Continuing education program and its relationship with the mental health of engineering faculty members

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Engineering education is complex and demanding. The COVID-19 pandemic necessitated a sudden shift from face-to-face to virtual teaching modalities, highlighting the need for robust university continuing education programs. This caused professors to invest more hours in attending training, which added to the stressors of the profession and those caused by the global situation and could add to the appearance of mental disorders such as anxiety, depression, stress, or burnout. This research aims to explore the relationship between continuing education programs and the prevalence of mental disorders such as anxiety, depression, stress, and burnout among faculty members. Utilizing a quantitative, non-experimental, cross-sectional, correlational design, the study involved 307 professors from the School of Engineering and Sciences at a private university in northeastern Mexico. Tools included a burnout scale, a stress scale, an anxiety scale, and a self-report depression scale. Findings suggest that faculty members dedicate an average of 20 h per semester to training programs. Although no significant gender differences in training hours were observed, perceived intensity differed with educational level and contract type, suggesting that continuing education programs impact faculty mental health variably. The study concludes a statistically significant relationship exists between stress, anxiety, burnout, and continuing education programs; but the magnitudes are too low to make generalizations. However, it was found that excessive time commitment is a factor that is detrimental to mental health; therefore, it is essential that training programs, in addition to meeting institutional and operational needs, also consider controls that promote the well-being and mental health of teachers. In this sense, continuing education programs contribute to professional growth and can also be a crucial component in the prevention and mitigation of mood disorders among teachers.

KEYWORDS

continuing education, anxiety, depression, stress, burnout, faculty development, higher education, educational innovation

1 Introduction

Engineering programs are inherently complex, necessitating continual adaptation to meet the evolving challenges of industry and the environment (National Research Council, 1985). This complexity not only demands universities to maintain faculty who are current in their disciplines but also deeply knowledgeable about their operational contexts. Faculty of this discipline are expected to possess advanced teaching competencies to effectively impart knowledge and ensure the professional formation of future engineers (Sigahi and Sznelwar, 2022; Zilbovicius et al., 2020). Consequently, universities have become environments

characterized by perpetual change and escalating demands (Villamar Sánchez et al., 2019).

Transitioning from being an expert engineer to an educator poses significant challenges, primarily involving the development of pedagogical skills and the ability to simplify complex content for students (Kokhan et al., 2021). A pertinent example is the increasing necessity to utilize digital tools and adapt teaching materials for online platforms. This adaptation requires professors to master technical procedures during virtual classes, a task that can induce anxiety and frustration, particularly among those unfamiliar with educational technology (Alfaro de Prado Sagrera, 2008). This intricate responsibility, coupled with the need to meet academic and social expectations and maintain high educational standards, contributes to an increased workload (Mitchell, 2004). Consequently, faculty members are at a heightened risk of experiencing mental health issues such as anxiety, depression, and burnout (Mora et al., 2021), which are interconnected and compound the challenges faced in academia.

This situation has been exacerbated by the COVID-19 pandemic, during which an educational paradigm shift occurred, adding to the challenges already faced (Maslach and Leiter, 2021). The consequences of the rapid transition to remote learning continue to be felt, highlighting significant impacts on educational processes (Said-Hung et al., 2021). Moreover, Evers et al. (2002) noted that with each passing year, teachers increasingly perceive a greater inability to continue their work due to activity overload and burnout. These psychosocial risks have become a prominent phenomenon within the workplace and have swiftly gained notoriety (Castañeda-Aguilera and García De-Alba-García, 2020).

1.1 Mental health concerns in academia

Recent studies among university faculty have identified multiple risk factors for anxiety disorders, including age, gender, marital status, educational level, discipline, and workload (Ma et al., 2022). This development is concerning for engineering schools and the broader community, with reported increases in cases of this syndrome worldwide (García and Ortiz, 2021; Gaitán-Rossi et al., 2021; Neri Vázquez et al., 2023).

Furthermore, the link between stress and anxiety in university professors has been extensively explored (Alvites-Huamaní, 2019; Cansoy et al., 2020; Ticona et al., 2021). Such disorders arise when individuals are unable to manage their activities or tasks effectively, necessitating the investment of additional personal resources (Lazarus and Folkman, 1984; Smetackova et al., 2019). Often, this situation is compounded by institutional pressures, such as demands for scientific production and dissemination, academic overload, conflict management, and administrative duties (Escudero and Barreto, 2022; Monroy-Castillo and Juárez-García, 2019). These pressures not only undermine well-being but also significantly impact work performance and classroom effectiveness (Corbett et al., 2021; Romeiro, 2015).

In response to growing awareness of burnout syndrome, faculties and schools of professional education have implemented measures to manage workload effectively (Oliveira et al., 2021). Burnout syndrome, characterized by emotional exhaustion, depersonalization, and diminished personal accomplishment, predominantly affects professions involving intensive social interaction, such as teaching (Karavasilis, 2019; Maslach and Leiter, 2016; Unda Rojas et al., 2020).

Initially, burnout may be underestimated or remain unnoticed, often concealed by high levels of motivation (Bitran et al., 2019). However, continuous exposure to unmitigated stress can deteriorate an individual's capacity for self-care, leading to more severe consequences (Burić et al., 2019; Pandey and Tripathi, 2001).

Depression, defined by the American Psychiatric Association (2014) as a pervasive feeling of sadness impacting interest, motivation, and satisfaction, frequently coexists with anxiety and burnout (Koutsimani et al., 2019). Research indicates a complex relationship between job stress, depression, and the overall mental health of university teachers, highlighting the multifaceted impacts of these conditions (Mendes et al., 2020). The significant overlap between burnout and depression underscores the necessity of addressing both the environmental stressors and their emotional and psychological repercussions (Sieglin and Ramos, 2007). Recognizing its importance, the World Health Organization (WHO) has included burnout in the 11th edition of the International Classification of Diseases (Živanović et al., 2021), further emphasizing the need for targeted interventions in professional settings.

The confluence of anxiety, depression, stress, and burnout severely impairs the psychological well-being and job performance of university teachers, highlighting the critical need for proactive mental health interventions (Mendes et al., 2020). The World Health Organization (2022) noted that mental disorders affect 15% of working-age adults, with depression and anxiety resulting in an estimated 12 billion lost workdays annually, costing the global economy about $1 trillion USD.

In response, universities have increasingly turned to continuing education programs to address academic, operational, and welfare needs comprehensively (de Lima Ferreira and Bertotti, 2016). According to Saline (1983) and Hammond (2004), these programs are typically structured into three main categories:

a Teacher Training: Focused on enriching didactic and psycho-pedagogical competencies.
b Discipline-Oriented: Aimed at keeping teachers current with the latest advancements in their respective fields.
c Development and Integration: Designed to foster a fulfilling work environment and support positive psychological health.

1.2 Continuing education programs

Continuing education programs are instrumental in promoting lifelong learning and enhancing the capacity for and interest in professional development, crucial in the fast-paced technological landscape (OECD, 2017). Particularly in engineering, where the dynamic demands constant learning, continuing education programs serve as an essential strategy for fostering self-directed learning and personal growth management (Diaz, 2020; Hadgraft and Kolmos, 2020). Research has shown that continuing education programs enhance faculty engagement with engineers and other professionals, facilitate the creation of learning communities, and bolster the ability of engineering educators to design and implement effective instructional plans (Mesutoglu and Baran, 2021).

However, training may be affected by external conditions, such as the pandemic. The education sector, particularly hard-hit by COVID-19 pandemic, faced unprecedented challenges as it

transitioned from traditional face-to-face instruction to online formats. This shift, crucial for maintaining both educational continuity and community health, placed considerable strain on all educational systems, including engineering education, which is inherently content-intensive and practice-oriented (Asgari et al., 2021; Beltran-Sanchez et al., 2020). The sudden need for online education highlighted the importance of robust continuing education programs (Donitsa-Schmidt and Ramot, 2020; Miranda et al., 2021). These programs expanded rapidly, offering an array of courses focused on teacher training and well-being, including educational technology and mental health care. While these resources were intended to support faculty, the surge in available courses may paradoxically impose additional demands on teachers' time, potentially making these initiatives counterproductive.

The aim of this research is to examine the relationship between stress, anxiety, burnout, and participation in continuing education programs among faculty members at an engineering school in Mexico. Also, test the following hypothesis:

- H_1: There is a statistically significant relationship among training hours, perceived training intensity, and mental health variables ($p \leq 0.050$)
- H_2: There are statistically significant differences in training hours, perceived training intensity, and mental health variables between men and women ($p \leq 0.050$)
- H_3: There are statistically significant differences in training hours, perceived training intensity, and mental health variables, across academic degrees ($p \leq 0.050$)
- H_4: There are statistically significant differences in training hours, perceived training intensity, and mental health variables across types of contracts ($p \leq 0.050$)
- H_5: Burnout and its dimensions, perceived stress, anxiety, and depression scores differ significantly across groups categorized by the number of hours invested in training ($p \leq 0.050$)

2 Method

2.1 Study design

A quantitative, non-experimental, cross-sectional, correlational study was conducted to explore the relationship between continuing education programs and faculty mental health.

2.2 Context

This study was conducted at a private university in northeastern Mexico during the COVID-19 pandemic. At that time, the university's continuing education programs aim to enhance knowledge, skills, and competencies across various domains, including institutional work culture, educational models, technological proficiency, and teaching practices, as well as the emergent teaching topics due to the switch to online education.

Typically, the institution's teacher training comprised four basic courses totaling approximately 16 h, designed to integrate teachers into the instructional practices of the university. In response to the pandemic, the continuing education program was expanded to include four additional courses focused on remote technology and distance learning methodologies, extending the total training duration to 24 h. Subsequently, four more courses aimed at promoting mental well-being were added, bringing the minimum total program duration to 30 h. This expansion not only increased the workload for faculty but also introduced significant emotional and logistical challenges. The rapid shift to virtual teaching required teachers to navigate a steep learning curve and adapt to new tools and pedagogical approaches.

Under this framework, the institution categorizes courses as priority or optional. Priority courses address immediate institutional needs and are time-sensitive, focusing on strategic curriculum requirements and critical institutional issues. These courses are pragmatically designed with an applied orientation to cover essential knowledge areas and competencies crucial for the institution's effective functioning. In contrast, optional complementary courses are characterized by their elective nature and flexible scheduling, accommodating the diverse interests and needs of university faculty. This flexibility allows faculty to select courses that align with their professional interests within a structured framework of institutional priorities, fostering a sense of autonomy and empowerment. Such an approach not only motivates faculty but also contributes to the continuous improvement of educational quality and job satisfaction. Complementary elective courses provide faculty with the freedom to explore personal interests, develop specialized skills, and broaden their knowledge beyond the core disciplinary areas. Their voluntary and adaptable format promotes a personalized and enriching educational experience, enhancing both professional and personal growth.

2.3 Sample

For the determination of the sample, a non-probabilistic convenience sampling method was used. This method is characterized by obtaining responses from individuals who are willing to participate in the study and who were selected without conscious bias (Coolican, 2017; Kerlinger and Lee, 2002). In this study participated 307 teachers of the engineering school at a private university in northeastern Mexico. The sample included 115 women and 192 men with an average age of 44.72 years ($SD = 10.81$) and an average teaching experience of 13.68 years ($SD = 12.20$). Professors were categorized by contract type: full-time teaching, full-time teaching and administrative duties, full-time teaching and research, administrative role with possibility to have teaching load, and part-time teaching (see Table 1).

Academic qualifications among the participants were as follows: 47.6% held doctorates, 49.8% master's degrees, and 2.6% bachelor's degrees. Participants also reported an average institutional tenure of 11.14 years (SD = 11.65).

Participants were informed about their confidential participation and about the use of their data for academic purposes.

2.4 Measures

Participants provided demographic information (gender, age, academic qualifications, contract type) and details about their engagement in continuing education programs, including the number of hours and perceived intensity of training. The number of

Type of contract	Frequency	Percentage	Cumulative percentage
Full-time teaching	69	22.5	85.3
Teaching and administrative role	19	6.2	91.5
Teaching and research	26	8.5	100.0
Administrative role	33	10.7	62.9
Part-time teaching	160	52.1	52.1
Total	307	100.0	

training hours was self-reported by the participants. It was not possible to validate the number of hours given that some training is offered by the institution (internal continuing education programs) and some training is external. The maximum number of hours that the survey allowed in the survey was 150 h per semester. Regarding the perceived intensity of training was also self-reported in a 5-point Likert-type scale from very low intensity (1) to very high intensity (5).

Mental health outcomes were assessed using four adapted and validated scales measuring symptoms of depression, anxiety, stress, and burnout. The description of each scale follows.

2.4.1 Burnout

The burnout measurement model used is an adaptation of the proposal made by Gil-Monte et al. (2009), consisting of three dimensions: illusion, composed of five items (e.g., I feel that my participation as a teacher is a stimulating challenge; emotional exhaustion), measured with three items (e.g., I think I am saturated by my work as a teacher); and indolence, with four items (e.g., During my activities as a teacher I do not feel like attending to some students). The response options were in a Likert-type frequency scale (0 = never and 4 = always). The scale demonstrated evidence of construct validity (χ^2 = 2054.0, p = 0.001, KMO = 0.85, λ = 0.32 to 0.94, variance explained = 60.8%) and reliability, as indicated by internal consistency measures, including Cronbach's alpha (α = 0.86) and McDonald's omega (ω = 0.83). The complete Spanish version of the scale is provided in Annex 1 for reference.

2.4.2 Perceived stress

Perceived stress was measured with an adaptation of the Cohen et al. (1983) scale, which is unidimensional and consists of five items measured by frequencies, where 0 equals never and 4 equals always. An example of an item is: "I feel unable to control the important things in my life." The scale had evidence of construct validity construct validity (χ^2 = 751.01, p = 0.001, KMO = 0.86, λ = 0.75 to 0.80, variance explained = 59.3%) and reliability, the latter identified by internal consistency, calculating Cronbach's alpha (α = 0.88) and McDonald's omega (ω = 0.88) coefficients. The full Spanish version of the scale is available in Annex 2 for reference.

2.4.3 Anxiety

An institutional version of the Generalized Anxiety Scale proposed by Spitzer et al. (2006) was applied. This is a Likert-type instrument composed of five items that are scored from 0 (never) to 3 (almost every day), where the maximum value obtained is 15, which indicates a severe degree of anxiety. An example of an item is: "I am so restless that it is difficult to sit still." The scale demonstrated evidence of construct validity (χ^2 = 768.44, p = 0.001, KMO = 0.87, λ = 0.67 to 0.86, variance explained = 60.0%) and reliability, the latter identified by internal consistency, calculating Cronbach's alpha (α = 0.88) and McDonald's omega (ω = 0.88) coefficients. Annex 3 includes the complete Spanish version of the scale.

2.4.4 Depression

The Self-Report Depression Scale proposed by Zung (1965) and validated by Diaz et al. (2005) was used. This adapted scale consists of seven items measured with a frequency scale where 0 equals never and 4 equals always. An example of an item is: "I feel more irritable than usual." The scale had evidence of construct validity (χ^2 = 1072.95, p = 0.001, KMO = 0.83, λ = 0.51 to 0.86, variance explained = 61.1%) and reliability, the latter identified by internal consistency, calculating Cronbach's alpha (α = 0.84) and McDonald's omega (ω = 0.84) coefficients. The complete Spanish version of the scale can be found in Annex 4.

2.5 Procedure

The present study lasted 5 months. During this time, the necessary approvals of the institutional authorities were obtained, and the data collection strategy was designed. Then, the implementation of the instrument occurred, in accordance with the ethics committee guidelines, through the Qualtrics platform, which facilitated the collection of data via an online portal accessible via a generic link sent by email. Participation was voluntary; all participants signed an informed consent form, and data was kept confidential. For the analysis, all identification information was removed to ensure anonymity. The data collected was analyzed and discussed by the research team. Finally, reports were prepared on the results found and recommendations.

2.6 Data analysis

Data analysis was performed with the IBM SPSS Statistics version 26 statistical software. The mean (measure of central tendency) and standard deviation (measure of dispersion) were used to describe the data. Likewise, quartiles were used to define groups (measure of position) and symmetry and kurtosis were checked to determine the distribution of the data.

Additionally, a series of hypothesis testing tests were applied, where the statistical significance value is equal to or less than 0.050. The tests are:

- *Student's t test* for independent groups to compare means, complemented by Levane's statistic to test the homogeneity of the variances of the groups and Cohen (1988) *d* statistic to determine the effect size.

- *Pearson's test-moment correlation coefficient* (*r*) to identify linear relationships between two variables.
- *Analysis of* Var*iance (ANOVA)* used to compare the means of three or more independent groups. Homogeneity of variances was tested by means of Levane's statistic and effect size by means of the *ω* statistic[2] (Field, 2009).

The levels of the measured variables were determined by intervals, considering the values of each of the scales, that is, equal-sized intervals centered around the mean. Thus, for perceived stress, depression and burnout with their dimensions, we considered: Very low (0.00–0.80), Low (0.80–1.60), Medium (1.60–2.40), High (2.40–3.20), Very high (3.20–4.00). On the other hand, for anxiety the intervals are: Very low (0.00–0.60), Low (0.60–1.20), Medium (1.20–1.80), High (1,0.80–2.40), Very high (2.40–3.00).

3 Results

The main findings indicate that teachers dedicate, on average, about 20 h to training programs during the semester and that this time investment represents a medium level of perceived intensity of the training. Table 2 shows the results related to teachers' mental health, where the highest score corresponds to emotional exhaustion, one of the dimensions of the burnout model. The rest of the indexes tend to be low or very low.

3.1 Continuing education, gender and mental health variables

Training hours in the continuing education programs were analyzed with respect to gender, academic qualifications, contract type, and the mental health variables. With respect to gender, a

TABLE 2 Descriptives related to training and mental health indices.

	$\bar{X}$	s	Minimum	Maximum
Continuing education				
Semiannual training hours	18.89	19.92	0	121
Perceived training intensity	2.83	0.96	1	5
Mental health				
Burnout	0.79	0.50	0	3.33
Illusion	3.54	0.57	0	4
Emotional exhaustion	1.89	1.06	0	4
Indolence	0.37	0.47	0	2.50
Perceived stress	1.03	0.75	0	4
Anxiety	0.55	0.57	0	3
Depression	1.19	0.72	0	4

X̄, mean; s, standard deviation.

t-test was conducted to compare the mean hours of training between women and men. The results showed no statistically significant differences by gender in either duration of training, measured in hours ($t = 1.04$, $p = 0.299$, Cohen's $d = 0.12$), or perceived training intensity ($t = -0.43$, $p = 0.667$, $d = 0.05$). Likewise, the differences between men and women were examined in relation to the mental health variables. Only the exhaustion, dimension of burnout, exhibited statistically significant differences, with women displaying a higher prevalence than men ($t = 2.27$, $p = 0.024$, Cohen's $d = 0.27$).

3.2 Continuing education and teachers' contract type

Further ANOVA testing with "contract type" as a factor showed differences in training hours and perceived training intensity among contract types. Faculty members with full-time teaching contracts (focus on teaching or on research) reported the highest training hours ($F = 8.79$, $p = 0.001$, $\omega^2 = 0.32$). Differences in the perceived training intensity were noted between part-time instructors and full-time researchers, with the latter group reporting higher levels ($F = 2.82$, $p = 0.025$, $\omega^2 = 0.19$). Moreover, analysis by contract type found significant differences among part-time instructors in perceived stress ($F = 3.39$, $p = 0.020$, *post hoc* = part-time teachers, administrative role < teaching and administrative role, $\omega^2 = 0.25$) and emotional exhaustion ($F = 3.09$, $p = 0.033$, *post hoc* = administrative role < teaching and administrative role, $\omega^2 = 0.25$).

In addition to the above, it was found that teachers with a "Teaching and research" contract report systematically higher levels in each of the mental health variables: Burnout ($F = 19.51$, $p < 0.001$, $\omega^2 = 0.19$), Illusion ($F = 9.15$, $p < 0.001$, $\omega^2 = 0.10$), Exhaustion ($F = 21.06$, $p < 0.001$, $\omega^2 = 0.21$), Indolence ($F = 5.03$, $p = 0.032$, $\omega^2 = 0.05$), Stress ($F = 9.56$, $p < 0.001$, $\omega^2 = 0.10$), Anxiety ($F = 5.61$, $p < 0.001$, $\omega^2 = 0.06$), and Depression ($F = 5.18$, $p = 0.006$, $\omega^2 = 0.05$). In most cases, the difference lies between part-time teaching and full-time teaching and research contracts.

3.3 Continuing education and academic qualifications

An Analysis of Variance (ANOVA) was performed to examine differences in training hours and perceived training intensity across academic qualifications. The analysis revealed no significant differences in training duration ($F = 1.38$, $p = 0.253$). However, significant differences were found in the perceived training intensity ($F = 4.27$, $p = 0.010$, $\omega^2 = 0.17$), with professors holding bachelor's degrees reporting the highest perceived training intensity, although data homogeneity between groups was not observed. On the other hand, the same test was performed to identify differences in mental health variables among academic qualifications, the test results were that teachers with doctoral degree report higher in burnout ($F = 10.16$, $p < 0.001$, $\omega^2 = 0.06$), exhaustion ($F = 12.46$, $p < 0.001$, $\omega^2 = 0.07$), indolence ($F = 3.47$, $p = 0.032$, $\omega^2 = 0.02$), stress ($F = 7.75$, $p < 0.001$, $\omega^2 = 0.04$), anxiety ($F = 5.24$, $p = 0.006$, $\omega^2 = 0.03$), and depression ($F = 5.51$, $p = 0.004$, $\omega^2 = 0.03$).

3.4 Continuing education, training hours and mental health variables

Pearson's correlation analysis explored the relationships among training hours, perceived training intensity, and mental health variables, revealing statistically significant correlations ($p < 0.050$). However, all correlations were trivial as none were greater than 0.30.

3.4.1 Analysis of training hours quartiles

To delve deeper into this last result, four groups were formed based on quartiles of reported training hours: low, mid-low, mid-high, and high. The criteria of training hours for each quartile is as follows: Professors were categorized into quartiles based on reported training hours:

- Low: 0–6 h ($n = 99$)
- Mid-Low: 6.01–15 h ($n = 69$)
- Mid-High: 15.01–25 h ($n = 70$)
- High: 25.01–121 h ($n = 69$)

An ANOVA was conducted to compare these groups, indicating significant differences in some dimensions of mental health. In Table 3, it is possible to observe that the test results indicate that training time has a statistically significant effect on burnout syndrome and its exhaustion dimension, as well as on perceived stress, anxiety and depression. That is, teachers who reported having received more hours of training (Group 4) also report higher levels of the above variables. However, the results for anxiety and depression should be interpreted with caution given the low effect size (Faul et al., 2007).

4 Discussion

For coherence, this section is structured as the previous one.

4.1 Continuing education, gender and mental health variables

Even though the academic community is a population at risk, especially during the pandemic (Gaitán-Rossi et al., 2021; García and Ortiz, 2021; Gómez et al., 2019; Neri Vázquez et al., 2023), the results of this study reveal that the participants present a low level of anxiety, depression, perceived stress and burnout and no significant differences were found between age and gender groups. These findings, coincide with a systematic review by Ma et al. (2022) who conducted a meta-analysis on anxiety in teachers, where most of the analyzes studies suggest that anxiety levels tend to be low in the field of higher education. Although, this discrepancy cannot be attributed exclusively to the continuing education program, it is known that job satisfaction, academic grade, and sense of accomplishment are protective factors that significantly decrease the risk of mood disorder (Ma et al., 2022; Menghi, 2018).

4.2 Continuing education and teachers' contract type

Although all professors have as a common denominator their participation in engineering education, it has been observed that tenured professors tend to dedicate more time to the continuing education program compared to their peers, especially in comparison with part-time instructors. This disparity in participation may be attributed to greater institutional commitment and job stability, as working on temporary contracts may lower attachment to the institution (Gómez et al., 2019). Regarding the differences found in the perceived intensity of the continuous education, this can be attributed to the level of commitment and responsibility by contract type; part-time instructors may require more training.

4.3 Continuing education and academic qualifications

Regarding the differences found in academic qualifications, these results coincide with the findings of Ma et al. (2022), who identified that groups of teachers with lower academic degrees tended to have a greater tendency to suffer burnout and stress. This phenomenon is mainly seen when learning and incorporating new technologies into the learning process (Fernández-Batanero et al., 2021). However, this stress factor gradually disappears when the individual masters and integrates technology into his or her life. This is because it facilitates social contact, creating a positive feeling that allows coping with stress instead of causing it (Mheidly et al., 2020).

TABLE 3 Means, standard deviation, and Analysis of Variance between groups by hours of training in mental health variables.

Variables	Low ($n = 99$)		Mid-low ($n = 69$)		Mid- high ($n = 70$)		High ($n = 69$)		F	p	Post hoc	ω^2
	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s				
Burnout	0.73	0.51	0.69	0.43	0.87	0.54	0.89	0.51	3.06	0.029	–	0.16
Illusion	3.51	0.59	3.61	0.52	3.45	0.61	3.59	0.53	1.24	0.294	–	–
Exhaustion	1.66	1.00	1.70	1.03	2.07	1.04	2.24	1.10	5.66	0.001	1, 2 < 4	0.23
Indolence	0.33	0.46	0.30	0.38	0.38	0.46	0.49	0.54	2.29	0.079	–	0.15
Perceived stress	0.88	0.75	0.89	0.70	0.73	0.69	1.29	0.80	5.65	0.001	1, 2 < 4	0.23
Anxiety	0.49	0.56	0.45	0.52	0.59	0.53	0.70	0.62	3.05	0.029	–	0.16
Depression	1.17	0.71	0.98	0.70	1.22	0.66	1.38	0.78	3.77	0.011	2 < 4	0.19

Groups: 1 = Low, 2 = Mid-low, 3 = Mid-high, 4 = High.

However, in the context of engineering, according to the National Research Council (1985), the success and results of continuing education are not reported as a function of time spent. It is known that programs tend to show a positive effect as long as they have a clear objective that is aligned with the goals established by the companies and they combine interactive and non-interactive instructional support (Robertson et al., 2003). In this sense, the institutional program offered by the university combines a modality of courses called synchronous (instructor-led) and asynchronous (self-directed), which allows to adapt to the time of teachers and also allow self-management of learning.

4.4 Continuing education and training hours and mental health variables

The study reveals that professors at the institution average 18.89 h of training, perceived as moderately intense, aligning with the university's statutory requirements. Despite the absence of clear guidelines in the literature regarding optimal duration for continuing education programs, factors such as duration, material quality, trainer experience, training context, participant knowledge level, and follow-up procedures significantly influence their effectiveness (Robertson et al., 2003).

It was observed that increased training duration correlates with heightened perceived stress and burnout, although these relationships are of low magnitude and do not necessarily indicate clinical anxiety disorders. Instead, they may reflect typical adjustments to new educational technologies and methodologies, a common occurrence among engineering faculty seeking to enhance their skills (Sastre-Merino et al., 2021).

5 Conclusion

The main objective of this study was to identify the relationship between stress, anxiety, burnout and continuing education programs in teachers of an engineering and science school. In this sense, it is possible to conclude that there is a statistically significant relationship between these variables, but with magnitudes too low to make the desired generalizations. Thus, hypothesis 1 was supported, however it is important to continue with its study for the reasons mentioned above.

In general, no significant differences were identified between men and women in terms of the number of hours invested in continuing education programs and the intensity with which they were perceived nor between mental health variables. Thus, hypothesis 2 cannot be confirmed. Conversely, statistically significant differences were identified among academic degrees about both the perceived intensity of continuing education programs and the mental health variables. Thus, hypothesis 3 is confirmed. Likewise, hypothesis 4 is confirmed by finding differences between the types of contracts, both in the hours spent and the perceived intensity of the training and the mental health variables Furthermore, a high number of training hours was identified as a factor detrimental to mental health (hypothesis 5).

The institution's continuing education program is strategically based on four pillars: institutional culture, integration into teaching practice, human dignity, and health and welfare (Valenzuela and Galvis, 2019). By focusing on these key areas, the program underscores a commitment to holistic development, addressing both pedagogical skills and emotional well-being. This comprehensive approach reflects a deep understanding of the unique challenges faced by faculty, aiming to improve educational outcomes and foster a supportive work environment (Rodríguez-Martínez et al., 2018). Being human development part of institutional philosophy, their training programs, from the design to the implementation, promote well-being as well as equal opportunities for all, besides the disciplinary content. We consider that the continuing education programs by embedding such characteristics play a fundamental role that could act as a buffer to mitigate the stressors inherent to the academic environment through the promotion of educational effectiveness and the creation of a positive work climate (Menghi, 2018).

5.1 Limitations and recommendations

It is important to acknowledge the limitations of the present study. Despite the large sample size, the study is not representative of the entire engineering teaching population at the participating university. It is recommended to conduct further replications using a probabilistic sampling technique with a greater scope, which would allow to generalize the findings and increase the impact. Also, the inclusion of other disciplines would facilitate a more comprehensive understanding of the phenomenon under study. Moreover, as a cross-sectional study, it is challenging to ascertain the causal relationships between variables, and the results may be influenced by atypical situations. Therefore, it is recommended to pursue the study through longitudinal research designs that can monitor trends and provide more reliable results.

5.2 Future directions

Educational institutions develop continuing education programs as a strategic response to adapt to the new realities introduced by the pandemic. However, it is crucial to acknowledge that increased participation in continuing education programs could lead to work overload, adversely affecting teachers' mental health and well-being. Balancing the demands of continuing education with academic and personal responsibilities is challenging and can exacerbate stress, contributing to feelings of overwhelm among faculty members (Kyndt et al., 2019).

It is important to adopt a holistic approach to the design and implementation of continuing education programs offered to university faculty. This approach should ensure the relevance and utility of courses while providing adequate support to enable effective participation without compromising faculty well-being. Considerations may include institutional policies that encourage a balance between professional development and self-care and the integration of additional resources for mentoring, counseling, and wellness services (Skaalvik and Skaalvik, 2017). Through such measures, continuing education programs can effectively enhance faculty skills and well-being, thereby improving the overall quality of higher education.

Thus, continuing education programs implemented by the university not only promotes faculty well-being and professional development but also acknowledges the critical importance of

addressing both pedagogical and emotional needs. These programs contribute significantly to enhancing educational quality and creating healthier, more engaging work environments. However, it is imperative that these initiatives are carefully designed and implemented, considering the real-world challenges and daily realities faced by faculty. Properly executed, continuing education programs can effectively strengthen teaching capabilities and foster well-being in higher education settings.

To deepen understanding of continuing education programs and their impact on engineering faculty mental health, further research should adopt a qualitative approach to capture the nuanced realities of teaching experiences. Differentiated analyses of course types could elucidate which are most taxing, and longitudinal or quasi-experimental studies could help identify various influencing factors and test intervention strategies.

Despite the low prevalence of anxiety and depression found in this study, it is imperative not to underestimate the importance of mental health within this sector. Continuing education, especially programs that emphasize wellness, can play a pivotal role in mitigating risks associated with mental health issues, thereby not only contributing to professional growth but also helping prevent and mitigate mood disorders among faculty.

Data availability statement

The datasets presented in this article are not readily available because of confidentiality issues. Requests to access the datasets should be directed to AD, angeles.dominguez@tec.mx.

Ethics statement

The studies involving humans were approved by Instituto Tecnologico y de Estudios Superiores de Monterrey. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

JN-M: Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. JB-S: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. IG-T: Conceptualization, Visualization,

Writing – review & editing. AD: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Visualization, Writing – review & editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1457642/full#supplementary-material

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