
Subject → Math. II	15.89	Male	19.43	32.83	Mathematics II	0.557
Subject → Math. III	15.89	Male	19.43	32.83	Mathematics III	0.483

**Table 4**  
Variable contributions to anxious state probability.

Variables	Coeff.	Mode	Max	Prob.Min.	Prob.Max	Range	%
SI	0.132	19	28	0.483	1.000	0.517	27.72
G	0.339	1	1	0.899	1.000	0.101	5.42
Age	-0.168	19	27	0.989	0.098	-0.891	47.79
HR	-0.034	32	43	0.996	0.837	-0.159	8.53
L <sub>1</sub>	0.891	0	1	0.960	1.000	0.040	2.15
L <sub>2</sub>	-0.524	0	1	0.960	0.998	0.040	2.13
L <sub>3</sub>	-0.748	0	1	0.960	0.998	0.038	2.06
L <sub>4</sub>	-0.734	0	1	0.960	0.998	0.038	2.06
L <sub>5</sub>	0.066	0	1	0.960	1.000	0.040	2.15

importance of considering these factors in educational settings.

## 5. Discussion

In this paper, we examine the prevalence of anxiety among undergraduate students and its association with academic, demographic, and family factors, while also considering the impact of COVID-19. Our results reveal that students who faced the restrictive measures applied during the pandemic show high levels of mental health problems, particularly among students. The shift away from in-person instruction has disrupted traditional learning and evaluation methods in higher education, leading to heightened levels of stress and anxiety. These results underscore the importance of addressing these factors to mitigate the impact of mental health challenges on undergraduate students, particularly during times of crisis like the COVID-19 pandemic.

### 5.1. Study summary

Our results were obtained from a survey conducted among predominantly male first and second-year URJC students enrolled in an experimental degree. Just over half of the students hold a positive self-perception of their academic achievement, with an equal proportion having repeated only one subject. Some of them had to endure difficult personal situations during the pandemic, such as being infected and/or isolated or losing a family member.

The findings of this study have significant implications for assessing and addressing anxiety among students. By identifying the contributing factors, educators, families, and mental health professionals can gain a better understanding of students' needs and implement targeted interventions to support their mental well-being. The use of a logistic regression model provides a reliable and effective approach to evaluating the impact of various factors on anxiety, enabling the identification of areas where additional support or resources may be required. Moreover, the high classification rate of the model suggests its potential as a valuable screening tool for identifying students who may benefit from additional support or intervention.

The statistical analysis confirmed that women exhibit higher levels of stress compared to men and a higher prevalence of anxiety. It is important to note that these findings should be considered within the context of predominantly male students in experimental degree programs. However, the predictive multivariate model for the probability of experiencing an anxious state does not identify the condition of being a woman as a significant factor. Instead, the model emphasizes that younger age in students becomes a risk factor, heightening the likelihood of experiencing anxiety. Our results are in line with other studies, where females reported higher anxiety [Eisenberg et al. \(2007\)](#).

Undergraduate students generally reported comfortable home study conditions, with access to a computer and the Internet. However, a noteworthy proportion experiencing anxiety (88 %) did not perceive their home environment as calm or quiet. Additionally, 52 % of those lacking adequate study space reported severe stress levels. These findings underscore the impact of home study conditions on emotional well-being. Prioritizing home resources and the establishment of quiet, dedicated study spaces is recommended, especially for students dealing with anxiety or high-stress levels. Similar findings related to home environment were found in [Brougham et al., 2009; Stallman, 2010](#).

Regarding their academic experience during the pandemic, most of them had the necessary tools for online classes. However, a significant proportion showed reluctance to actively engage, preferring to use only the chat function, possibly due to a lack of dedicated study spaces at home. Anxiety prevalence increased with the number of subject failures. Similarly, two-thirds of those students who perceived their academic achievement poorly reported severe stress. While students generally had the necessary resources, active participation tended to decrease. As academic demands rise—as when enrolling in more challenging subjects—stress levels and anxiety prevalence also tend to increase.

The correlation between students' stress levels and the onset of anxiety ( $\rho = 0.33$ ) is noteworthy. In the predictive model, stress levels emerge as the most influential risk factor for the likelihood of experiencing anxiety. Notably, students without a calm home environment were more prone to anxiety compared to the general prevalence of stress, as also highlighted in (Brougham et al., 2009; Stallman, 2010).

These results have broader implications for addressing anxiety in educational settings and promoting the well-being and academic success of students. Specifically, considering the importance of age as an individual factor, particularly for students in their early years of university, it would be beneficial to provide them with online simulations to practice and review before examinations, as they may have limited experience with university evaluations. Additionally, students who face less favorable home environments due to limited resources or a high number of household members could benefit from access to study spaces in university libraries. By addressing these two factors, we can exert a certain level of control to mitigate the manifestation of anxiety in students.

## 5.2. Comparison with related studies

Our findings are consistent with previous research highlighting the impact of academic performance and home environment on student well-being. Studies have shown that academic stress is a major contributor to anxiety among students, and supportive home environments can mitigate this stress (Brougham et al., 2009; Stallman, 2010). The gender disparity in anxiety levels, with females reporting higher anxiety, has also been observed in other studies such as Eisenberg et al. (2007).

The adaptation to remote learning during the pandemic and the associated challenges have been widely reported. Research indicates that while remote learning provided continuity, it also posed challenges such as reduced engagement and increased stress (Adedoyin & Soykan, 2020; Garbe et al., 2020). Our findings support these observations and highlight the need for improved online learning strategies.

## 5.3. Theoretical implications

More studies should be conducted to address research gaps to help identify subgroups, such as those defined by gender, family conditions, or other factors, that may be disproportionately impacted by academic stress and lower well-being. Furthermore, dynamic models should be considered to detect trends and significant changes across different student cohorts.

A change in teaching models could be considered, integrating the results of this and other similar studies to better manage classroom emotional states. Personalized teaching models that consider subgroups of the population (gender, age, family situation, etc.) and promote the social integration of students in the classroom can positively impact students' academic success.

## 6. Conclusions and future research

This study contributes to the understanding of the multifaceted factors influencing student stress and anxiety, providing a comprehensive analysis of academic, environmental, and demographic variables. By identifying specific factors such as home resources and subject-specific anxiety, this research offers actionable insights for educational institutions to develop targeted interventions.

Our findings reveal a significant prevalence of anxiety among students, with a notable gender discrepancy indicating higher anxiety levels among female students compared to males. This underscores the necessity of tailored interventions to address the distinct challenges faced by female students in coping with academic stressors and fostering mental well-being. Additionally, our study investigates the impact of the COVID-19 pandemic on students' stress and anxiety levels, highlighting the disruptive effect of the shift away from in-person instruction on traditional learning and evaluation methods in higher education.

The predictive model developed in this study can serve as a tool for identifying students at risk of anxiety, enabling timely support and counseling. The high accuracy of the model (71.4 %) underscores its potential utility in educational settings.

By elucidating the relationship between academic, demographic, and family factors with stress and anxiety levels, our study provides valuable insights for educators, mental health professionals, and policymakers. These insights can inform the development of effective strategies and interventions aimed at mitigating the adverse effects of stress and anxiety on students' academic performance and overall well-being. In summary, our study offers actionable recommendations and guidelines for positive interventions to enhance student motivation and academic success. Understanding the underlying factors contributing to stress and anxiety among undergraduate students enables stakeholders to implement targeted interventions and create a more supportive learning environment. Other research, such as Wang and Xu (2023), highlights the importance of feedback in assessing language proficiency and stresses the literacy required to deliver effective feedback during assessments. This reveals several implications for EFL teachers, assessors, and teacher educators, enabling them to deepen their comprehension of writing assessment feedback literacy and its diverse components.

### 6.1. Study limitations

Limitations of this study include not having considered students from other knowledge areas such as arts, health sciences, and social sciences, where the student profile may be an additional factor to account for.

### 6.2. Future research lines

In exploring prospective avenues for research within teacher-related domains, Zhang et al. (2023) highlight that the emotional states of teachers, particularly their levels of work engagement and emotional resilience, serve as robust predictors of their professional growth. This underscores the critical role emotional factors play in educational contexts, especially when teachers face the myriad challenges and pressures inherent in their profession. On a different note, Yang and Wang (2024) shed light on the significant impact of technophobia among educators. This fear not only hinders teachers from embracing novel teaching approaches but also fosters a reluctance to adopt innovative educational technologies, as outlined by Yang and Wang (2024). In terms of statistical analysis, further exploration of mixed research methods and longitudinal studies should also be considered.

Another research area that should be explored is the academic engagement of students. Pedagogical insights, which can be developed from dimensions such as teacher-student relationships or teacher roles are discussed in Wang and Kruk (2024), where students' perception of the role of teacher's confirmation and credibility in enhancing their academic engagement is addressed. Additionally, Akram and Li (2024) investigate the complex interplay in higher education between teacher-student relationships, academic motivation, and online learning engagement.

### Ethics approval and consent to participate

All procedures were performed in compliance with relevant laws and institutional guidelines and have been approved by URJC's Ethics Committee.

### Author Agreement Statement

We the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us. We understand that the Corresponding Author is the sole contact for the Editorial process. He/she is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs.

### Funding

This work was partially supported by "Proyectos de innovación educativa de la URJC 2023–24".

### Author statement

The manuscript represents the results of original work. Each of the authors has read and concurs with the content in the final manuscript. The material within will not be submitted for publication elsewhere. If accepted, it will not be published elsewhere, including electronically in the same form, in English, or any other language, without the written consent of the copyright-holder.

The work also meets all Ethical Standards for the Reporting and Publishing of Scientific Information, has received the approval of an ethics committee, and follows the latest guidelines of Learning and Motivation (APA manual, edition VII).

### CRediT authorship contribution statement

**Javier Cano:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Claudia Córdoba:** Writing – original draft, Methodology, Investigation, Conceptualization. **Clara Simon de Blas:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sonia Hernández Alonso:** Methodology, Investigation, Data curation, Conceptualization. **María Eugenia Castellanos:** Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Karina Rojas:** Writing – original draft, Investigation, Data curation, Conceptualization. **Ana E. García Sipols:** Writing – original draft, Methodology, Investigation, Formal analysis.

### Declaration of Competing Interest

None.



## Acknowledgements

We would like to thank the referees for carefully reading our manuscript and for giving such constructive comments which substantially helped improve the quality of the paper.

## References

- American Psychiatric Association. (2000). *Manual Diagnóstico y Estadístico de los Trastornos Mentales* (4th edition). Barcelona: Masson.
2024. Our world in data. (<https://ourworldindata.org/>) Accessed June 1, 2024.
- Adedoyin, O. B., & Soykan, E. (2020). Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments*, 31(2), 863–875. <https://doi.org/10.1080/10494820.2020.1813180>
- Akram, H., & Li, S. (2024). Understanding the role of teacher-student relationships in students' online learning engagement: Mediating role of academic motivation. *Perceptual and Motor Skills*, 131(4), 1415–1438. <https://doi.org/10.1177/00315125241248709>
- Brougham, R. R., Zail, C. M., Mendoza, C. M., et al. (2009). Stress, sex differences, and coping strategies among college students. *Current psychology*, 28, 85–97. <https://doi.org/10.1007/s12144-009-9047-0>
- Cabezas-Heredia, E., Delgado-Altamirano, J., Molina-Granja, F., & Ruiz-Duarte, D. (2021a). Computer, teleworking and Covid-19 syndrome in undergraduate and postgraduate students. *Natural Volatiles & Essential Oils*, 8(6), 5229–5242.
- Cabezas-Heredia, E., Herrera-Chávez, R., Ricaurte-Ortiz, P., & NovilloYahuarshungo, C. (2021b). Depresión, Ansiedad, estrés en estudiantes y docentes: Análisis a partir del Covid 19. *Revista Venezolana De Gerencia*, 26(94), 603–622. <https://doi.org/10.52080/rvgluzv26n94.9>
- Chacón, E., Xatruch, D., Fernández, M., & Murillo, R. (2021). Generalidades sobre el trastorno de ansiedad. *Cúpula*, 35(1), 23–36.
- Derakhshan, A., Wang, Y., Wang, Y., & Ortega-Martín, J. L. (2023). Towards innovative research approaches to investigating the role of emotional variables in promoting language teachers' and learners' mental health. *International Journal of Mental Health Promotion*, 25(7), 823–832. <https://doi.org/10.32604/ijmh.2023.029877>
- Díaz-Jiménez, R. M., Caravaca-Sánchez, F., Martín-Cano, M. C., & De la Fuente-Robles, Y. M. (2020). Anxiety levels among social work students during the COVID-19 lockdown in Spain. *Social Work in Health Care*, 59(9–10), 681–693. <https://doi.org/10.1080/00981389.2020.1859044>
- Dobson, A. J., & Barnett, A. G. (2018). *An Introduction to Generalized Linear Models* (4th Edition). Chapman and Hall/CRC. <https://doi.org/10.1201/9781315182780>
- Eisenberg, D., Gollust, S. E., Golberstein, E., & Hefner, J. L. (2007). Prevalence and correlates of depression, anxiety, and suicidality among university students. *The American journal of orthopsychiatry*, 77(4), 534–542. <https://doi.org/10.1037/0002-9432.77.4.534>
- Garbe, A., Ogurlu, U., Logan, N., & Cook, P. (2020). COVID-19 and Remote Learning: Experiences of Parents with Children during the Pandemic. *American Journal of Qualitative Research*, 4(3), 45–65. <https://doi.org/10.29333/ajqr/8471>
- Goldberg, D., Bridges, K., Duncan-Jones, P., & Grayson, D. (1988). Detecting anxiety and depression in general medical settings. *BMJ (Clinical research ed.)*, 297(6653), 897–899. <https://doi.org/10.1136/bmj.297.6653.897>
- González-Sanguino, C., Ausín, B., Castellanos, M.Á., Saiz, J., López-Gómez, A., Ugidos, C., & Muñoz, M. (2020). Mental health consequences during the initial stage of the 2020 Coronavirus pandemic (COVID-19) in Spain. *Brain Behavior and Immunity*, 87, 172–176. <https://doi.org/10.1016/j.bbi.2020.05.040>
- Holmes, T. H., & Rahe, R. H. (1967). The social readjustment rating scale. *J Psychosomatic Research*, 11(2), 213–218. [https://doi.org/10.1016/0022-3999\(67\)90010-4](https://doi.org/10.1016/0022-3999(67)90010-4)
- Kang, D., & Park, M. J. (2022). Interaction and online courses for satisfactory university learning during the covid-19 pandemic. *The International Journal of Management Education*, 20(3), Article 100678. <https://doi.org/10.1016/j.ijme.2022.100678>
- King, F. D., & Kabat-Farr, D. (2022). Student stress in focus: Short-term fixes and long-term pedagogical change in business school curriculum. *The International Journal of Management Education*, 20(1), Article 100605. <https://doi.org/10.1016/j.ijme.2022.100605>
- Li, S., Wu, H., & Wang, Y. (2024). Positive emotions, self-regulatory capacity, and efl performance in chinese senior high school students. *Acta Psychologica*, 243, 1–6. <https://doi.org/10.1016/j.actpsy.2024.104143>
- Marcén-Román, Y., Gasch-Gallen, A., Vela Martín de la Mota, I. I., Calatayud, E., Gómez-Soria, I., & Rodríguez-Roca, B. (2021). Stress perceived by university health sciences students, 1 year after COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 18(10), 5233. <https://doi.org/10.3390/ijerph18105233>
- Marco-Ahulló, A., Villarrasa-Sapiña, I., & Monfort-Torres, G. (2022). Estudio descriptivo sobre las diferencias de género en el estrés académico derivado del contexto COVID-19 en población universitaria española (Descriptive study on gender differences in academic stress derived from the COVID-19 context in a Spanish unive. *Retos*, 43, 845–851. <https://doi.org/10.47197/retos.v43i0.88968>
- Marques, G., Drissi, N., Diez, I. T., de Abajo, B. S., & Ouhbi, S. (2021). Impact of COVID-19 on the psychological health of university students in Spain and their attitudes toward Mobile mental health solutions. *International Journal of Medical Informatics*, 147, Article 104369. <https://doi.org/10.1016/j.ijmedinf.2020.104369>
- Morales-Rodríguez, F. M. (2021). Fear, stress, resilience and coping strategies during COVID-19 in Spanish university students. *Sustainability*, 13(11), 5824. <https://doi.org/10.3390/su13115824>
- Morales-Rodríguez, F. M., & Pérez-Mármol, J. M. (2019). The role of anxiety, coping strategies, and emotional intelligence on general perceived self-efficacy in university students. *Frontiers in Psychology*, 10, 1689. <https://doi.org/10.3389/fpsyg.2019.01689>
- Nunnally, J. C., & Bernstein, I. H. (1994). The assessment of reliability. *Psychometric Theory*, 3, 248–292.
- Odrizola-González, P., Planchuelo-Gómez, A., Irujo, M. J., & de Luis-García, R. (2020). Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. *Psychiatry Research*, 290, Article 113108. <https://doi.org/10.1016/j.psychres.2020.113108>
- Ozamiz-Etxebarria, N., Dosal-Santamaria, M., Picaza-Gorrochategui, M., & Idoiaga-Mondragon, N. (2020a). Stress, anxiety, and depression levels in the initial stage of the COVID-19 outbreak in a population sample in the northern Spain. Niveles de estrés, ansiedad y depresión en la primera fase del brote del COVID-19 en una muestra recogida en el norte de España. *Cadernos de saude publica*, 36(4), Article e00054020. <https://doi.org/10.1590/0102-311X00054020>
- Ozamiz-Etxebarria, N., Santa María, M. D., Munitis, A. E., & Gorrotxategui, M. P. (2020b). Reduction of COVID-19 anxiety levels through relaxation techniques: A study carried out in Northern Spain on a sample of Young University Students. *Frontiers in psychology*, 11, 2038. <https://doi.org/10.3389/fpsyg.2020.02038>
- Pan, Z., Wang, Y., & Derakhshan, A. (2023). Unpacking Chinese EFL Students' academic engagement and psychological well-being: The roles of language Teachers' affective scaffolding. *J Psycholinguist Res*, 52, 1799–1819. <https://doi.org/10.1007/s10936-023-09974-z>
- R Core Team (2021). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.
- Ramón-Arbués, E., Gea-Caballero, V., Granada-López, J. M., Juárez-Vela, R., Pellicer-García, B., & Antón-Solanas, I. (2020). The prevalence of depression, anxiety and stress and their associated factors in college students. *International Journal of Environmental Research and Public Health*, 17(19), 7001. <https://doi.org/10.3390/ijerph17197001>
- Rodríguez-Besteiro, S., Tornero-Aguilera, J. F., Fernández-Lucas, J., & Clemente-Suárez, V. J. (2021). Gender differences in the COVID-19 pandemic risk perception, psychology, and behaviors of Spanish University students. *International Journal of Environmental Research and Public Health*, 18(8), 3908. <https://doi.org/10.3390/ijerph18083908>
- Rodríguez-Rey, R., Garrido-Hernansaiz, H., & Collado, S. (2020). Psychological impact of COVID-19 in Spain: Early data report. *Psychological Trauma: Theory, Research Practice and Policy*, 12(5), 550–552. <https://doi.org/10.1037/tra0000943>
- Sanford, D. (2017). Course format and learning: The moderating role of overall academic performance. *The International Journal of Management Education*, 15(3), 490–500. <https://doi.org/10.1016/j.ijme.2017.08.003>
- Saunders, R. (2014). Improving student performance through enhanced feedback. *The International Journal of Management Education*, 12(2), 167–176. <https://doi.org/10.1016/j.ijme.2013.02.003>

- Schneiderman, N., Ironson, G., & Siegel, S. D. (2005). Stress and health: Psychological, behavioral, and biological determinants. *Annual review of clinical psychology*, 1, 607–628. <https://doi.org/10.1146/annurev.clinpsy.1.102803.144141>
- Stallman, H. M. (2010). Psychological distress in university students: A comparison with general population data. *Australian Psychologist*, 45(4), 249–257. <https://doi.org/10.1080/00050067.2010.482109>
- Vivanco Vidal, A., Saroli Aranibar, D., Caycho Rodríguez, T., Carbajal León, C., & Noé Grijalva, M. (2020). Ansiedad por Covid-19 y salud mental en estudiantes universitarios. *Revista de Investigación en Psicología*, 23(2), 197–215.
- Wang, Y., Derakhshan, A., Pan, Z., & Ghiasvand, F. (2023a). Chinese efl teachers' writing assessment feedback literacy: A scale development and validation study. *Assessing Writing*, 56, 1–16. <https://doi.org/10.1016/j.asw.2023.100726>
- Wang, Y., Derakhshan, A., & Zhang, L. J. (2021). Researching and practicing positive psychology in second/foreign language learning and teaching: The past, current status and future directions. *Frontiers in psychology*, 12, Article 731721. <https://doi.org/10.3389/fpsyg.2021.731721>
- Wang, Y., & Kruk, M. (2024). Modeling the interaction between teacher credibility, teacher confirmation, and English major students' academic engagement: A sequential mixed-methods approach. *Studies in Second Language Learning and Teaching*, 14(2), 235–265. <https://doi.org/10.14746/ssllt.38418>
- Wang, Y. S., Xin, Y. H., & Chen, L. M. (2024). Navigating the emotional landscape: Insights into resilience, engagement, and burnout among chinese high school english as a foreign language learners. *Learning and Motivation*, 86, Article 101978. <https://doi.org/10.1016/j.lmot.2024.101978>
- Wang, Y., & Xu, J. (2023). A latent profile analysis of L2 writing emotions and their relations to writing buoyancy, motivation and proficiency. *Applied Linguistics Review*. <https://doi.org/10.1515/applirev-2022-0080>
- WHO (2024). (<https://www.who.int/es>). Accessed June 1, 2024.
- Wu, H., Wang, Y., & Wang, Y. (2024). How burnout, resilience, and engagement interplay among EFL learners? A mixed-methods investigation in the Chinese senior high school context. *Porta Linguarum An International Journal of Foreign Language Teaching and Learning*, (IX), 193–213. <https://doi.org/10.30827/portalin.viIX.29878>
- Yang, L., & Wang, J. (2024). Exploring the causes, consequences, and solutions of EFL Teachers' perceived technophobia. *Asia-Pacific Educational Research*, 33, 931–942. <https://doi.org/10.1007/s40299-023-00780-8>
- Zhang, X., Yang, L., & ProiettiErgün, A. L. (2023). Exploring the predictive power of EFL teachers' work engagement and buoyancy in their professional development. *Porta Linguarum An International Journal of Foreign Language Teaching and Learning*, 159–176. <https://doi.org/10.30827/portalin.vi2023c.29634>