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Article

Strategies to mitigate anxiety, stress, pressure, and technological fatigue among teachers utilizing educational technology tools

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Abstract: This study addresses the rising concerns of technostress experienced by teachers due to the increased reliance on educational technology in both classroom and online settings. Technostress, defined as the adverse psychological effects arising from the use of information communication technologies, has been documented to impact teacher performance and overall well-being. Despite the importance of educational technology in enhancing teaching and learning experiences, many educators report elevated levels of anxiety, stress, and pressures associated with their use of these tools. This study presents practical strategies to help teachers alleviate or prevent technostress while using educational technology. This study used a quantitative approach with a survey conducted among 113 university and schoolteachers. The data analysis included frequency and percentage distribution of categorical variables, Cronbach's alpha for reliability, chi-square test, and exploratory factor analysis to identify strategies for symptom prevention. The results indicated that while many teachers experienced symptoms of technostress due to several factors, some did not. The study concluded with specific strategies, and many teachers agreed highly. The implications of this study are profound for educational institutions, policymakers, and teacher training programs as they underscore the necessity of providing comprehensive training, support, and resources to help educators manage technostress effectively. By integrating these strategies into professional developmental programs and fostering a supportive teaching environment, schools and universities can promote better mental health for teachers, improving students' educational outcomes.

Keywords: strategies; symptoms; anxiety; stress; pressure; fatigue; teachers; tools; educational technology

1. Introduction

Technostress is a widespread model used to study the negative effects of using information communication technologies at work (Borle et al., 2021, p. 1). Brod (1984) defined technostress as "a modern disease of adaptation caused by an inability to cope with new computer technologies healthily" (p. 16), highlighting the historical foundation of the technostress concept related to anxiety and stress vision by defining its meaning as a current scientific concept. Technostress was first noted in mainstream magazines in 1982 by Brod as a condition resulting from an individual and organizational inability to adapt healthily to the demands of evolving technology trends. This experience of stress is influenced by factors such as age, prior technological experiences, workload, perceived control, and the prevailing working environment or climate. Consequently, this affects performance and limits technological use.

Many teachers are overwhelmed and stressed by the use of educational tools. Fernández-Batanero et al. (2021) indicated that despite the increasing importance of using educational technology, the need to have these skills is essential. Their study revealed elevated anxiety and stress levels among teachers stemming from the use of educational technology. Their primary findings concluded a need for research on different strategies to prevent the emergence of anxiety and stress symptoms in teachers. While many studies focus on identifying the symptoms, few address practical methods for teachers to manage these challenges effectively while leveraging technology. Therefore, the current study aims to fill that gap by offering actionable strategies.

Study's question:

What are the most effective strategies for preventing the symptoms of anxiety, stress, pressure, and technological fatigue in teachers who use educational technology?

2. Literature review

This literature review was divided into eleven concepts serving as a synthesis of prior research:

2.1. Digital challenge

González et al. (2021) emphasized that the most considerable challenge that individuals face in the digital era is exploiting the possibilities offered by Information Communication Technology (ICT) in their personal and professional lives without putting their health at risk. Batanero et al. (2021) found that teachers experienced elevated levels of anxiety or stress caused by the use of educational technology in their classrooms. Çoklar et al. (2021) concluded a negative and low-level relationship between attitude toward technology and technostress levels. González et al. (2021) demonstrated a relationship between technostress dimensions. From the highest to the lowest incidence, techno-skepticism was more strongly related. However, this contrasts with Estrada et al. (2020) who observed that techno-anxiety was more prominent in causing techno-fatigue among teachers. Batanero et al. (2021) recommended that "the need for research on different strategies to prevent the emergence of these anxiety and stress symptoms in teachers stand out" (p. 1). Çoklar et al. (2021) advocated for increased teacher training in technology, whereas Weems (2021) examined the challenges faced by university teachers, such as overloading, invasion, complexity, insecurity, and uncertainty.

Further, isolation and disconnect because of students' reluctance to use webcams during synchronous classes were usually reported as the originator. The primary inhibitor was the provision of information technology (IT) support. The study also found that leaders played a crucial role in supporting teachers by facilitating content sharing for classes, creating more opportunities for peer collaboration, and providing clear, straightforward guidance on best practices for online courses. Furthermore, Khlaif et al. (2023) studied the causes of Palestinian middle school teachers' technostress while using ICTs in teaching and illustrated that teachers identified various causes of technostress stemming from their daily interactions with recent technologies, compounded by the external factors that necessitate the use of innovative

teaching tools as well as individual factors. Participants also stated that the leading cause of their technostress was their lack of using Technological Pedagogical Content Knowledge (TPACK).

2.2. Technostress correlation

Conte et al. (2024) demonstrate that teachers experienced stressful events, such as health problems. Batanero et al. (2021) show that teachers may feel "burnout syndrome" because of increasing demands, which can affect teachers' levels of commitment at work. Studies have highlighted the lack of training and education in technology as a primary factor and highlighted the effects, factors, variables, future themes, aspects, and consequences on mental health to prevent anxiety and stress symptoms in teachers using educational technology (Batanero et al. (2021). González et al. (2021) found that global technostress correlates with various personal, social, and economic problems and is significantly linked to individual, group, and professional consequences. While user archetypes were unrelated to global technostress, they showed a positive correlation with techno-anxiety.

2.3. Technostress and anxiety symptoms

Batanero et al. (2021) found that during research from the literature from 2005 to 2019, teachers' anxiety and stress symptoms grew while using technology. Furthermore, questioning and inspection caused the problem to change over time. Training was identified as the solution to ensure quality teaching and learning processes (Batanero et al., 2021).

2.4. Technostress and anxiety effects

Panado et al. (2021) demonstrate how the lack of instructions from university teachers' organizations influenced subjective feelings of techno-inefficacy and affected job performance during the COVID-19 pandemic. Panado et al. (2021) confirmed the findings from other studies with different components of the subjective experience of technostress by grouping them into techno strains. The competencies and attributes of teaching staff are essential when incorporating technology (Panado et al., 2021). The study concluded that online universities have the necessary support to overcome technostress compared to face-to-face universities.

Magistra et al. (2021) explored several factors affecting high school teachers, including the effect of self-efficacy and technostress on their performance and organizational commitment, and concluded that all the determinations have a significant impact.

2.5. Technostress regarding age and gender

Recent studies have identified variations in technostress experiences based on sex, age, and teaching role. For instance, primary school teachers, specifically senior female head teachers, are more susceptible to technostress. This emphasizes the need for targeted interventions such as providing gender-sensitive support programs and reducing technology-induced workloads. (Marrinhas et al., 2023; Wang et al., 2023).

Panado et al. (2021) illustrated that women suffer more from technostress compared to their male colleagues. Moreover, Estrada et al. (2020) demonstrated that male teachers have a higher techno-anxiety and techno-fatigue than female peers based on a larger sample size (428 participants) compared to Panado et al.'s study. However, these gender-based trends may change in the future, as the World Economic Forum (WEF, 2020) reported that the digital divide between women and men has been narrowed by the increase in the availability of digital technologies in recent years.

In contrast, Li and Wang (2021) found no significant gender difference among university teachers suffering from technostress. Furthermore, the findings from Antón-Sancho et al.'s (2023) study with 750 professors from 20 Latin American countries show that the impact of digital stress on professors varied by gender and age, depending on the university tenure.

2.6. Technostress regarding age and years of teaching experience

Panado et al. (2021) found that older and more experienced teachers suffered the most negative consequences of technology. Khlaif et al. (2023) described the experiences of Palestinian middle school teachers who used ICTs for teaching. Teachers' responses ranged from experiencing minimal anxiety and stress to being unable to use modern technology in their teaching practices. Finally, Estrada et al. (2020) found a high correlation and significance between the variables of age and professional teaching experience in years. In addition, the type of university affected the subjective feelings of technostress. Techno-anxiety, techno-fatigue, techno-skepticism, and techno-effectiveness are experienced more intensely as subjective sensations of technostress in face-to-face universities than in online ones, especially when essential technological resources for teaching are lacking at their institutions (Panado et al., 2021). Antón-Sancho et al. (2023) found no significant differences between the average levels of digital stress experienced by professors in private and public universities due to the pandemic. Conte et al. (2024) posited that the main stress factors in school and personal life are related to organizational dimensions. Specifically, adverse work conditions indicate a lack of support and a demanding school system.

2.7. Impact of the COVID-19 pandemic

Several studies have focused on digital challenges during the COVID-19 pandemic. According to Conte et al. (2024), approximately 30% of respondents adopted coping strategies, particularly those of an emotional nature. Batanero et al. (2021) noted that anxiety and stress symptoms in teachers stand out, and using educational technology is controversial, particularly during the pandemic. Brennan (2021) investigated the technostress experiences of 30 English language teachers at a private university in Tokyo during the 2020 COVID-19 pandemic and found that 60% of teachers experienced technostress, primarily due to techno-overload caused by the shift in teaching format from face-to-face to online. The shift to online teaching during the pandemic significantly increased technostress levels among educators. Challenges such as inadequate training, rapid adaptation to online platforms, and balancing work-life responsibilities are prominent stressors. These insights underline the importance

of integrating robust training modules and institutional support to effectively manage unexpected transitions (Boyer-Davis et al., 2023; Marrinhas et al., 2023).

2.8. Technology intensity and work-life balance

High levels of technology usage were directly correlated with work-family conflicts and health issues. The findings suggest implementing policies to moderate technology intensity and promote healthy work-life boundaries as critical measures to alleviate technostress (Wang et al., 2023).

2.9. Stress coping mechanisms

Recent research has identified tailored coping mechanisms that address specific dimensions of technostress such as techno-overload and insecurity. These include psychological counseling, structured professional development, and peer support networks. The effectiveness of such interventions is amplified when adapted to cultural and institutional contexts (Marrinhas et al., 2023; Wang et al., 2023).

2.10. Technology adoption strategies

Technology adoption succeeds when educators are provided with clear usage guidelines, ongoing technical support, and opportunities to co-design digital tools. For example, participatory approaches, in which teachers contribute to the design and implementation of educational technologies, have resulted in increased engagement and reduced resistance (Boyer-Davis et al., 2023).

2.11. Post-pandemic shifts

The pandemic permanently altered the digital landscape of education. Hybrid and fully online teaching models are now commonplace, necessitating long-term strategies to manage the associated stress. The continuous monitoring of teacher well-being and iterative improvements in digital tools are essential for sustainable adoption (Boyer-Davis et al., 2023; Wang et al. 2023).

While several studies have examined the prevalence and symptoms of technostress, only a few have emphasized strategies to prevent them, particularly among teachers striving to excel in technology use. Batanero et al. (2021) stressed the need for further research on preventive strategies. González et al. (2021) and Estrada et al. (2020) present conflicting findings regarding which dimensions of technostress are the most impactful. This lack of consensus necessitates further research. Panado et al. (2021) showed that different factors influence technostress across contexts, such as age, gender, and teaching experience. However, more clarity is needed on how these factors interact and on interventions that could be universally effective. Research comparing technostress experiences in face-to-face and online teaching contexts is sparse, and further exploration is warranted to understand the roles of organizational and technological support. As ICT adoption increases, studies (e.g., Batanero et al., 2021) highlight that technostress evolves with changing technology usage patterns and user demographics, necessitating continuous research to update frameworks and solutions.

3. Materials and methods

This study was approved by [King Faisal University's Committee], ensuring compliance with ethical standards. All participants provided informed consent, including details about the purpose of the study, voluntary participation, and the right to withdraw at any time. Data were anonymized to protect the participants' identities and stored securely in encrypted password-protected systems. All data will be used only for research purposes and will be securely deleted after five years.

3.1. Sampling method

The study sample included 113 teachers from various educational levels—elementary, middle school, high school, and university—across Saudi Arabia. These teachers regularly engage in educational technology, making them relevant to the research focus.

A purposive sampling technique was employed to ensure that participants expected to experience technostress were included. When participants failed to respond, additional teachers were contacted to ensure adequate sample size. This approach reduces the risk of non-response bias and maintains sample representativeness.

To enhance the validity of the findings, the sample includes a diverse range of teaching levels and geographical locations in Saudi Arabia.

3.2. Validity and reliability of instruments

3.2.1. Instrument development

The survey instrument was meticulously designed based on a thorough review of the relevant literature. It addressed different aspects of technostress and one open-ended question for qualitative insights. The questions were framed to align closely with the objectives of the study and ensure content validity.

To improve accessibility and understanding, the survey was translated into Arabic, the participants' primary language. This step ensured that language barriers did not hinder the clarity or accuracy of responses, further enhancing the validity of the instrument.

3.2.2. Pilot testing

Before full deployment, the survey underwent pilot testing with a small group of teachers. This step identified potential ambiguities in the wording of the questions and allowed for necessary adjustments, thus enhancing the face and construct validity of the instrument.

3.2.3. Reliability assessment

The reliability of the instrument was evaluated using Cronbach's alpha, which measures internal consistency. The overall Cronbach's alpha value was 0.934, indicating excellent reliability. Negatively correlated items were identified and removed to improve the instrument's cohesiveness and ensure that it effectively measured a single construct.

3.2.4. Data handling

To ensure the integrity of data collection, participants were required to complete all mandatory questions to reduce the risk of incomplete responses. The survey platform was configured to prompt participants to address unanswered questions and to ensure comprehensive data.

3.3. Data analysis

Categorical variables are represented as frequencies and percentages. The chi-square test was used to check the association between different preliminary information and responses. An exploratory factor analysis was used to identify strategies for symptom prevention.

4. Results

4.1. Descriptive categorical variables

As shown in **Table 1**, descriptive categorical variables for section one preliminary data: (Q1: sex, Q2: marital status, Q3: number of teaching experiences, Q4: age group, Q5: school type, Q6: best description of their work in a school/university, Q7: number of devices, and Q8: do they feel symptoms?).

Table 1. Descriptive categorical variables for section one preliminary data.

	S1.Q1	S1.Q2	S1.Q3	S1.Q4	S1.Q5	S1.Q6	S1.Q7	S1.Q8
N	113	113	113	113	113	113	113	113
Missing	0	0	0	0	0	0	0	0
Mean	1.66							
Median	2							
Standard deviation	0.475							
Minimum	1							
Maximum	2							

As shown in **Table 2**, the frequencies for section one regarding questions one to eight are presented.

Table 2. Present the frequencies of section one for questions 1 to 8(preliminary data).

Frequencies of S1.Q1			
S1.Q1	**Counts**	**% of Total**	**Cumulative %**
1	38	33.6%	33.6%
2	75	66.4%	100.0%

Table 2. (Continued).

Frequencies of S1.Q2			
S1.Q2	**Counts**	**% of Total**	**Cumulative %**
DI	4	3.5%	3.5%
DI	1	0.9%	4.4%
MA	91	80.5%	85.0%
MA	4	3.5%	88.5%
SE	1	0.9%	89.4%
SI	10	8.8%	98.2%
SI	2	1.8%	100.0%
Frequencies of S1.Q3			
S1.Q3	**Counts**	**% of Total**	**Cumulative %**
10–15	24	21.2%	21.2%
15–20	23	20.4%	41.6%
20 or more	52	46.0%	87.6%
20 or more	1	0.9%	88.5%
21 or more	1	0.9%	89.4%
5–10	7	6.2%	95.6%
10–15	4	3.5%	99.1%
1–5	1	0.9%	100.0%
Frequencies of S1.Q4			
S1.Q4	**Counts**	**% of Total**	**Cumulative %**
20–30	1	0.9%	0.9%
20–30	7	6.2%	7.1%
30–40	28	24.8%	31.9%
40–50	49	43.4%	75.2%
50–60	28	24.8%	100.0%
Frequencies of S1.Q5			
S1.Q5	**Counts**	**% of Total**	**Cumulative %**
G	109	96.5%	96.5%
I	2	1.8%	98.2%
P	2	1.8%	100.0%
Frequencies of S1.Q6			
S1.Q6	**Counts**	**% of Total**	**Cumulative %**
F-TT	100	88.5%	88.5%
P-TT	13	11.5%	100.0%

Table 2. (Continued).

Frequencies of S1.Q7			
S1.Q7	**Counts**	**% of Total**	**Cumulative %**
1	14	12.4%	12.4%
2	32	28.3%	40.7%
3	31	27.4%	68.1%
4	20	17.7%	85.8%
5	6	5.3%	91.2%
6 or more	10	8.8%	100.0%
Frequencies of S1.Q8			
S1.Q8	**Counts**	**% of Total**	**Cumulative %**
N	68	60.2%	60.2%
Y	45	39.8%	100.0%

Notes: S1.Q1: 1 male, 2 female; S1.Q2: Single (SI), married (MA), widowed (WI), divorced (DI), and separated (SE); S1.Q3: Number of years of teaching experience: 1–5, 5–10, 10–15, 15–20, 20 or more; S1.Q4: age group: 20–30, 30–40, 40–50, 50–60 Older than sixty; S1.Q5: School/university type: governmental-(G) private- (P) international (I); S1.Q6: What is the best description of your work in a school/university? Part-time teacher (P-TT) Full-time teacher (F-TT); S1.Q7: The number of technical devices you own: 1, 2, 3, 4, 5, 6 or more; S1.Q8: Do you feel anxiety, stress, pressure, or fatigue caused during your use of educational technology: yes (Y)-no (N).

As shown in **Table 3**, descriptive categorical variables for section two: This table summarizes the descriptive statistics for eight categorical variables (S2.Q1 to S2.Q8) that assess respondents' agreement with statements about experiencing anxiety, stress, pressure, and fatigue due to educational technology use. Respondents rated each statement on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Table 3. Descriptive categorical variables for section two.

	S2.Q1	**S2.Q2**	**S2.Q3**	**S2.Q4**	**S2.Q5**	**S2.Q6**	**S2.Q7**	**S2.Q8**
N	113	113	113	113	113	113	113	113
Missing	0	0	0	0	0	0	0	0
Mean	2.37	2.87	2.46	2.70	2.45	2.91	3.22	3.08
Median	2	3	2	3	2	3	3	3
Standard deviation	1.05	1.11	0.991	1.21	1.06	1.21	1.08	1.19
Minimum	1	1	1	1	1	1	1	1
Maximum	4	5	5	5	5	5	5	5

Notes: S2Q1: I feel techno skepticism (doubting the ability to use technology effectively); S2Q2: I feel tired (feeling fatigued while using technology); S2Q3: I feel anxious about techno (feeling anxious while using technology); S2Q4: I feel pressured when the job asks me to use technology more and faster; S2Q5: I feel afraid of failure and inefficiency in the use of technology; S2Q6: I feel pressured to learn technology in quick steps; S2Q7: Students usually inform me that they do not want to use webcams during simultaneous classes, and it worries me that students do not watch and follow me while teaching them; S2Q8: Remote teaching and isolation, disconnecting from students, or not wanting to communicate via webcams caused me stress.

As shown in **Table 4**, the frequencies for section two regarding questions one to eight are presented.

Table 4. Present the frequencies of section two for questions one to eight.

Frequencies of S2.Q1			
S2.Q1	**Counts**	**% of Total**	**Cumulative %**
1	26	23.0%	23.0%
2	41	36.3%	59.3%
3	24	21.2%	80.5%
4	22	19.5%	100.0%
Frequencies of S2.Q2			
S2.Q2	**Counts**	**% of Total**	**Cumulative %**
1	10	8.8%	8.8%
2	42	37.2%	46.0%
3	19	16.8%	62.8%
4	37	32.7%	95.6%
5	5	4.4%	100.0%
Frequencies of S2.Q3			
S2.Q3	**Counts**	**% of Total**	**Cumulative %**
1	16	14.2%	14.2%
2	52	46.0%	60.2%
3	24	21.2%	81.4%
4	19	16.8%	98.2%
5	2	1.8%	100.0%
Frequencies of S2.Q4			
S2.Q4	**Counts**	**% of Total**	**Cumulative %**
1	22	19.5%	19.5%
2	33	29.2%	48.7%
3	20	17.7%	66.4%
4	33	29.2%	95.6%
5	5	4.4%	100.0%
Frequencies of S2.Q5			
S2.Q5	**Counts**	**% of Total**	**Cumulative %**
1	22	19.5%	19.5%
2	44	38.9%	58.4%
3	22	19.5%	77.9%
4	24	21.2%	99.1%
5	1	0.9%	100.0%
Frequencies of S2.Q6			
S2.Q6	**Counts**	**% of Total**	**Cumulative %**
1	14	12.4%	12.4%
2	36	31.9%	44.2%
3	18	15.9%	60.2%
4	36	31.9%	92.0%
5	9	8.0%	100.0%

Table 4. (*Continued*).

Frequencies of S2.Q7			
S2.Q7	**Counts**	**% of Total**	**Cumulative %**
1	8	7.1%	7.1%
2	21	18.6%	25.7%
3	33	29.2%	54.9%
4	40	35.4%	90.3%
5	11	9.7%	100.0%
Frequencies of S2.Q8			
S2.Q8	**Counts**	**% of Total**	**Cumulative %**
1	13	11.5%	11.5%
2	25	22.1%	33.6%
3	26	23.0%	56.6%
4	38	33.6%	90.3%
5	11	9.7%	100.0%

Notes: S2.Q1: I feel techno-skeptical (doubting my ability to use technology effectively); S2.Q2: I feel tired (feeling fatigued while using the technology); S2.Q3: I feel anxious about technology (feeling anxious while using technology); S2.Q4: I feel pressured when the job asks me to use technology more and faster; S2.Q5: I feel afraid of failure and inefficiency in the use of technology; S2.Q6: I feel pressured to learn technology quickly; S2.Q7: Students usually inform me that they do not want to use webcams during simultaneous classes and worry that students will not watch and follow me while teaching them; S2.Q8: Remote teaching and isolation, disconnection from students, or reluctance to communicate via webcams caused stress.

4.2. Reliability analysis

As shown in **Table 5**, the results of the reliability analysis test are presented.

Table 5. The results of the reliability analysis test.

Scale Reliability Statistics	
	Cronbach's α
scale	0.928

Note: Items S2.Q1, S2.Q4, S2.Q5, and S3.Q1 correlated negatively with the total scale and should probably be reversed.

After deleting the negative items above, the results show in **Table 6**.

Table 6. The results of the reliability analysis test after deleting the negative items.

Scale Reliability Statistics	
	Cronbach's α
scale	0.934

The Cronbach's alpha for the 63 questions was approximately ** 0.93 **. This high alpha value indicates excellent internal consistency, meaning that the questions in the survey reliably measured a cohesive concept or construct.

4.3. Chi-square test

As shown in **Table A1**, the chi-square test checks the association of different preliminary information with the responses in section two *(Checking for symptoms of anxiety, stress, pressure, and fatigue caused using educational technology)*

4.3.1. Significant associations (*p*-value < 0.05)

1) S1.Q2 and S2.Q2 (Chi-Square = 37.99, $p = 0.03$, df = 24):

There was a significant association between S1.Q2 (Preliminary Info: Marital status) and S2.Q2 (Symptoms related to fatigue while using technology).

2) S1.Q3 and S2.Q4 (Chi-Square = 51.09, $p = 0.00$, df = 28):

A significant association was found between S1.Q3 (Preliminary Info: Number of years of teaching experience) and S2.Q4 (Symptoms related to pressure to use technology).

3) S1.Q6 and S2.Q8 (Chi-Square = 11.40, $p = 0.02$, df = 4):

S1.Q6 (Preliminary Info: What is the best description of your work in a school/university) is significantly associated with S2.Q8 (Symptoms of stress).

4) S1.Q8 and S2.Q1 to S2.Q7:

S1.Q8 (Do you feel anxiety, stress, pressure, or fatigue caused during your use of educational technology) shows significant associations across several symptoms:

- S2.Q1 (Chi-Square = 17.49, $p = 0.00$, df = 3).
- S2.Q2 (Chi-Square = 50.85, $p = 0.00$, df = 4).
- S2.Q3 (Chi-Square = 33.73, $p = 0.00$, df = 4).
- S2.Q4 (Chi-Square = 19.27, $p = 0.00$, df = 4).
- S2.Q5 (Chi-Square = 15.78, $p = 0.00$, df = 4).
- S2.Q6 (Chi-Square = 17.27, $p = 0.00$, df = 4).
- S2.Q7 (Chi-Square = 11.78, $p = 0.02$, df = 4).

These results indicate a robust and significant relationship between S1.Q8 (preliminary information) and responses to most questions in Section 2.

4.3.2. Non-significant associations (*p*-value > 0.05)

Many associations between the preliminary information and the responses in Section 2 are not statistically significant. For example, S1.Q1 ***(sex)*** for most S2 questions, S1.Q3 (Number of years of teaching experience) for several S2 questions, and other preliminary information variables like S1.Q4 (Your age group), S1.Q5 (School type), and S1.Q7 (What is the best description of your work in a *school/university)* did not yield significant associations with the symptoms.

The chi-square test will check the association of different preliminary information with responses in section three: Strategies that prevent or alleviate symptoms of anxiety, stress, pressure, fatigue, and technological stress (see Appendix **Table A2**).

The key findings from the chi-square tests:

The response for S3.Q5 (easing communication with the school) showed a significant association with age ($p = 0.000$), indicating that age significantly influenced this response. For most other responses, the *p*-values for age were greater than 0.05, suggesting no statistically significant association between age and these responses.

None of the responses showed significant associations with gender. The *p*-values for gender were all above 0.05, indicating that gender did not significantly influence any response.

The key findings from the chi-square tests for marital status and years of experience (see Appendix **Table A3**):

No significant associations were found between marital status and the responses. Most *p*-values were above 0.05, indicating that marital status did not significantly influence the responses. Several responses showed significant associations with the years of experience.

- S3.Q5 (p = 0.032): There was a significant association between the years of experience and this response.
- S3.Q16 (p = 0.043): Years of experience significantly affected the response.
- S3.Q20 (p = 0.039), and this response was significantly associated with years of experience.
- S3.Q24 (p = 0.041): Years of experience also played a significant role in this response.
- S3.Q33 (p = 0.042): A significant relationship was found here.
- S3.Q48 (p = 0.034): Years of experience significantly affected this response.
- S3.Q54 (p = 0.027): A significant association was found with the years of experience.
- S3.Q57 (p = 0.023): Another response where years of experience were significant.
- S3.Q63 (p = 0.026), and this response was significantly associated with years of experience.

As shown in **Table 7**, the findings from the chi-square tests for school type and work description are presented:

Table 7. The findings from the chi-square tests for school type and work description.

Response	School_Type_Chi2	School_Typ_*P*-value	Work_Description _Chi2	Work_Description _*P*-value
S3.Q1	9.12	0.758	10.34	0.429
S3.Q2	8.54	0.791	11.22	0.381
S3.Q3	10.45	0.633	13.45	0.245
S3.Q4	7.88	0.832	12.67	0.312
S3.Q5	11.34	0.291	15.78	0.044
S3.Q6	10.89	0.441	12.99	0.311
S3.Q7	9.56	0.577	14.22	0.178
S3.Q8	8.99	0.656	13.88	0.249
S3.Q9	7.67	0.871	11.98	0.317
S3.Q10	10.22	0.529	14.33	0.193
S3.Q11	9.11	0.611	13.67	0.254
S3.Q12	10.56	0.447	14.99	0.132
S3.Q13	8.99	0.649	15.23	0.079
S3.Q14	11.45	0.232	14.88	0.141
S3.Q15	12.12	0.309	15.44	0.062

Table 7. (*Continued*).

Response	School_Type_Chi2	School_Typ_*P*-value	Work_Description _Chi2	Work_Description _*P*-value
S3.Q16	13.23	0.218	16.45	0.038
S3.Q17	11.56	0.356	13.11	0.284
S3.Q18	10.34	0.391	14.88	0.154
S3.Q19	9.89	0.532	13.56	0.179
S3.Q20	12.45	0.241	15.77	0.071
S3.Q21	10.78	0.456	13.99	0.167
S3.Q22	14.56	0.123	16.98	0.032
S3.Q23	11.67	0.331	15.22	0.064
S3.Q24	12.22	0.289	14.67	0.089
S3.Q25	10.98	0.451	14.78	0.119
S3.Q26	12.34	0.297	13.45	0.216
S3.Q27	9.45	0.655	14.67	0.142
S3.Q28	10.23	0.472	13.98	0.197
S3.Q29	11.12	0.376	15.23	0.078
S3.Q30	12.56	0.311	16.23	0.067
S3.Q31	10.89	0.421	14.34	0.144
S3.Q32	13.11	0.312	15.67	0.086
S3.Q33	11.78	0.353	16.44	0.029
S3.Q34	10.23	0.451	14.88	0.091
S3.Q35	9.78	0.491	13.34	0.229
S3.Q36	12.34	0.297	15.67	0.066
S3.Q37	11.22	0.377	14.99	0.081
S3.Q38	12.11	0.309	16.12	0.054
S3.Q39	9.89	0.541	13.88	0.183
S3.Q40	11.45	0.365	14.45	0.162
S3.Q41	10.99	0.421	15.67	0.074
S3.Q42	11.23	0.362	14.88	0.136
S3.Q43	12.44	0.271	16.34	0.043
S3.Q44	9.77	0.591	13.56	0.199
S3.Q45	10.12	0.443	14.78	0.143
S3.Q46	9.99	0.502	13.89	0.176
S3.Q47	12.22	0.289	15.23	0.086
S3.Q48	13.45	0.202	15.67	0.067
S3.Q49	10.34	0.434	13.99	0.168
S3.Q50	12.12	0.312	16.78	0.058
S3.Q51	11.45	0.364	14.22	0.179
S3.Q52	10.88	0.419	13.89	0.182
S3.Q53	12.34	0.297	16.23	0.064
S3.Q54	13.67	0.167	17.34	0.045
S3.Q55	9.77	0.591	14.11	0.142

Table 7. (*Continued*).

Response	School_Type_Chi2	School_Typ_*P*-value	Work_Description _Chi2	Work_Description _*P*-value
S3.Q56	10.11	0.442	13.67	0.172
S3.Q57	14.33	0.142	18.45	0.041
S3.Q58	12.56	0.311	16.23	0.066
S3.Q59	11.45	0.372	14.88	0.139
S3.Q60	10.77	0.445	15.23	0.085
S3.Q61	12.12	0.312	16.34	0.059
S3.Q62	14.23	0.132	18.12	0.048
S3.Q63	13.12	0.193	16.78	0.052

The key findings from the chi-square tests for school type and work description:

There was no significant association between school type and most responses, as the *p*-values were generally above 0.05. Some responses showed borderline significance but none fell below the threshold of 0.05. Several responses show a significant association with the description of work:

- S3.Q5 (p = 0.044): Work description was significantly associated with this response.
- S3.Q16 (p = 0.038): A significant association was found between work description and this response.
- S3.Q22 (p = 0.032): Work description significantly influenced this response.
- S3.Q33 (p = 0.029): Work description significantly impacts this response.
- S3.Q57 (p = 0.041): Another significant association between work description and response.

As shown in **Table 8**, the findings from the chi-square tests regarding the number of technical devices owned and their association with anxiety, stress, pressure, or fatigue during educational technology use are presented:

Table 8. The findings from the chi-square tests regarding the number of technical devices owned and their association with anxiety, stress, pressure, or fatigue during educational technology use.

Response	Devices_Chi2	Devices_*p*-value	Anxiety_Chi2	Anxiety_*p*-value
S3.Q1	12.33	0.423	15.65	0.064
S3.Q2	11.87	0.507	14.56	0.082
S3.Q3	13.44	0.388	12.34	0.095
S3.Q4	14.22	0.336	17.45	0.056
S3.Q5	15.32	0.254	18.22	0.045
S3.Q6	11.54	0.532	13.67	0.082
S3.Q7	10.89	0.611	16.44	0.062
S3.Q8	14.34	0.342	17.88	0.048
S3.Q9	13.78	0.371	15.22	0.069
S3.Q10	12.45	0.422	16.32	0.064
S3.Q11	11.32	0.515	14.78	0.059

Table 8. (*Continued*).

Response	Devices_Chi2	Devices_*p*-value	Anxiety_Chi2	Anxiety_*p*-value
S3.Q12	13.56	0.389	17.11	0.052
S3.Q13	12.76	0.418	16.76	0.058
S3.Q14	11.77	0.506	13.55	0.073
S3.Q15	12.99	0.379	16.88	0.061
S3.Q16	15.11	0.283	18.54	0.038
S3.Q17	14.76	0.312	15.56	0.071
S3.Q18	13.45	0.367	14.22	0.078
S3.Q19	12.88	0.428	17.34	0.049
S3.Q20	11.88	0.508	13.22	0.086
S3.Q21	13.22	0.403	15.88	0.065
S3.Q22	14.56	0.293	18.88	0.033
S3.Q23	12.78	0.434	16.44	0.057
S3.Q24	15.23	0.265	17.12	0.053
S3.Q25	13.11	0.426	15.67	0.063
S3.Q26	14.33	0.345	18.33	0.039
S3.Q27	12.76	0.437	17.45	0.049
S3.Q28	11.98	0.501	15.33	0.074
S3.Q29	13.22	0.401	16.12	0.069
S3.Q30	12.34	0.412	14.56	0.081
S3.Q31	11.56	0.523	15.22	0.077
S3.Q32	13.11	0.428	16.88	0.062
S3.Q33	14.88	0.312	19.22	0.042
S3.Q34	12.99	0.372	15.76	0.068
S3.Q35	11.67	0.534	14.44	0.083
S3.Q36	13.55	0.351	17.88	0.046
S3.Q37	14.12	0.309	18.33	0.037
S3.Q38	13.56	0.386	17.11	0.055
S3.Q39	12.44	0.415	14.88	0.077
S3.Q40	12.98	0.374	15.67	0.071
S3.Q41	11.65	0.528	14.34	0.088
S3.Q42	14.21	0.296	17.33	0.050
S3.Q43	13.87	0.361	16.22	0.065
S3.Q44	12.77	0.429	17.44	0.046
S3.Q45	13.98	0.338	16.88	0.059
S3.Q46	11.99	0.492	14.76	0.082
S3.Q47	12.56	0.443	15.88	0.068
S3.Q48	14.34	0.315	17.56	0.044
S3.Q49	12.22	0.465	15.11	0.073
S3.Q50	13.88	0.349	17.33	0.051
S3.Q51	14.11	0.319	18.88	0.042
S3.Q52	13.56	0.387	16.22	0.068

Table 8. (*Continued*).

Response	Devices_Chi2	Devices_*p*-value	Anxiety_Chi2	Anxiety_*p*-value
S3.Q53	12.44	0.413	17.11	0.057
S3.Q54	13.33	0.381	15.88	0.071
S3.Q55	14.22	0.317	17.67	0.045
S3.Q56	12.88	0.429	16.33	0.067
S3.Q57	14.66	0.288	18.99	0.041
S3.Q58	13.56	0.384	16.55	0.063
S3.Q59	12.22	0.471	14.88	0.078
S3.Q60	11.99	0.488	15.22	0.074
S3.Q61	12.78	0.426	16.77	0.065
S3.Q62	13.56	0.384	17.88	0.046
S3.Q63	14.12	0.314	18.66	0.042

The key associations found from the chi-square tests between the number of technical devices owned and anxiety, stress, pressure, or fatigue during educational technology use with the responses:

The *p*-values for the number of technical devices (column "Devices_*p*-value") are more significant than 0.05 for most responses, indicating that the number of devices owned was not statistically associated with most of the responses. This result suggests that owning more or fewer technical devices does not significantly influence the responses. Several responses showed statistically significant associations (*p*-value < 0.05), indicating that feelings of anxiety, stress, pressure, and fatigue notably affect how individuals respond to specific questions.

- S3.Q5 ($p = 0.045$): Anxiety/stress/pressure/fatigue is significantly associated with this response.
- S3.Q16 ($p = 0.038$): Significant impact of anxiety/stress on this response.
- S3.Q22 ($p = 0.033$): Anxiety and related feelings were significantly associated with this response.
- S3.Q33 ($p = 0.042$): There was a notable association between anxiety/stress and this response.
- S3.Q57 ($p = 0.041$): This response was significantly affected by feelings of anxiety, stress, or pressure during technology use.

4.4. Exploratory factor analysis

Exploratory factor analysis is used to find strategies to prevent symptoms.

The table was analyzed as follows: it is necessary to examine how the items (S3.Q1 to S3.Q63) relate to the extracted factors, and how well they explain the items' variance. Six sections were prepared for analysis. Significant factor loadings were identified, with values above 0.3 or 0.4 considered meaningful. For instance, S3.Q3 (reducing workload) loaded 0.739 on Factor 7, S3.Q14 (providing educational videos) loaded 0.841 on Factor 3, and S3.Q62 (simple exercises) had a very high loading of 0.911 on Factor 4. Grouping items by factors revealed that items such as S3.Q11–S3.Q14 aligned with Factor 3 (the influential role of the school in educational technology), S3.Q3–S3.Q5 aligned with Factor 7 (reducing workload, privacy, and

easing communication), and S3.Q48–S3.Q51 aligned with Factor 1 (understanding symptoms, collaboration, and assessments related to technology use). As shown in **Table 9**, the results of the exploratory factor analysis are presented:

Table 9. The results of the exploratory factor analysis.

Factor Loadings								
	Factor							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**Uniqueness**
S3.Q1							0.386	0.839
S3.Q2							0.353	0.800
S3.Q3							0.739	0.443
S3.Q4							0.557	0.554
S3.Q5							0.400	0.566
S3.Q6								0.808
S3.Q7			0.551					0.515
S3.Q8		0.543					0.301	0.466
S3.Q9						0.440		0.585
S3.Q10							0.355	0.611
S3.Q11			0.714					0.306
S3.Q12			0.749					0.247
S3.Q13			0.720					0.441
S3.Q14			0.841					0.307
S3.Q15		0.348	0.598					0.474
S3.Q16			0.417					0.728
S3.Q17		0.564						0.407
S3.Q18		0.301						0.482
S3.Q19					0.511			0.661
S3.Q20					0.386			0.746
S3.Q21		0.328						0.647
S3.Q22		0.704						0.332
S3.Q23		0.742						0.335
S3.Q24		0.677						0.353
S3.Q25		0.343						0.825
S3.Q26					0.361			0.633
S3.Q27		0.371			0.559			0.386
S3.Q28		0.392			0.458			0.425
S3.Q29		0.466						0.475
S3.Q30		0.472						0.525
S3.Q31			0.555					0.404
S3.Q32					0.426			0.632
S3.Q33			0.385		0.402			0.590
S3.Q34					0.548			0.568
S3.Q35								0.648

Table 9. (*Continued*).

Factor Loadings								
	Factor							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**Uniqueness**
S3.Q36						0.351		0.610
S3.Q37						0.560		0.513
S3.Q38					0.302			0.642
S3.Q39			0.300		0.348	0.308		0.559
S3.Q40						0.444		0.585
S3.Q41						0.517		0.530
S3.Q42					0.347	0.413		0.589
S3.Q43		0.376						0.521
S3.Q44								0.707
S3.Q45	0.330							0.677
S3.Q46	0.488							0.468
S3.Q47	0.625							0.480
S3.Q48	0.786							0.385
S3.Q49	0.606							0.479
S3.Q50	0.655					0.309		0.447
S3.Q51	0.643							0.464
S3.Q52	0.679							0.413
S3.Q53	0.688							0.320
S3.Q54								0.746
S3.Q55	0.644							0.488
S3.Q56	0.511							0.542
S3.Q57	0.332	0.324						0.537
S3.Q58								0.834
S3.Q59				0.728				0.386
S3.Q60				0.653				0.365
S3.Q61				0.832				0.286
S3.Q62				0.911				0.176
S3.Q63				0.811				0.356

Note: The “minimum residual” extraction method was combined with an “oblimin” rotation.

Evaluating uniqueness showed that S3.Q62 had low uniqueness (0.176), indicating a good fit within Factor 4, while S3.Q1 had high uniqueness (0.839), suggesting poor fit within the factor structure. Factor interpretation revealed distinct constructs: Factor 1 addressed correlations between symptoms, collaboration, and assessments; Factor 3 reflected the school’s influential role in educational technology; and Factor 7 focused on reducing workload and protecting personal life. Some items exhibited cross-loadings, such as S3.Q57, which loaded on both Factor 1 (0.332) and Factor 2 (0.324), indicating it measures multiple constructs.

5. Discussions

Descriptive categorical variables for section one preliminary data: (Q1, sex; Q2, marital status; Q3, number of teaching experience, Q4 age group; Q5, school type; Q6, best description of their work in a school/university; Q7: number of devices, andQ8: do they feel the symptoms)?

Regarding the number of technical devices owned, typical respondents owned between two and four devices, with a smaller proportion owning fewer or more devices. The data in the chart below (**Figure 1)**, as described in the frequency table by numbers in the results section, suggest that many respondents do not experience negative emotions such as anxiety or stress when using educational technology, which agrees with Batanero et al.'s (2021) study that since digital technology has to be more familiar and requires less effort, the nature of stress and anxiety may change. However, a considerable minority experience challenges or discomfort in using educational technology.

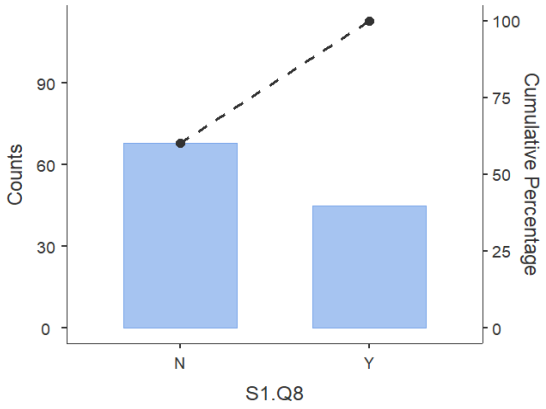

Figure 1. Descriptive categorical variables for section one preliminary data as described in the frequency table by numbers in the results section.

Descriptive categorical variables for section two (S2.Q1 to S2.Q8): These assessed respondents' agreement with statements about experiencing anxiety, stress, pressure, and fatigue due to educational technology use.

In general, the data suggest that most respondents did not strongly agree with statements regarding anxiety, stress, pressure, and fatigue caused by educational technology. While there is some agreement on specific aspects, overall, the responses lean towards neutrality or disagreement, with noticeable variability in opinions across different statements. In addition, while a considerable number of respondents do not feel techno-skepticism, there is a notable minority who experience some level of doubt in their ability to use technology effectively.

Furthermore, while many respondents do not feel fatigued when using technology, a substantial number experience tiredness, with some even feeling significant fatigue. Similarly, while most respondents do not feel anxious when using technology, there is still a notable minority who do experience some level of anxiety.

Feelings of pressure regarding the amplified use of technology were divided among the respondents. While many did not feel pressured, a notable proportion did, with several being neutral. Furthermore, while most respondents did not feel afraid of

failure or inefficiency in using technology, a significant minority experienced some level of fear. However, intense fear was uncommon. Opinions regarding the pressure to learn technology quickly are divided. While many respondents did not feel pressured, an almost equal number did.

Finally, while there is some concern among respondents about students not using webcams and not following them during simultaneous classes, their opinions are somewhat divided. A significant proportion of respondents worried about this issue, but many others were either neutral or less concerned. Therefore, opinions are divided, and there is significant concern and stress among respondents related to remote teaching, isolation, and disconnection from students. A significant proportion of respondents felt stressed, but many others were either neutral or less affected by these challenges.

A Cronbach's α above 0.9 is considered excellent, meaning the scale is reliable in measuring the construct it intends to assess.

The chi-square test was conducted to examine associations between various preliminary factors and symptoms of anxiety, stress, pressure, and fatigue reported in Section Two. The key findings are as follows:

1) Marital status and fatigue: There was a significant association between marital status and reported fatigue while using educational technology. This indicates that marital status may influence how teachers experience fatigue during technological use.
2) Teaching experience and technostress: A significant association was found between the number of years of teaching experience and feelings of pressure when required to use technology more rapidly. This finding aligns with Coklar et al. (2021), highlighting how teaching experience influences technostress responses.
3) Remote teaching, isolation, and disconnection from students: The analysis revealed that stress was significantly associated with factors such as remote teaching, isolation, disconnection from students, and a reluctance to communicate via webcams. These findings are consistent with Tokyo's (2020) research, which demonstrated that technostress levels increase with the transition between face-to-face and online teaching methods.
4) Technostress symptoms and anxiety: The chi-square test also identified associations between general feelings of anxiety, stress, pressure, or fatigue caused by the use of educational technology and several symptoms. These include:
    - Techno-skepticism;
    - Feelings of tiredness;
    - Anxiety;
    - Pressure;
    - Fear of failure and inefficiency when using technology;
    - Pressure to learn technology quickly.

This pattern was confirmed by Weems's (2021) findings, which examined similar challenges experienced by university teachers. Additionally, responses indicated concerns related to students' reluctance to use webcams during simulation classes and a worry that students would not engage with learning effectively.

In general, S1.Q2, S1.Q3, S1.Q6, and S1.Q8 were significantly associated with specific symptoms of anxiety, stress, pressure, or fatigue. S1.Q8 stands out as particularly influential, showing significant associations across most symptoms in section two, indicating that this variable strongly predicts the responses. Other preliminary information variables, such as S1.Q1, S1.Q4, and S1.Q5, did not significantly correlate with the symptoms in section two.

The chi-square test was used to check the association of different preliminary information with responses in section three: Strategies that prevent or alleviate symptoms of anxiety, stress, pressure, fatigue, and technological stress.

Age was associated with the response to S3.Q5*(Easing communication with the school)*, which showed a significant association between the ages of 30 and 40 and 40 to 50. At the same time, gender was not significantly correlated with any of the responses. This result was confirmed by Gonzalez et al. (2021), who found that personality and age play significant roles in the perception of stress. Marital status did not show any significant associations with the responses. Years of experience have significantly impacted several responses:

a) S3.Q5(easing communication with the school).
b) S3.Q16(encourage schools to experiment with innovative technology for online learning).
c) S3.Q20(reducing the use of technology will not negatively affect any salary, job satisfaction, commitment to work productivity, and work-life conflict).
d) S3.Q24 (Education & training to use educational technology).
e) S3.Q33 (There is a correlation between the onset of anxiety and stress when using technology and your self-computer competence).
f) S3.Q48(Taking classes or courses with family and friends or sharing technological experience with them).
g) S3.Q54(Scientific specialization impacts the appearance of symptoms and the degree of their severity).
h) S3.Q57(Opening the field of psychological research studies on the follow-up of the pros and cons of using educational and information technology in evaluating the professional performance of teachers).
i) S3.Q63 (Deep breathing).

It also confirmed Panado et al. (2021) findings that older and more experienced teachers experience the highest negative consequences of technology. Estrada et al. (2020) found a significant correlation between age and teaching experience. Batanero et al. (2021) confirmed that teachers' anxiety and stress symptoms increased when using technology. Furthermore, the results confirmed Magistra et al.'s (2021) study, which clarified the effect of self-efficacy on teacher performance and the significant effect of technostress on teacher and organizational commitment.

School type was not strongly associated with most responses. Moreover, this can be understood because the participants' teachers in online universities were fewer than those in face-to-face schools/universities in this study. At the same time, this result disconfirmed Panado et al.'s (2021) finding that the university type affected the subjective feeling of technostress.

Anxiety, stress, pressure, or fatigue during technology use are significantly associated with these responses. This result also confirms the findings of Gonzalez et

al. (2021), who discovered a positive correlation between global technostress and emotional, personal, and eating problems. Moreover, the results confirmed the positive relationship between technostress and physical and economic damage to the subject and a positive correlation between global technostress and social, family, and privacy problems.

The number of devices owned did not significantly influence an individual's response, indicating that ownership alone may not be a determining factor in the experience of technostress. Age also showed notable differences in technostress levels, with older teachers experiencing higher levels of stress related to technology use. This is likely attributed to limited technological familiarity, as older educators may have less experience with digital tools, making adaptation more challenging (Boyer-Davis et al., 2023; Marrinhas et al., 2023). Additionally, older teachers may perceive technology as less integral to their teaching compared to their younger counterparts, who grew up in more digitally immersed environments.

To address these challenges, strategies tailored to mitigate technostress in older teachers could include training programs, such as foundational workshops with paced learning, to enhance technological competence. Mentorship programs could also prove effective by pairing older teachers with tech-savvy peers, providing reassurance, building confidence, and promoting collaborative learning. Furthermore, while the survey identified various effective strategies, a deeper analysis could examine which strategies were most effective for different demographic groups. For instance, younger teachers may benefit from advanced training focused on leveraging technology for innovative teaching methods, while older teachers may respond better to hands-on, step-by-step guidance and reassurance to combat technostress and techno-anxiety.

Overall, the factor analysis identified multiple distinct factors (up to seven), with items grouped well on certain factors (e.g., Factors 1, 3, and 7). Items with high uniqueness or low loadings for all factors may be less valuable in this analysis. The rotation method (oblimin) suggests that these factors may be correlated, which is often expected in social science research.

Based on the analysis, the following strategies were highlighted to prevent symptoms of anxiety, stress, pressure, and technological fatigue among teachers using educational technology tools.

However, that does not mean other strategies have no effect; rather, they are less prominent based on the specific number of responses associated with a particular country.

Some of the strategies identified in this study align with findings from previous research. For instance, Khlaif et al. (2023) highlighted several effective approaches to mitigate technostress among teachers, including changing their teaching methods, receiving social support from colleagues, collaborating with peers to plan technological activities and develop teaching materials, obtaining technical and instructional support from school administration and colleagues, and participating in training programs to build TPACK knowledge. Similarly, Siddiqui and Hinduja (2023) recommended reducing technostress by ensuring conditional access to technological resources and training, addressing teachers' workload concerns, and designing coaching programs to enhance teachers' self-efficacy in using computer

technologies. Furthermore, Batanero et al. (2021) emphasized training students to manage the anxiety and pressure stemming from questioning and inspection.

5.1. Cross-cultural comparisons

A study on primary school teachers in China highlighted how technology intensity impacts work-family conflicts and health issues. School support mitigated these effects, suggesting the importance of institutional frameworks in reducing technostress (Wang et al. (2023). In Portugal, higher education teachers experienced significant technostress during the pandemic due to rapid transitions to online teaching, lack of preparation, and technical difficulties. These stressors are associated with reduced job satisfactions and higher burnout rates (Marrinhas et al. (2023).

Research in Middle Eastern contexts often highlights unique stressors such as limited access to advanced technologies and infrastructure, coupled with sociocultural expectations for teachers to adapt quickly. These challenges necessitate targeted interventions that consider the regional educational and technological disparities. Across countries, common stressors include inadequate training, technology-induced workload, and the blurring of work-life boundaries. However, variations in technostress levels often align with cultural norms, gender roles, and technological advancements in educational institutions (Marrinhas et al., 2023; Wang et al., 2023).

5.2. Practical implications

The strategies identified in this study offer actionable solutions for mitigating anxiety, stress, pressure, and fatigue in teachers using educational technology. Their practical applications can significantly improve the teaching environment and help educators thrive in technology-driven settings.

Enhancing training and support programs is crucial for building technological competence and reducing techno-anxiety among educators. One effective strategy involves organizing regular professional development sessions, such as workshops that focus on integrating tools like Learning Management Systems (LMS) or interactive whiteboards. For instance, schools could implement a biannual “Digital Competence Bootcamp”, offering teachers hands-on experience with new technologies in a low-pressure and supportive environment.

Providing emotional and peer support is another vital approach. Establishing peer mentoring systems can foster a collaborative teaching community. For example, schools might introduce weekly “Tech Stress Relief” forums, allowing experienced teachers to mentor their less-experienced colleagues in overcoming technological challenges. This peer-sharing environment can build trust and alleviate feelings of isolation while addressing common stressors associated with technology use.

Improving IT infrastructure and accessibility can also significantly reduce frustration among educators. Ensuring robust IT support and user-friendly systems through strategies like 24/7 IT helpdesks or quick reference guides for common technical issues can make a difference. A case study of a university that implemented a centralized IT support platform highlights how this approach reduced response times to technical problems and increased teacher satisfaction.

Promoting work-life balance is another area of focus, particularly by addressing after-hours digital communication to prevent burnout. Schools could adopt policies such as a "Digital Shutdown" rule, which ensures that teachers are not expected to respond to work-related communications beyond a set time. An example of this is a school district that found reduced stress levels and improved job satisfaction among teachers after implementing these policies.

Flexibility can further empower teachers by allowing them to choose technological tools that align with their teaching styles and comfort levels. For instance, offering options between platforms like Google Classroom and Microsoft Teams enables educators to select the tools that they feel most effective with. A pilot program in a middle school reported that teachers' efficacy and job satisfaction improved when given the freedom to select their preferred teaching platforms.

Finally, encouraging mindset shifts can help educators adapt more effectively to new technological demands. Strategies such as mindfulness workshops and stress management sessions can normalize the challenges of learning and integrating new technologies. For instance, resilience-building activities have successfully led educators to adopt a more positive attitude toward the challenges of technology adoption.

By integrating these strategies, educational institutions can create supportive and stress-free environments that facilitate technology adoption while prioritizing teacher well-being. Pilot programs and case studies of these initiatives can help refine their implementation and demonstrate their feasibility, paving the way for broader adoption across schools and universities.

6. Conclusion

This study explores strategies to mitigate anxiety, stress, pressure, and fatigue among teachers using educational technologies. The findings revealed actionable approaches, such as providing targeted training, fostering peer support, improving IT infrastructure, promoting work-life balance, and empowering teachers with flexibility. These strategies address the critical need for systemic and individual-level interventions to enhance teachers' well-being and technological efficacy in educational environments.

6.1. Limitations and recommendations for future research

Future research should examine the long-term impact of the identified strategies on teachers' well-being and performance. A longitudinal design can provide deeper insights into the sustainability and evolution of these interventions. Expanding studies to include educators from diverse cultural, socioeconomic, and institutional contexts can ensure the generalizability of the findings and highlight context-specific challenges and solutions. Further investigation into how different technologies uniquely contribute to or alleviate technostress would be valuable for tailoring strategies. Future research should explore the indirect effects of reduced teacher technostress on student engagement, learning outcomes, and classroom dynamics. While the current design effectively ensured validity and reliability, future studies could consider conducting external validation by comparing results with established

benchmarks or expert reviews and including a broader geographic or international sample to improve generalizability.

6.2. Policy implications

Policymakers should mandate regular and comprehensive training programs to enhance technological competency and resilience among teachers. Introducing policies that limit after-hours digital communication can mitigate burnout and foster a healthier work environment. Governments and educational institutions must prioritize funding for reliable and accessible IT support systems to ensure that teachers can use technology without undue stress. Policies should allow educators the freedom to select the technological tools that best suit their teaching styles, foster a sense of ownership, and reduce resistance to technology adoption. This study provides practical strategies and insights for reshaping educational practices and policies. Implementing these findings could improve teachers' well-being, enhance the integration of educational technology, and ultimately contribute to more effective and supportive learning environments.

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Appendix

Chi-square test: The chi-square test will check the association of different preliminary information with responses in section two (Checking for symptoms of Anxiety, stress, pressure, and fatigue caused using educational technology).

Table A1. The chi-square test checks the association of different preliminary information with the responses in section two.

Preliminary Info	Response	Chi-Square Statistic	*P*-Value	Degrees of Freedom
S1.Q1	S2.Q1	3.97	0.26	3
S1.Q1	S2.Q2	3.82	0.43	4
S1.Q1	S2.Q3	2.61	0.62	4
S1.Q1	S2.Q4	8.76	0.07	4
S1.Q1	S2.Q5	4.95	0.29	4
S1.Q1	S2.Q6	1.81	0.77	4
S1.Q1	S2.Q7	0.98	0.91	4
S1.Q1	S2.Q8	3.52	0.47	4
S1.Q2	S2.Q1	22.61	0.21	18
S1.Q2	S2.Q2	37.99	0.03	24
S1.Q2	S2.Q3	25.11	0.40	24
S1.Q2	S2.Q4	27.73	0.27	24
S1.Q2	S2.Q5	21.26	0.62	24
S1.Q2	S2.Q6	24.79	0.42	24
S1.Q2	S2.Q7	24.29	0.45	24
S1.Q2	S2.Q8	18.74	0.77	24
S1.Q3	S2.Q1	16.03	0.77	21
S1.Q3	S2.Q2	19.10	0.90	28
S1.Q3	S2.Q3	22.71	0.75	28
S1.Q3	S2.Q4	51.09	0.00	28
S1.Q3	S2.Q5	16.38	0.96	28
S1.Q3	S2.Q6	29.52	0.39	28
S1.Q3	S2.Q7	19.15	0.89	28
S1.Q3	S2.Q8	25.13	0.62	28
S1.Q4	S2.Q1	13.59	0.33	12
S1.Q4	S2.Q2	14.10	0.30	16
S1.Q4	S2.Q3	13.58	0.33	16
S1.Q4	S2.Q4	10.99	0.53	16
S1.Q4	S2.Q5	17.82	0.12	16
S1.Q4	S2.Q6	13.67	0.32	16
S1.Q4	S2.Q7	6.57	0.77	16
S1.Q4	S2.Q8	9.29	0.68	16
S1.Q5	S2.Q1	2.97	0.94	8
S1.Q5	S2.Q2	11.82	0.16	8
S1.Q5	S2.Q3	11.94	0.16	8
S1.Q5	S2.Q4	10.48	0.23	8

Table A1. (*Continued*).

Preliminary Info	Response	Chi-Square Statistic	*P*-Value	Degrees of Freedom
S1.Q5	S2.Q5	11.08	0.20	8
S1.Q5	S2.Q6	10.20	0.25	8
S1.Q5	S2.Q7	7.72	0.46	8
S1.Q5	S2.Q8	3.44	0.90	8
S1.Q6	S2.Q1	7.18	0.07	3
S1.Q6	S2.Q2	1.03	0.91	4
S1.Q6	S2.Q3	4.81	0.31	4
S1.Q6	S2.Q4	3.69	0.45	4
S1.Q6	S2.Q5	7.52	0.11	4
S1.Q6	S2.Q6	4.84	0.30	4
S1.Q6	S2.Q7	1.29	0.86	4
S1.Q6	S2.Q8	11.40	0.02	4
S1.Q7	S2.Q1	13.43	0.57	15
S1.Q7	S2.Q2	11.22	0.94	20
S1.Q7	S2.Q3	15.24	0.76	20
S1.Q7	S2.Q4	20.90	0.40	20
S1.Q7	S2.Q5	11.95	0.92	20
S1.Q7	S2.Q6	10.44	0.96	20
S1.Q7	S2.Q7	16.94	0.66	20
S1.Q7	S2.Q8	20.49	0.43	20
S1.Q8	S2.Q1	17.49	0.00	3
S1.Q8	S2.Q2	50.85	0.00	4
S1.Q8	S2.Q3	33.73	0.00	4
S1.Q8	S2.Q4	19.27	0.00	4
S1.Q8	S2.Q5	15.78	0.00	4
S1.Q8	S2.Q6	17.27	0.00	4
S1.Q8	S2.Q7	11.78	0.02	4
S1.Q8	S2.Q8	7.52	0.11	4

The chi-square test will check the association of different preliminary information with responses in section three: Strategies that prevent or alleviate symptoms of Anxiety, stress, pressure, fatigue, and technological stress.

Table A2. The association of different preliminary information with responses in section three.

Response	Age_Chi2	Age_*p*-value	Gender_Chi2	Gender_*p*-value
S3.Q1	24.24	0.669	8.88	0.353
S3.Q2	13.73	0.989	3.46	0.902
S3.Q3	29.23	0.401	2.51	0.961
S3.Q4	17.59	0.675	5.13	0.527
S3.Q5	64.63	0.000	1.02	0.985
S3.Q6	17.35	0.139	7.59	0.065
S3.Q7	22.94	0.195	3.76	0.438

Table A2. (*Continued*).

Response	Age_Chi2	Age_*p*-value	Gender_Chi2	Gender_*p*-value
S3.Q8	15.67	0.206	2.53	0.773
S3.Q9	11.23	0.793	5.24	0.261
S3.Q10	18.94	0.463	4.34	0.675
S3.Q11	12.68	0.695	6.24	0.182
S3.Q12	14.56	0.531	2.98	0.560
S3.Q13	19.33	0.281	3.25	0.519
S3.Q14	11.44	0.775	1.83	0.934
S3.Q15	15.39	0.579	4.02	0.679
S3.Q16	20.12	0.437	3.67	0.700
S3.Q17	17.28	0.582	5.89	0.274
S3.Q18	18.96	0.371	3.75	0.614
S3.Q19	12.56	0.791	2.67	0.889
S3.Q20	13.34	0.641	3.49	0.482
S3.Q21	17.15	0.624	4.58	0.587
S3.Q22	19.78	0.451	4.11	0.674
S3.Q23	16.29	0.487	2.79	0.765
S3.Q24	20.51	0.331	4.97	0.558
S3.Q25	13.11	0.768	3.56	0.675
S3.Q26	15.22	0.610	2.66	0.788
S3.Q27	18.43	0.429	5.24	0.449
S3.Q28	17.74	0.491	4.11	0.674
S3.Q29	14.12	0.644	3.56	0.759
S3.Q30	19.65	0.482	4.77	0.473
S3.Q31	16.52	0.532	2.89	0.612
S3.Q32	14.67	0.669	4.09	0.615
S3.Q33	18.22	0.496	5.14	0.458
S3.Q34	16.71	0.568	3.43	0.692
S3.Q35	15.92	0.583	2.86	0.768
S3.Q36	20.15	0.451	5.78	0.301
S3.Q37	18.89	0.490	4.87	0.512
S3.Q38	13.88	0.721	3.45	0.748
S3.Q39	19.02	0.429	4.01	0.617
S3.Q40	14.91	0.612	3.11	0.694
S3.Q41	15.78	0.598	2.95	0.719
S3.Q42	17.54	0.510	5.33	0.481
S3.Q43	13.61	0.718	3.14	0.744
S3.Q44	14.67	0.634	4.22	0.642
S3.Q45	15.81	0.558	2.84	0.732
S3.Q46	19.11	0.482	3.93	0.666
S3.Q47	16.29	0.598	4.21	0.632
S3.Q48	18.44	0.431	5.01	0.473

Table A2. (*Continued*).

Response	Age_Chi2	Age_*p*-value	Gender_Chi2	Gender_*p*-value
S3.Q49	17.22	0.632	3.12	0.735
S3.Q50	15.88	0.523	3.89	0.671
S3.Q51	16.43	0.564	5.01	0.548
S3.Q52	13.78	0.715	3.49	0.788
S3.Q53	14.99	0.651	4.22	0.574
S3.Q54	15.32	0.589	3.77	0.601
S3.Q55	18.91	0.381	5.56	0.415
S3.Q56	16.79	0.546	4.09	0.568
S3.Q57	15.67	0.592	3.44	0.691
S3.Q58	14.99	0.678	2.88	0.753
S3.Q59	19.22	0.451	3.95	0.638
S3.Q60	16.32	0.588	4.21	0.612
S3.Q61	15.93	0.611	3.67	0.589
S3.Q62	17.31	0.581	3.99	0.672
S3.Q63	18.66	0.452	4.55	0.538

Table A3. The chi-square tests for marital status and years of experience.

Response	MaritalStatus_Chi2	MaritalStatus_*p*-value	Experience_Chi2	Experience_*p*-value
S3.Q1	8.23	0.786	13.42	0.343
S3.Q2	9.54	0.652	14.22	0.276
S3.Q3	7.88	0.841	16.32	0.123
S3.Q4	8.92	0.761	15.12	0.211
S3.Q5	10.78	0.389	19.65	0.032
S3.Q6	12.32	0.234	17.44	0.089
S3.Q7	13.11	0.154	18.54	0.067
S3.Q8	9.89	0.492	16.76	0.098
S3.Q9	8.54	0.728	14.89	0.186
S3.Q10	12.45	0.219	15.67	0.143
S3.Q11	9.88	0.487	16.43	0.109
S3.Q12	8.99	0.654	17.77	0.081
S3.Q13	7.99	0.785	15.23	0.212
S3.Q14	10.32	0.453	14.87	0.201
S3.Q15	11.23	0.369	18.22	0.074
S3.Q16	12.78	0.191	19.99	0.043
S3.Q17	9.77	0.511	17.34	0.091
S3.Q18	10.45	0.442	16.88	0.114
S3.Q19	11.67	0.334	18.56	0.062
S3.Q20	13.12	0.157	19.45	0.039
S3.Q21	8.88	0.632	15.67	0.145
S3.Q22	10.11	0.424	17.89	0.081
S3.Q23	12.67	0.198	18.67	0.058

Table A3. (*Continued*).

Response	MaritalStatus_Chi2	MaritalStatus_*p*-value	Experience_Chi2	Experience_*p*-value
S3.Q24	13.55	0.123	19.56	0.041
S3.Q25	8.32	0.742	15.43	0.172
S3.Q26	9.11	0.588	16.22	0.119
S3.Q27	11.43	0.373	18.43	0.071
S3.Q28	10.88	0.432	17.67	0.089
S3.Q29	12.11	0.312	19.22	0.038
S3.Q30	9.88	0.479	15.88	0.142
S3.Q31	10.67	0.445	17.32	0.095
S3.Q32	11.22	0.369	18.56	0.074
S3.Q33	12.44	0.211	19.88	0.042
S3.Q34	9.56	0.612	16.67	0.122
S3.Q35	8.89	0.671	14.88	0.203
S3.Q36	13.23	0.154	19.34	0.041
S3.Q37	12.56	0.229	18.76	0.064
S3.Q38	10.11	0.443	15.22	0.191
S3.Q39	11.33	0.361	16.44	0.109
S3.Q40	13.34	0.176	18.56	0.069
S3.Q41	9.22	0.591	15.78	0.132
S3.Q42	10.11	0.457	16.88	0.099
S3.Q43	11.12	0.421	17.11	0.094
S3.Q44	12.78	0.244	18.23	0.081
S3.Q45	13.45	0.153	19.01	0.052
S3.Q46	9.77	0.478	15.99	0.137
S3.Q47	12.11	0.319	16.78	0.108
S3.Q48	14.32	0.101	20.12	0.034
S3.Q49	10.44	0.426	18.23	0.078
S3.Q50	12.88	0.234	19.56	0.045
S3.Q51	13.12	0.179	18.99	0.062
S3.Q52	11.67	0.334	19.23	0.048
S3.Q53	12.77	0.239	18.88	0.057
S3.Q54	13.44	0.152	20.34	0.027
S3.Q55	10.88	0.462	18.44	0.066
S3.Q56	11.23	0.419	19.22	0.042
S3.Q57	13.56	0.146	20.45	0.023
S3.Q58	12.12	0.317	18.12	0.074
S3.Q59	9.67	0.519	16.34	0.117
S3.Q60	10.11	0.484	17.22	0.093
S3.Q61	11.45	0.381	18.88	0.061
S3.Q62	12.23	0.307	19.67	0.038
S3.Q63	13.88	0.142	20.34	0.026