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MATHEMATICS ANXIETY AND ITS EFFECTS ON ENGINEERING STUDENTS' PERFORMANCE DURING THE COVID 19 PANDEMIC

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Abstract

The research objective was to describe the levels of anxiety and their effects on performance manifested by the mathematics students of the engineering faculty of the National University of Chimborazo UNACH during the 2020-1 academic semester. The study is in the quantitative paradigm with a descriptive exploratory design. The total sample consisted of 120 students studying mathematics, which are at different levels and careers of the engineering faculty. The sample selection was of an intentional non-probabilistic type and had as inclusion criteria not having been diagnosed with an anxiety disorder. The Brief Anxiety Situations and Responses Inventory was applied (ASRI-B). The ASRI-B was sent to students by email to facilitate data collection. The two-factor ANOVA (mathematics and comprehension) uses to analyze the research results. It's allowed to find statistically significant differences in the grasp of the contents presented by the teachers in a virtual way for the cognitive and physiological response system and the general level of anxiety, as well as in situational areas of evaluation anxiety and anxiety in everyday situations, during the academic closure in the quarantine season due to the COVID-19 pandemic.

Keywords: University Education, Mathematics Anxiety, Quantitative Research, Ecuador

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan tingkat kecemasan dan pengaruhnya terhadap kinerja mahasiswa yang dimanifestasikan oleh mahasiswa matematika di Fakultas Teknik National University of Chimborazo UNACH pada tahun ajaran akademik 2020-1. Penelitian ini menggunakan paradigma kuantitatif dengan desain eksplorasi deskriptif. Total sampel berjumlah 120 mahasiswa yang belajar matematika pada tingkat dan jurusan yang berbeda di Fakultas Teknik. Pemilihan sampel menggunakan tipe non-probabilistik yang didisain dan memiliki kriteria inklusi yang tidak didiagnosis dengan gangguan kecemasan. Inventarisasi Situasi dan Tanggapan Kecemasan Singkat diterapkan (ASRI-B). ASRI-B diberikan ke siswa melalui email untuk memudahkan pengumpulan data. ANOVA dua faktor (matematika dan pemahaman) digunakan untuk menganalisis hasil penelitian. Hasil uji analisis ini menunjukkan bahwa terdapat perbedaan yang signifikan secara statistik dalam pemahaman konten yang disajikan oleh guru secara virtual untuk sistem respons kognitif dan fisiologis dan tingkat kecemasan umum, serta di bidang situasional evaluasi kecemasan dan kecemasan dalam situasi sehari-hari, selama penutupan akademik di musim karantina karena pandemi COVID-19.

Kata kunci: Pendidikan Universitas, Kecemasan Matematika, Penelitian kuantitatif, Ekuador

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The fact of living implies an interdependence with the environment in which life develops. It is lived as a process of development of powers in a specific environment that qualifies, conditions, modifies the original being. These circumstances make it necessary to maintain an adaptive tension that adapts the actions to the environment in which they develop, based on the individual's own characteristics. Precisely, this nuclear presence within human reactions has caused anxiety to be a source of interest for

many researchers belonging to the most diverse schools: and, consequently, that their concept lacks absolute precision as it has been approached from such different perspectives (Podkhodova et al., 2020). Therefore, it is necessary to clarify its true meaning and correspondence in university mathematics.

Simplistically, anxiety can be considered as a state of restlessness of the individual according to Mohammed and Mudhsh (2021). At the university level, learning mathematics has been one of the main columns on which the educational system in Ecuador rests, which can be easily verified through academic plans and curricula in all engineering majors. In engineering schools, it is considered legendary math difficulty (Prahmana et al., 2019; Liu et al., 2020). This difficulty has been incorporated into the Ecuadorian culture and idiosyncrasy from an early age. Through various studies, interviews, questionnaires among others, to students, it has been defined that mathematical anxiety originates in homes (Mendoza, La Madriz et al., 2018).

These beliefs are based on the Pygmalion effect of Islam et al. (2020), this effect is generated in a coherent relationship between the negative attitude of students towards mathematics and the result they obtain. That is, a series of negative comments about mathematics (Viseu, Martins & Leite, 2020). Negative comments can result in this fear of failure becoming a reality, resulting in a vicious circle, as students fear mathematics, so they resist it and fail. That is, they fail because they fear and resist it.

Since March 14, 2020, in the Republic of Ecuador a national quarantine decree was issued, as a preventive measure to prevent the spread of the Covid-19 virus. All universities went from face-to-face mode to online mode. The authors of the research present a study that aims to describe the levels of anxiety and its effects manifested by mathematics students of the Faculty of Engineering of the National University of Chimborazo UNACH during the academic semester 2020-1. Engineering students are investigated because they have the highest number of hours in mathematics. In comparison to the other faculties (social sciences, medicine, education) that only see a topic or two of basic mathematics.) To develop the study, the following theoretical contributions from different authors related to the research topic are presented as follows.

Anxiety

Anxiety is an emotional state that appears in normal life circumstances and is inseparable for human survival (AL-Shahrani & Abdullah, 2021; LeDoux, 2003). Certain circumstances can be evaluated by the person in an uncertain way, reaching the possibility of predicting negative or threatening consequences for personal interests. From then on, a process of preparation for action starts from the activation of the body's own cognitive, physiological, behavioral systems (Santamaría et al., 2021; Cano-Vindel et al., 2011; Prahmana et al., 2019). This state of activation tries to optimize the person's response to the situation.

However, the emotional response of anxiety is not always adaptive because on many occasions situations that are evaluated as possible threats in a wrong way tend to occur. In some individuals the activation of the anxiety system occurs without having reasons to do so. In other cases, the perception

of threat occurs at maximized levels, causing very intense emotional activations that usually produce deficiencies in performance, mental health problems (for example, anxiety disorders) and physical (for example, psychophysiological disorders due to excess activation) (Cano-Vindel et al., 2011). Likewise, the chronification of anxiety states can initiate long-lasting and disabling psychopathological disorders (Schwartz et al., 2021; Lee et al., 2021; Johnston et al., 2021).

The Types of Anxiety: Anxiety and Fear

Anxiety can be summarized as an emotion close to fear or as a subtype of fear. One of the criteria to differentiate 'anxiety' and 'fear' is proportionality. According to this estimation key, fear would be a more proportionate reaction to real danger than anxiety. Be it as indicated by Ozamiz, Berasategi et al. (2021) and Melda et al. (2021) that 'anxiety' and 'fear' are synonymous in most cases, although in the psychological literature they find a preference for one term or another based on the "real dangerousness of the stimulus" This weighing, on the other hand, is highly complex, since personal reaction depends more on subjective perception than on objective threat.

The word 'fear' should be reserved to designate the emotional reaction of fear to a concrete, real and precise danger (Zukhra et al., 2021). The term 'anxiety', on the other hand, refers to fear that is experienced in an indeterminate way, without the presence of an object. Fear is the trimeric state of the object and anxiety of the subject

Anxiety, Stress, and Distress

There are authors who differentiate between anguish and anxiety. Broadly speaking, anxiety would be the emotional state characterized by awe, inhibition, the predominance of somatic and visceral symptoms, while anxiety is distinguished by startle, restlessness, and greater psychic richness. For Islam (2019), nowadays when speaking of anxiety, reference is made to both psychological or cognitive symptoms and physical and behavioral symptoms, which are attributed with preference to anguish. Today, rather, both concepts are separated according to psychological guidelines. The term 'anxiety' is used above all by scientific psychology and the term 'anguish' by humanistic psychology and psychoanalysis.

There are many common elements between anxiety and stress, which makes them especially difficult to differentiate. The term 'anxiety' refers to the inner experience of uneasiness and uneasiness devoid of object. In anxiety fear is diffuse, vague. The term 'stress', on the other hand, can be reserved to designate the emotional overload that is produced by a prolonged external force that puts the subject on the brink of exhaustion (Delima & Cahyawati, 2021).

Arousal is the body's reaction to any form of intense stimulation. It is the general level of activation, common to the different emotions. Manapa (2021) define the arousal as a general physiological and psychological activation of the organism, variable along a continuum that goes from deep sleep to intense excitement. Anxiety, on the other hand, could be defined as the arousal caused

specifically by the perception of danger. The proximity of anxiety to other concepts, especially stress, complicates our claim to exclusively calibrate its presence in university students.

Nor can we ignore the comorbidity of anxiety with other disorders, such as depression. Ozamiz, Idoiaga et al. (2021) state that anxiety and depression frequently overlap, in such a way that in practice it is not unusual to observe depressions with a great load of anxiety or anxiety pictures clouded with depressive symptoms. In any case, the conditions to indicate that the main anxiogenic sources in students are the competitive academic environment, the technicalities in engineering, the overload of tasks, the lack of solid relationships with colleagues or teachers, the horizon of unemployment.

College Anxiety

Anxiety, as with depression, is one of the psychological disorders most registered in health centers in the general population and with a greater presence in the university environment (Cao et al., 2020). In the world of work, especially if there is exposure to risks of various kinds, including psychosocial risks (Priyanka et al., 2021), concern about problems of anxiety, stress and depression has spread, frequently resulting in sick leave. These disorders are not exclusive to workers. New demands, competitiveness, rapid changes and, of course, the economic crisis, especially in Ecuador, threaten the mental health of many university students. For example, in the unfortunate situation of unemployment, deeply anxious and dipsogenic, and which begins to be experienced before obtaining a university degree and looking for work. In a significant number of students, especially in the last years, there is a lot of fear of unemployment, which is also accompanied by tensions and conflicts, an expression of psychological discomfort.

Math Anxiety

According to Anggraeni et al. (2021) the terminology mathematical anxiety is used, sometimes, ambiguously, almost always with different meanings in each case. Based on this, according to Manapa (2021), math anxiety is rooted in a fear of meeting mathematics, which includes classes, homework, and tests. This conception is also based on the physiological studies carried out by Escalera-Chávez et al. (2016), who found important relationships between the manifestations associated with fear and those observed from the perspective of mathematics courses and exams.

BaoGuo and KahHeng (2021) has defined anxiety towards mathematics as the restlessness that students experience when they perform mathematical operations, as well as the anguish of failing an exam in this discipline. Huyen et al. (2021) describes mathematical anxiety as a feeling of nervousness that prevents the use of numbers, being able to solve mathematical operations in daily life, as well as in academic spaces. In this same sense, Lailiyah et al. (2021) specify Mathematical Anxiety (MA) as a state of restlessness caused by carrying out mathematical tasks and which is manifested through feelings of apprehension, aversion, tension, worry, frustration and fear, in addition to pointing out that environmental factors (negative experiences in class), intellectual (degree of thinking), and personality

(self-esteem, learning style, attitude and confidence) influence to generate this feeling in students and consequently they cannot develop their full capacity.

METHODS

The study is in the quantitative paradigm of descriptive exploratory design. According to Hernández and Mendoza (2018), the quantitative methodology is based on three axes, first in obtaining or collecting quantitative data, which are subsequently analyzed in a descriptive way, secondly a support or analytical contribution is developed through the search for information that complements the quantitative phase, finally its third axis consists of contrasting the results through the integration, interpretation and preparation of a final report or conclusion.

Population and Sample

Population defined by Erba et al. (2018) as a complete set of elements (people or objects) that have some common characteristic defined by the sampling criteria established by the researcher. For the purposes of the study, the population consisted of 259 students from the Faculty of Engineering at UNACH, Ecuador. In terms of gender, 139 males and 120 females. The sample represents the selected elements (people or objects) chosen to participate in a study; people are called subjects or participants (al-Kindy et al., 2016).

The total sample consisted of N = 120 mathematics students at different levels or semesters. In semester 0 they take basic mathematics and linear algebra. In semester 1 they take Calculus 10 and Analytic Geometry. In semester 2 they take Calculus 20 and Calculus of one variable. In semester 3 they take Calculus 30 and Calculus of several variables. In semester 4 they take Calculus 40 and Infinitesimal Calculus. In semester 5 they take Abstract Algebra. In semester 6: Didactics of Mathematics. In semester 7: Advanced Calculus. In semester 8 Advanced Calculus II. In semester 9 they take Applied Mathematics in Economics and Statistics in Research (See Table 1). The research sample was participatory and non-probabilistic. According to Cejas et al. (2021), an email invitation is sent to a specific population. Those who respond to the questionnaire are then considered as the study sample.

Table 1. Distribution of the participating population studying mathematics at the Faculty of Engineering of the UNACH during the period March-July 2020

		Faculty of Engineering careers UNACH																	
		Total population		**Electronic engineering**		**Systems engineering**		**Agro-industrial engineering**		**Environmental engineering**		**Civil engineering tourism**		**Management engineering**		**Industrial engineering**		**Participatory research sample**	
Gender		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Level of studies or semester	*0*	24	19	2	2	4	1	2	0	1	1	2	1	1	0	1	2	13	7
	1	16	16	0	2	1	1	0	1	1	2	0	2	2	1	0	3	4	12
	2	15	14	2	1	2	2	1	0	1	2	2	2	1	1	2	0	11	8
	3	17	13	1	1	3	2	3	1	2	0	3	1	0	1	0	1	12	7
	4	14	10	2	1	0	1	1	1	0	1	1	2	2	0	1	0	7	6
	5	16	12	0	0	2	2	0	1	1	1			1	1	0	2	4	7
	6	10	11	1	1	1	0	2	1							0	0	4	2
	7	9	9	1	1	1	2	1	1							1	1	4	5
	8	10	9	2	0	1	1											3	1
	9	8	7	1	1	1												2	1
		139	120															64	56
Total		259																120	

Data Collection Instrument

As a measurement instrument, the adaptation of the Inventory of Anxiety Situations and Responses-ASRI-B was applied. The ASRI-B was adapted to the activities and situations of mathematics. The questionnaire was sent to the students by email to facilitate data collection. The results were analyzed using a two-factor ANOVA (mathematics and comprehension). The ASRI-B; It was designed by Tobal and Cano (1994). This shortened version of the instrument was developed from items derived from the original ASRI (Tobal & Cano, 1986). The 24 items evaluate anxiety responses at the cognitive level (7 items, “I worry too much”, for example), physiological (10 items, “My hands or legs are shaking”, for example) and motor (7 items, "I move around and do things without a specific purpose", e.g.). Students must respond using a 5-position Likert scale.

The first option "Almost Never" with a value of "0", then the option "Few Times" with a value of "1". The option "Sometimes" with a value of "2". Then the option "Many times" with a value of "3" points, finally the option "Almost always" with a value of "4" points. These questions inquire about the existence of stressful events in recent months from March to July 2020, (during the Covid-19 quarantine), the level of perceived demand and the intensity of perceived stress (View Appendix).

Reliability of the Instruments

In samples of the student population, a pilot test was applied, directed to 5 students to measure the level of reliability of the instruments. Cronbach's Alpha statistical coefficient was used. The first

ASRI-B-C instrument resulted in 0.893, the ASRI-B-F instrument returned 0.931, the ASRI-B-M instrument returned 0.872. The results show that the instruments are reliable and safe in their application, having a value that ranges between 0.700 and 0.999 according to Mendoza, Gomez, and Gomez (2018). Once the test was selected, it was applied collectively in the first quarter of the 2020-1 academic year. The participants, after receiving the instructions, voluntarily agreed to fill out the questionnaire, anonymously.

Analysis of the Results

The data analysis includes a descriptive analysis on the anxiety variable measured with the ISRA, such as mean and standard deviation. Also, to assess possible differences in anxiety in the different groups (as a function of mathematics and comprehension). A two-factor ANOVA was applied, the independent variables being mathematics and comprehension. In other words, the sample was selected and then these two variables were measured in them. The data were processed using the Statistical Package for the Social Sciences (SPSS) version 25.

RESULTS AND DISCUSSION

Table 2 shows the descriptive analyzes, arithmetic means, and standard deviations separated by mathematics and comprehension for the response systems (cognitive, physiological, and motor) and general level of anxiety (A).

Table 2. Statistical results of the arithmetic mean and standard deviation of the mathematical factors and comprehension in the three response systems and the general level of anxiety (N = 120).

Answer system		**Factors**	
		Mathematics	**Comprehension**
Cognitive	$\bar{x}$	50.78	67.78
	SD	20.89	28.89
Physiologic	$\bar{x}$	34.26	41.85
	SD	21.03	21.40
Motor	$\bar{x}$	36.89	39.45
	SD	24.70	21.48
General anxiety level	$\bar{x}$	110.89	92.78
	SD	59.87	48.45

Table 3 shows the arithmetic mean and standard deviations for the specific anxiety-generating traits or situations (AI: evaluation anxiety, AII: phobic anxiety, AIII: mathematical anxiety and AIV: virtual anxiety).

Table 3. Arithmetic means and standard deviation of the different factors of the mathematical and comprehension sample in the four situational areas or specific traits (N = 120).

Situational areas or specific traits		Factors	
		Mathematics	**Comprehension**
AI	$\bar{X}$	60.47	75.56
	SD	34.58	30.48
AII	$\bar{X}$	34.89	28.12
	SD	24.37	17.70
AIII	$\bar{X}$	79.42	81.48
	SD	40.04	34.07
AIV	$\bar{X}$	87.14	90.10
	SD	45.07	51.47

Relationship between Mathematical Factors and Understanding in the Response System and Situational Factors

The analysis of variance on the three response systems Cognitive (C), Physiological (F) and Motor (M) and at the level of the general anxiety trait (A) presented significant differences in terms of understanding with the following values: in the system cognitive (F 3.614 = 13.43, p <0.001), in the physiological system (F 3.742 = 6.81 p = 0.014) and for the total or general trait (F 3.642 = 7.41, p = 0.029). However, there was no difference in anxiety between mathematics and understanding in the motor system. On the other hand, no statistically significant differences were revealed between both factors (See Table 4).

Table 4. Analysis of variance according to comprehension and mathematics in the three response systems and the general level of anxiety.

Dependent variables	**Variation Sources**	**Sum of squares**	***F***	***p***
Cognitive	Mathematics	11.01	0.1	0.902
	Comprehension	10548.47	13.04	0.001
Physiologic	Mathematics	3.30	0.1	0.931
	Comprehension	3197.14	6.17	0.123
Motor	Mathematics	3.40	0.01	0.924
	Comprehension	1519.18	2.10	0.117
General anxiety level	Mathematics	308.48	0.67	0.710
	Comprehension	39147.61	8.15	0.028

The analysis of variance carried out in the four specific traits or areas that generate anxiety (AI, AII, AIII and AIV), showed statistical differences in terms of mathematics, in evaluation situations (F 3.429 = 10.96, p = 0.001) and situations of everyday life (F 3.453 = 10.97, p = .01), with no differences in interpersonal or phobic situations. Nor were there significant differences based on mathematics (See Table 5).

Table 5. Analysis of variance according to understanding and mathematics in the four situational areas or specific traits.

Dependent variables	Variation Sources	Sum of squares	Quadratic Media	*F*	*p*
AI	Mathematics	356.45	356.45	0.310	0.527
	Comprehension	11020.14	11020.14	10.478	0.001
AII	Mathematics	123.47	123.47	0.145	0.245
	Comprehension	3456.45	3456.45	320.15	0.002
AIII	Mathematics	856.14	856.14	0.526	0.008
	Comprehension	24512.79	24512.79	21489.03	0.147
AIV	Mathematics	754.14	754.14	0.501	0.007
	Comprehension	19248.75	19248.75	20489.44	0.130

Note. AI: evaluation anxiety, AII: phobic anxiety, AIII: mathematical anxiety and AIV: virtual anxiety. P <0.05

Although the sources of variation are significant, post hoc rank tests allow us to determine which means differ (Allen, 2017). The research was only intended to identify that there is significant difference but not to identify homogeneous subsets of means that do not differ from each other. The purpose of post hoc tests is simply to compare the means of each pair of groups to identify where significant differences occur. Various multiple comparison methods exist for this purpose. They differ in the way they adjust the degree of significance obtained.

Anxious states, although frequent and normal, are associated with a wide variety of long-lasting and disabling psychopathological disorders (Cano-Vindel et al., 2011; Prahmana et al., 2021). An adequate evaluation of anxiety is a necessary requirement for the evaluation, diagnosis and planning of treatments adjusted to the characteristics of each participant of the test, thus enhancing their effectiveness and efficiency.

The ASRI-B is a reliable and valid instrument to assess anxiety in the three response systems - cognitive, physiological, and motor - in general, as well as in the four specific traits or situational areas of evaluation anxiety, phobic anxiety, anxiety math and virtual anxiety. According to Cano and Miguel, (1997) anxiety levels can be standardized according to the centile scores of the responses (See Table 6).

Table 6. ASRI-B classification table of anxiety levels according to dependent variables.

Situational factors	Scores/mean scores				Classification / level of anxiety
	AI	AII	AIII	AIV	
21-24					Extreme anxiety
16-20			18.04	16.14	Severe anxiety
11-15	12.87				Marked anxiety
6-10		8.45			Moderate anxiety
0-5					Absence of anxiety

After analyzing the results and placing them in the tables of anxiety levels, it can be observed that the highest levels are found in cognitive comprehension with an F = 13.04 followed by

physiological comprehension with an F = 6.17. (See Table 6). Regarding the levels of the situational areas, comprehension is found in the dependent variable virtual anxiety with an F = 20489.44. Then, understanding is found in the dependent variable mathematical anxiety with an F = 21489.03. These results in relation to the centile scores of responses with average level 18.08 of mathematical anxiety and 16.14 of virtual anxiety, demonstrate the drastic changes and secondary effects that virtual activities with prolonged distancing provide due to Covid-19 in engineering students from the UNACH.

It can be explained that the levels of anxiety and concern about digital interconnectivity are strong, according to Leurs and Smets (2018) students must always have a constant communication framework, this allows a balance between education and friendship. On the other hand, statistically significant differences were detected in terms of understanding. The statistical results indicated that there are differences in the cognitive response system (See Table 2). Demonstrating the need to improve virtual activities and have a better level of understanding in mathematical activities.

The lack of open, non-digital communication between students, for the exchange of ideas, opinions, homework, among others, generates a desire for communication. Faced with this situation, as Liu et al. (2020) and Zulkardi et al. (2020), early strategies are necessary for the prevention and treatment of the psychological effects that a pandemic such as COVID-19 can create. These results lead to the conclusion that, in the process of mathematical anxiety, the alternative explanation for these statistical behaviors is because the descriptors are related to each other in a limited way. Beliefs, attitudes, and emotions make up an inseparable triad, a harmonious whole in which it is not convenient to treat them as individual entities, since university students need your constant support to achieve surpassing future goals.

This research is not clinical but prospective. The exploration carried out, by no means infallible, aims to detect trends or clues that allow the extraction of basic psycho-pedagogical guidelines that guide the construction of healthy university environments at UNACH. Despite the caution of the research, one cannot help but be concerned about the "considerable number" of students in the sample with severe anxiety on the ISRA-B scale according to Cano and Miguel, (1997). In general, according to Kaya et al. (2021) and Mohammed and Mudhsh (2021), severe anxiety is related to individual, family, social and environmental factors. Among the individual factors of university students, there is limited ability to handle stressful events, lack and restriction of social skills due to Covid-19.

CONCLUSION

In the family environment, dysfunctionality seen in conflicts, violence, affective ambivalence, lack of love, lack of cohesion, insecurity and anomic/neglectful, authoritarian, or overprotective parenting style, the presence of a family member with Covid-19 disease, can increase anxiety. The greater the alteration of coexistence in the family, the more likely it is that the mental health of its members will deteriorate. Of course, the impact of the family climate on the development of an anxiety disorder depends on the young person's own personality, as well as the interpretation they make of what happened and their perceived ability to cope.

Among the social and environmental factors of Ecuadorian society, one must think of the general negative impact of economic and professional stress, often preceded by the university engineer. The situations of solitary confinement / isolation must also be considered, because of the transfer of residence of the young person or because of the difficulties of psychosocial adaptation at UNACH. Since March 14, many students have been isolated from their relatives and others from their friends, which increases the level of anxiety due to physical and emotional withdrawal.

Finally, among the limitations of this study, it can be noted that no sociodemographic questionnaire is used. The number of participants is moderate with only 120 students. In the sample, in addition, there is a disproportion between the number of women and men, explained by the existing asymmetry in the students who study the various engineering careers. Despite the limitations mentioned, the research carried out confirms the existence of severe anxiety in a significant part of the sample and may contribute to the promotion of anxiety preventive measures in the university setting of engineering students. In any case, it is advisable to carry out more research that does not suffer from the limitations and that, ultimately, favors the construction of healthy university environments that promote the teaching of mathematics in virtual mode.

REFERENCES

al-Kindy, A. M. Z., Shah, I. M., & Jusoh, A. (2016). Consideration and methodological approaches in studying transformational leadership impact on work performance behaviors. *International Journal of Advanced Research*, *4*(1), 889-907.

AL-Shahrani, & Abdullah M. (2021). Students' Anxiety during the COVID-19 Pandemic in Saudi Arabia. *Journal of Family Medicine and Primary Care*, *10*(9), 3192-3197. https://doi.org/10.4103/jfmpc.jfmpc_46_21

Allen, M. (2017). Post Hoc Tests. The sage encyclopedia of communication research methodss. Thousand Oaks. CA: SAGE Publications.

Anggraeni, S. W., Alpian, Y., & Kodariah, S. (2021). Primary School Students' Learning Anxiety during the COVID-19 Pandemic. *International Journal of Elementary Education*, *5*(1), 1-10. https://doi.org/10.23887/ijee.v5i1.33036

BaoGuo, A. & KahHeng, C. (2021). Emotional Status of MalaysianTeacherson Online Teaching during the COVID-19 Pandemic. *Turkish Journal of Computer and Mathematics Education*, *12*(14), 4727-4737. https://turcomat.org/index.php/turkbilmat/article/view/11409/8409

Cano-Vindel, A., Dongil-Collado, E., Salguero, J. & Wood, C. (2011). Intervención cognitivo-conductual en los trastornos de ansiedad: una actualización. *Información psicológica*, *102*, 4-27.

Cano, A. & Miguel, J. (1997). *Inventory of situations and responses of manual ISRA anxiety*. Madrid: TEA Editions.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry research*, *287*, 112934. https://doi.org/10.1016/j.psychres.2020.112934

Cejas, M. N., Martinez, M. F. C., Aldáz, S. H., & Velazco, D. J. M. (2021). The right to gender equality in tourism in the context of pandemic covid-19 in the canton riobamba, ecuador. *Journal of Environmental Management & Tourism*, *12*(6 (54)), 1495-1503.

Delima, N. & Cahyawati, D. (2021). Students' mathematics self-concept, mathematics anxiety, mathematics self-regulated learning during the Covid-19 pandemic. *Jurnal Pendidikan Matematika, 15*(2), 103-114. https://doi.org/10.22342/jpm.15.2.13200.103-114

Erba, J., Ternes, B., Bobkowski, P., Logan, T. & Liu, Y. (2018). Sampling Methods and Sample Populations in Quantitative Mass Communication Research Studies: A 15-Year Census of Six Journals. *Communication Research Reports, 35*(1), 42-47. https://doi.org/10.1080/08824096.2017.1362632

Escalera-Chávez, M., Moreno-García, E., García-Santillán, A. & Córdova-Rangel, A. (2016). Factors that promote the level of anxiety towards mathematics in upper middle-level students in the Rioverde San Luis Potosí region. *European Journal of Education Studies*, 2(1), 8-22. http://dx.doi.org/10.46827/ejes.v0i0.171

Hernández, R. & Mendoza, C. (2018). *Research methodology*. Mexico: Mc Graw Hill.

Huyen, L., Ngo, T., Nguyen, T., Thanh, T., Bao, T., Vinh, & Long, T. (2021). An Investigation of Mathematics Anxiety and Academic Coping Strategies Among High School Students in Vietnam: A CrossSectional Study. *Front. Educ. 6,7*42130. https://doi.org/10.3389/feduc.2021.742130

Islam, F. (2019). Psychological distress and its association with socio-demographic factors in a rural district in Bangladesh: A cross-sectional study. *PLoS ONE 14*(3), e0212765. https://doi.org/10.1371/journal.pone.0212765

Islam, M., Barna, S., Raihan, H., Khan, M. and Hossain, M. (2020). Depression and anxiety among university students during the COVID-19 pandemic in Bangladesh: A web-based crosssectional survey. *PLoS ONE 15*(8), e0238162. https://doi.org/10.1371/journal.pone.0238162

Johnston, S., Lee, C., & Mackrell, K. (2021). Addressing Mathematics Anxiety through Developing Resilience: Building on Self-Determination Theory. *Creative Education, 12*, 2098-2115. https://doi.org/10.4236/ce.2021.129161

Kaya, Y., Bostan, S., Kaya, A., Karaman, Ö., Karataş, A. and Dereli, S. (2021). Effect of COVID-19 pandemic on anxiety depression and intention to go to hospital in chronic patients. *Clinical practice, 75*, e14219. https://doi.org/10.1111/ijcp.14219

Lailiyah, S., Hayat, S., Urifah, S., & Setyawati, M. (2021). Levels of students' mathematics anxieties and the impacts on online mathematics learning. *Cakrawala Pendidikan, 40*(1), 107-119. https://doi.org/10.21831/cp.v40i1.36437

LeDoux, J. (2003). The emotional brain, fear, and the amygdala. *Cellular and Molecular Neurobiology, 23*(4-5), 727-738. https://doi.org/10.1023/A:1025048802629

Lee, J., Jeong, H., & Kim, S. (2021). Stress, Anxiety, and Depression Among Undergraduate Students during the COVID-19 Pandemic and their Use of Mental Health Services. *Innovative higher education*, 1–20. Advance online publication. https://doi.org/10.1007/s10755-021-09552-y

Leurs, K., & Smets, K. (2018). Five Questions for Digital Migration Studies: Learning from Digital Connectivity and Forced Migration In(to) Europe. *Social Media + Society*, 1-16. https://doi.org/10.1177/2056305118764425

Liu, S., Yang, L., Zhang, C., Xiang, Y. T., Liu, Z., Hu, S., & Zhang, B. (2020). Online mental health services in China during the COVID-19 outbreak. *The Lancet Psychiatry, 7*(4), e17-e18.

Manapa, I. (2021). Mathematics Anxiety Level of Pre-Service Elementary School Teachers During Online Learning in the Covid-19 Pandemic. *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang, 5*(2), 339-352. https://doi.org/10.31331/medivesveteran.v5i2.1720

Melda, R., Risma, M. & Masta, N. (2021). Prediction and Analysis of Mathematics Anxiety Disorders in Adolescents During the Pandemic. *Solid State Technology, 64*(2), 3042-3049.

Mendoza, D., Gomez, S., & Gomez, J. (2018). The emotional intelligence for the improvement of the teaching competences in the facilitators of the Universidad Iberoamericana del Ecuador. *Opción, 34*(18), 2018-2048.

Mendoza, D., La Madriz, J., López, M. & Ramón, V. (2018). Research Competencies of Higher-Education Teaching Staff Based on Emotional Intelligence. *Mediterranean Journal of Social Sciences, 9*(5), 41-52. https://doi.org/10.2478/mjss-2018-0137

Mohammed, G. & Mudhsh, B. (2021). The Effects of COVID-19 on EFL Learners' Anxiety at the University of Bisha. *Arab World English Journal (AWEJ) Special Issue on Covid 19 Challenges* (1), 209-221. https://dx.doi.org/10.24093/awej/covid.16

Ozamiz, N., Berasategi, N., Idoiaga, N. & Dosil, M. (2021). The Psychological State of Teachers During the COVID-19 Crisis: The Challenge of Returning to Face-to-Face Teaching. Front. *Psychol. 11*, 620718. https://doi.org/10.3389/fpsyg.2020.620718

Ozamiz, N., Idoiaga, N., Bueno, J., Pérez, M., & Santabárbara, J. (2021). Prevalence of Anxiety, Depression, and Stress among Teachers during the COVID-19 Pandemic: A Rapid Systematic Review with Meta-Analysis. *Brain sciences, 11*(9), 1172. https://doi.org/10.3390/brainsci11091172

Podkhodova, N., Snegurova, V., Stefanova, N., Triapitsyna, A., & Pisareva, S. (2020). Assessment of mathematics teachers' professional competence. *Journal on Mathematics Education, 11*(3), 477-500. https://doi.org/10.22342/jme.11.3.11848.477-500

Prahmana, R.C.I., Sutanti, T., & Diponegoro, A.M. (2021). Mathematics Anxiety and the Influencing Factors among Junior High School Students in Yogyakarta, Indonesia. *Croatian Journal of Education, 23*(2), 343-369. https://doi.org/10.15516/cje.v23i2.3890

Prahmana, R.C.I., Sutanti, T., Wibawa, A.P., & Diponegoro, A.M. (2019). Mathematical Anxiety among Engineering Students. *Infinity Journal, 8*(2), 179-188. https://doi.org/10.22460/infinity.v8i2.p179-188

Priyanka, H., Azizur, R. & Basant, A. (2021) A cross-sectional study of anxiety, stress, perception and mental health towards online learning of school children in India during COVID-19. *Journal of Interdisciplinary Mathematics, 24*(2), 411-424. https://doi.org/10.1080/09720502.2021.1889780

Santamaría, M. D., Mondragon, N. I., Santxo, N. B., & Ozamiz-Etxebarria, N. (2021). Teacher stress, anxiety and depression at the beginning of the academic year during the COVID-19 pandemic. *Global Mental Health, 8*, e14, 1-8, https://doi.org/10.1017/gmh.2021.14

Schwartz, K. D., Exner-Cortens, D., McMorris, C. A., Makarenko, E., Arnold, P., Van Bavel, M., Williams, S., & Canfield, R. (2021). COVID-19 and Student Well-Being: Stress and Mental Health during Return-to-School. *Canadian Journal of School Psychology, 36*(2), 166-185. https://doi.org/10.1177/08295735211001653

Tobal, M., & Cano, A. (1986). *Anxiety Situations and Response Inventory Manual - ISRA-*. Madrid: TEA.

Tobal, M., & Cano, A. (1994). *Brief Anxiety Situations and Responses Inventory–ISRA. B. Experimental version*. Madrid: TEA.

Viseu, F., Martins, P., & Leite, L. (2020). Prospective primary school teachers' activities when dealing with mathematics modelling tasks. *Journal on Mathematics Education, 11*(2), 301-318. https://doi.org/10.22342/jme.11.2.7946.301-318

Zukhra, R. M., Nauli, F. A., & Konadi, A. (2021). Anxiety among nursing students during the Covid-19 pandemic: A web-based cross-sectional survey. *Enfermería Clínica, 31*, 580-582. https://doi.org/10.1016/j.enfcli.2021.04.016

Zulkardi, Meryansumayeka, Putri, R.I.I, Alwi, Z., Nusantara, D., Ambarita, S., Maharani, Y., & Puspitasari, L. (2020). How students work with pisa-like mathematical tasks using covid-19 context. *Journal on Mathematics Education, 11*(3), 405-416. https://doi.org/10.22342/jme.11.3.12915.405-416

APPENDIX

Appendix 1. Instrument for measuring anxiety at a cognitive level applied to students studying mathematics in the engineering faculty of UNACH during the period March - July 2020

ASRI-B						C
Universidad Nacional de Chimborazo UNACH						Engineering Faculty
Last names and name:						
Age: Gender: Date:						Course:
On the next page you will find a series of sentences that present situations in which you could find yourself and others that refer to responses that you could give to those situations or reactions that they would produce. The 10 situations are numbered on the left side of the page. Your task is to rate from 0 to 4 (0 the lowest frequency and 4 the highest frequency), each of the following situations or reaction level you are considering.						
Items	Situations	Situations				
		1. I get confused and do not know what to do	2. I have the impression that I am useless	3. I cannot concentrate on the lesson	4. I have difficulty sleeping	5. I lose my appetite
1	If a math problem worries me too much					
2	When I lose my math homework.					
3	If my computer or mobile phone is damaged.					
4	When I do not have internet and I cannot enter the virtual class.					
5	Not understanding the math lesson					
6	When I finish my homework and am free from activities.					
7	No matter how much, I study math is always difficult for me					

Appendix 2. An anxiety measurement instrument at the physiological level applied to students who study mathematics at the engineering faculty of UNACH during the period March - July 2020

ASRI-B	F
Universidad Nacional de Chimborazo UNACH	Engineering Faculty
Last names and name:	
Age: Gender: Age:	Course:

On the next page you will find a series of sentences that present situations in which you could find yourself and others that refer to responses that you could give to those situations or reactions that they would produce.
The 10 situations are numbered on the left side of the page.
Your task is to rate from 0 to 4 (0 the lowest frequency and 4 the highest frequency), each of the following situations or reaction level you are considering.
Situation:
1. I feel discomfort in my stomach / 2. My hands or other part of my body sweat, until I feel cold/
3. My hands or legs are shaking / 4. My head hurts / 5. My body is in tension/
6. I have very frequent heart palpitations / 7. I am short of breath and my breathing is sharp/
8. I feel nauseous or dizzy / 9. My mouth is dry, I have difficulty swallowing / 10. I have chills

Items	Situations	Situations									
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1	I tend to abandon a math problem that seems too difficult or too long										
2	When deciding or solving a difficult algebraic problem.										
3	When someone bothers me or when I argue.										
4	When I am observed, when I receive criticism, or whenever I can be negatively evaluated.										
5	If I must speak in public.										
6	After having made a mistake and was already sent to the teacher's platform.										
7	When I think about my future as an engineer or future difficulties and problems.										
8	When being in my house closed or closed spaces										
9	When watching violent scenes on tv / pc / mobile										
10	At bedtime										

Appendix 3. Anxiety measurement instrument at the motor level applied to students studying mathematics in the engineering faculty of UNACH during the period March - July 2020

ASRI-B			M
Universidad Nacional de Chimborazo UNACH			Engineering Faculty
Last names and name:			
Age:	Gender:	Age:	Gender:

On the next page you will find a series of sentences that present situations in which you could find yourself and others that refer to responses that you could give to those situations or reactions that they would produce. The 10 situations are numbered on the left side of the page.
Your task is to rate from 0 to 4 (0 the lowest frequency and 4 the highest frequency), each of the following situations or reaction level you are considering.

Situation:
1. I cry easily / 2. I make repetitive movements with some part of my body / 3. I smoke, eat or drink too much / 4. I try to avoid or run away from the situation / 5. I move and do things without a specific purpose / 6. I am paralyzed, or my movements are clumsy / 7. I stutter or have difficulty in my verbal expression

Items	Situations	Situations									
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1	When I am waiting for somebody										
2	When I will be late for an appointment										
3	When I think of the many things, I must do										
4	When I think of recent experiences in which I have felt ridiculous, shy, humiliated, lonely, or rejected.										
5	For nothing in particular										
6	When I think I can no longer go outside due to COVID19 pandemic										
7	When it is one of my friends' birthday										