Assessing The Relationship Between Digital Competencies and Technostress in Higher Education

Lida Vásquez-Pajuelo[1], Jhonny Richard Rodriguez-Barboza[2], Karina Raquel Bartra-Rivero[3], Elba María Andrade-Díaz[4], Jazmín Alicia Tuesta-Vila[5], Ena Cecilia Obando-Peralta[6], Yvonne Jacqueline Alarcón-Villalobos[7]

Abstract

This study explored the relationship between digital competencies and technostress among university instructors teaching remotely in Peru. It aimed to determine whether enhancing digital skills could alleviate technostress. The research utilized a quantitative, non-experimental approach and collected data from 120 instructors from a private university in Lima, Perú using established surveys like the DigCompEdu Check-In and RED TIC. The analysis, performed through logistic regression in SPSS v27, revealed that 55.6% of instructors displayed a high level of commitment to their profession, while 58.9% exhibited adept digital pedagogical abilities. Further inferential analysis found a substantial link between digital competencies and technostress, evidenced by a Nagelkerke index of 0.622. This indicates that approximately 62.2% of the variance in technostress levels could be attributed to differences in digital skills. The findings underscore the importance of improving digital competencies among educators to significantly lower their technostress, suggesting that a greater integration of these skills in teaching practices could enhance the educational experience in digital environments.

Keywords: *Digital Competencies, Technostress, Remote Modality, University Education, Digital Pedagogy.*

Introduction

This detailed research delves into the complex link between digital competencies and technostress among university educators in Peru, assessing the effects of these competencies on the mental well-being and effectiveness of educators. Previous studies by García et al. (2007) and Caro et al. (2015) have explored the integration of digital skills in various generational and professional contexts. Reports by the European Commission (2016) and the United Nations (2023) underscore the critical importance of digital skills in educational and sustainable development, while also noting the regional gaps in these areas.

UNESCO (2020) recognizes global initiatives aimed at shifting towards online educational formats and calls for increased support for educators. Research from regions like South Korea, highlighted by Kim and Lee (2018) and Ayyagari et al. (2019), indicates that the relentless requirement for digital adaptation can lead to heightened technostress, which can be alleviated through proper training and institutional support.

In the Peruvian context, studies such as those by MINEDU (2019) and Perez (2020) have shown notable variations in the development of digital competencies among teachers. Researchers like Gomez (2019) and Torres (2018) point out issues like resistance to change and problematic evaluation criteria. The legal considerations surrounding remote work (Diario Gestión 2020) and health reports (Ministerio de Salud, 2021) underline the emerging challenges from extended digital engagement.

The research employs tools like RED-TIC and DigCompEdu to investigate how digital engagement, resources, and pedagogical approaches influence technostress factors such as anxiety and

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[1] Universidad Peruana de Ciencias Aplicadas. Lima, Perú, https://orcid.org/0000-0002-1241-3190, Email: pcaplvas@upc.edu.pe, (Corresponding Author)

[2] Universidad Peruana de Ciencias Aplicadas. Lima, Perú, https://orcid.org/0000-0001-9299-6164, Email: pcidjhro@upc.edu.pe.

[3] Universidad Peruana de Ciencias Aplicadas. Lima, Perú, https://orcid.org/0000-0002-9686-2347, Email: pchukbar@upc.edu.pe.

[4] Universidad Peruana de Ciencias Aplicadas. Lima, Perú, https://orcid.org/0000-0002-5025-213X, Email: pcmaelan@upc.edu.pe.

[5] Universidad Peruana del Norte. Lima, Perú, https://orcid.org/0000-0001-6616-3978, Email: jaztuesta@gmail.com

[6] Universidad Católica de Trujillo. Trujillo, Perú, https://orcid.org/0000-0001-5734-6764, Email: e.obando@uct.edu.pe

[7] Universidad de la Integración de las Américas. Asunción, Paraguay, https://orcid.org/ 0009-0009-6993-8201, Email: yalarcon@unida.edu.py

inefficacy, as discussed by Salanova & Llorens (2019), Alejo (2022), and others. It underscores the urgent need for effective technology management policies in educational environments to lessen the negative impacts of technostress, which have been intensified by the pandemic-driven shift to remote working practices.

THEORETICAL FRAMEWORK

This extensive study delves into the complex connections between digital competencies, technostress, and emotional intelligence in educational settings, with a particular focus on university educators in Peru. The research is organized into three thematic areas as outlined by Wilson et al. (2011): digital competencies, technostress, and the interplay between emotional intelligence and digital skills.

Within the digital competencies framework, the research underscores the disparities in ICT management abilities among Lima's university professors, influenced by differences in gender, age, and experience. This highlights the need for tailored diagnostic training programs. Dávila et al. (2023) recognize a positive correlation between digital skills and ICT proficiency, pointing to the advantages of online training environments. Bustillos (2023) connects motivation with the development of digital competencies, promoting community-oriented learning in digital platforms. Additionally, Huamanlazo & Tapia (2021) link digital skills directly to improved teaching performance (Khan et al., 2019; 2022)

In the realm of technostress, the study refers to Torres (2021), who notes that transformational leadership within educational institutions can help reduce technostress levels. Alcas et al. (2019) discuss how technological expertise and its perceived quality impact teacher well-being in a university setting in Lima. Malaver (2021) explores how working conditions in online teaching formats contribute to technostress, while Pancorbo (2022) highlights the significant role of digital competency management in inducing technofatigue. Through these findings, the study emphasizes the need for effective management of digital skills and support systems to enhance teacher well-being and effectiveness in educational environments.

This research thoroughly investigates the convergence of emotional intelligence and digital competencies, specifically highlighting the work of Ruiz (2023), who establishes a strong correlation indicating that emotional skills, such as stress management, significantly enhance the use of digital resources. Méndez and Cuéllar (2021), along with Romero et al. (2015), emphasize the utility of platforms like ZOOM and Google MEET, and the application of gamification techniques as pivotal in cultivating organizational and motivational skills essential for dynamic learning environments (Iqbal et al., 2020).

Additionally, the study draws on the theoretical contributions of Piaget's cognitive development theories and Vygotsky's sociocultural theories (García, 2020) to provide a framework for understanding the acquisition and application of digital competencies. These theories underscore that effective educational strategies should cater to the cognitive development stages identified by Piaget and should leverage social interactions and cultural tools, as suggested by Vygotsky, in the learning process (Khan et al., 2014; 2015)

Employing the RED Model and the Person-Environment Fit Theory, the study further explores how digital tools and working environments interact to present psychosocial risks. It highlights the critical need to align technological demands with the individual capabilities and environmental resources to optimize educational outcomes and enhance teacher well-being. This comprehensive approach offers profound insights into the psychosocial dynamics prevalent in technology-enriched educational settings, thereby guiding the development of more effective interventions and policies to improve digital competencies and manage technostress effectively (Li et al., 2022; Abbas et al., 2023).

Digital Competencies

The concept of digital literacy, as defined by Martínez et al. (2013), is increasingly recognized as crucial in contemporary workplaces and educational settings. It comprises a broad array of skills essential for effectively navigating technological environments. These skills are not limited to basic technical capabilities but extend to collaboration, communication, content creation, and the maintenance of online

security and privacy—elements vital for proficient communication, research, and information management through digital platforms.

The importance of digital literacy is underscored by its role in mitigating psychosocial risks associated with technology use in professional environments. This critical competency is supported by theoretical models such as the RED Model and the Person-Environment Fit Theory, which facilitate the analysis and enhancement of how individuals engage with technology in their respective workspaces. Furthermore, the European Commission (2016) highlights that digital competencies include the safe and reflective use of ICT, crucial not only in professional but also in leisure contexts. These competencies are integral for effectively maneuvering through the complexities of the Information Society, emphasizing the need for comprehensive digital literacy in today's digital-centric world.

Furthermore, these competencies encompass the management of computer operations for acquiring, evaluating, storing, producing, presenting, and exchanging information. They also extend to skills required for effective communication and active participation in collaborative networks, as detailed by Cabero-Almenara et al. (2020). These researchers have also examined various international frameworks for assessing digital skills, highlighting the DigCompEdu of the European Union and the ISTE standards for US teachers as highly regarded based on expert assessments.

Digital competence, as structured by the National Institute of Educational Technologies and Teacher Training (INTEF, 2017), includes several dimensions that are critical for the effective use of technologies in education. These dimensions encompass professional engagement, digital resources management, digital pedagogy, assessment and feedback, and digital empowerment. These areas are essential for educators who are dedicated to continuously adapting and acquiring new technologies to improve their teaching methods.

Each dimension, from securely selecting and managing digital resources (Freundt et al., 2023) to using digital technologies for collaborative and self-directed learning (INTEF, 2017), plays a pivotal role in education. Other aspects, such as providing constructive feedback (García & Acuña, 2022), facilitating media and information literacy (García et al., 2022), and promoting responsible use and digital well-being (Torres, 2023), are also highlighted. Moreover, skills like digital content creation (Fernando et al., 2023), problem-solving (Centurión, 2023), and active participation in digital projects (Palacios and Cadenillas, 2023) are crucial for educators to effectively navigate and utilize digital platforms.

Technostress

The concept of technostress, initially identified by Broad in 1984 as stress stemming from an inability to cope with technological demands at work, has expanded significantly over the years. It is now recognized as a multifaceted phenomenon that affects various aspects of human well-being, including attitudes, behaviors, thoughts, and physical health. This broader understanding is supported by research from Sánchez et al. (2020), Martínez et al. (2022), and Bufon (2021), who view technostress as a complex condition with wide-ranging negative impacts on individuals interacting with technology.

Recent studies, such as those by Carabel et al. (2020), have further refined our understanding of technostress by examining its impact across cognitive, affective, behavioral, and physiological dimensions. The challenges associated with technostress have been exacerbated by the COVID-19 pandemic, which led to technological overload as many activities shifted online. This highlighted the disparities between external demands and individuals' internal capabilities, as well as dependencies on technology and varying levels of computer self-efficacy.

Salanova et al. (2003) highlight that technostress arises from perceived discrepancies between the demands of technology and the available resources to manage them. This misalignment can trigger adverse psychophysiological responses and foster negative attitudes towards information and communication technologies (ICTs). Further exploration by Cárdenas and Bracho (2020) identifies specific symptoms of technostress such as anxiety, fatigue, skepticism, and inefficacy, which are particularly prevalent in

technology-intensive environments.

The real-world implications of these theories are clearly observable in modern workplaces, where issues such as anxiety over technological obsolescence, fatigue from continuous digital engagement, skepticism about the utility of new technologies, and feelings of inefficacy due to inadequate digital skills are common. These challenges are often exacerbated by factors like information overload and intense work pressure, yet they can be mitigated through enhanced digital literacy and strong organizational support.

Finally, the dimensions of technostress defined by Ventura et al. (2005)—anxiety, fatigue, skepticism, and inefficacy—are key indicators for assessing its impact on both professional and personal life. Understanding and addressing these dimensions, as well as recognizing the factors that contribute to and mitigate technostress, are crucial for developing strategies that promote better technological adaptation and reduce the negative effects of this increasingly prevalent workplace issue.

Research Methodology

This study elaborates on the framework and procedures utilized to explore the influence of digital competencies on technostress among university teachers in remote settings in Peru. This research adheres to the classification of basic research as defined by Luna (1989), which aims to contribute to scientific knowledge without direct practical applications. Employing a non-experimental design, as specified by Sautu et al. (2005), this study observes and analyzes phenomena without manipulating variables, utilizing a deductive approach to test hypotheses within the positivist paradigm (Mesa, 2015).

Study Design and Setting

The research employs a quantitative methodology to establish causal correlations between digital competencies and technostress. This approach is guided by a comprehensive review of literature sourced from databases like Scielo, Web of Science, and Scopus, ensuring a robust theoretical foundation. The study is conducted among the faculty of a Peruvian university that operates remotely, providing a context that underscores the relevance of digital competencies in modern educational settings.

Study Participants and Sampling

The participant group consists of teachers from all undergraduate faculties at the aforementioned university, engaged in remote teaching modalities. A total of 120 teachers were selected using a non-probabilistic convenience sampling method (Velasco & Martínez, 2017), designed to facilitate ease of access and participation, reflective of the common practices in educational research where specific groups are targeted based on their availability and relevance to the study's objectives.

Data Collection Tool and Technique

Data collection was executed through structured surveys employing standardized questionnaires: the DigCompEdu Check-In for assessing digital competencies and the RED TIC for measuring technostress. Both instruments have been validated by experts for reliability and accuracy, with Cronbach's Alpha scores of 0.889 for Digital Competencies and 0.939 for Technostress, indicating high reliability (Patiño & Siccha, 2021). Data analysis involved descriptive statistics to outline basic trends and inferential statistics, including ordinal logistic regression, to probe deeper into the relationships between the studied variables.

Table 1 Reliability Results of Instruments

Instrument	Reliability Coefficient	Reliability Result	Number of Participants

Digital Competencies	Cronbach's Alpha	0.889	30
Technostress	Cronbach's Alpha	0.939	30

Note: Statistical results.

Table 1 presents the reliability results for two instruments used in a study examining digital competencies and technostress among university teachers. The reliability of these instruments is assessed using Cronbach's Alpha, a statistic that measures the internal consistency of a questionnaire, indicating how well a group of items measures a single attribute or concept.

For the instrument measuring digital competencies, a Cronbach's Alpha coefficient of 0.889 is obtained from responses of 30 participants. This value suggests high reliability, indicating that the items in the questionnaire are coherent with each other and provide a consistent measurement of digital competencies. A value close to 0.9 is generally considered very good, reflecting the robustness of the instrument in terms of internal consistency.

The second instrument, aimed at assessing technostress, shows an even higher Cronbach's Alpha coefficient of 0.939, with the same number of participants. This exceptionally high result indicates excellent reliability of the instrument, ensuring that the questions are well-aligned to consistently evaluate technostress. Such a high coefficient is indicative of the instrument's extremely effective capability in capturing the dimensions of technostress cohesively.

In summary, both instruments demonstrate excellent reliability, which is crucial for ensuring that the assessment of digital competencies and technostress is accurate and consistent. This high reliability also reinforces the validity of the conclusions that can be drawn from the study, as the instruments used are effective and coherent in measuring the concepts under investigation.

Ethical Considerations

Ethical rigor was a cornerstone of this study, with strict adherence to ethical guidelines set by Sánchez-Chero et al. (2023). These included ensuring participant autonomy, non-maleficence, beneficence, and justice. Ethical approval was secured, and informed consent was obtained from all participants, emphasizing the confidentiality and academic intent of the data usage. The ethical framework was in accordance with standards prescribed by the Pontificia Universidad Católica del Perú (2017), Prats et al. (2016), and Manig et al. (2022), guaranteeing that all procedures respected the rights and welfare of the participants.

This comprehensive methodological and ethical framework not only strengthens the scientific validity of the study but also ensures that it contributes valuable insights capable of informing future research and enhancing educational practices in digital environments.

Results

In the results section of the study, a detailed analysis of the data offers insights into how digital competencies influence technostress among university teachers operating in remote environments in Peru. The analysis consists of two parts: the descriptive component, which outlines the current levels of digital competencies and technostress among the teachers, and the inferential component, which explores the causal relationships between these variables.

This dual approach is visually represented through various charts and accompanied by detailed statistical data, providing a quantitative view of the challenges and conditions faced by teachers in the modern digital educational context. This structured presentation not only clarifies the extent of digital competencies and technostress but also highlights their interactions, offering valuable perspectives on potential interventions or policy adjustments needed to support educators in remote settings.

The descriptive analysis breaks down the levels of digital competencies across six key dimensions:

- Professional Engagement: Over half of the teachers (55.6%) displayed high levels of professional engagement, indicating effective adaptation to remote teaching demands and a proactive approach to improving digital skills. Approximately 38.9% of teachers achieved a regular level of engagement, suggesting adequate, yet improvable, competencies. A small minority (5.6%) were found to be deficient, highlighting a clear need for professional development in this area.

- Digital Resources: The majority of participants (58.9%) were efficiently equipped with necessary technological tools, indicating strong capabilities in managing digital resources. However, about 28.9% were at a regular level and 12.2% displayed deficiencies, pointing to potential areas for enhancement in technology integration and management.

- Digital Pedagogy: Similarly, 58.9% of teachers were proficient in integrating digital technologies into their pedagogy, effectively utilizing digital tools to enhance teaching. Yet, there remains a considerable portion (26.7% at regular and 14.4% at deficient levels) who need further training to fully capitalize on digital teaching methods.

- Assessment and Feedback: Half of the respondents (50%) were proficient in digital assessment and feedback strategies, crucial for effective online education. Still, 38.9% were only at a regular level and 11.1% were deficient, indicating a need for focused development programs in these areas.

- Empowerment of Students: A significant number of teachers (56.7%) excelled at empowering students in digital settings, fostering autonomy and active participation. However, improvements are necessary for the 33.3% at a regular level and 10.2% at a deficient level to enhance educational effectiveness online.

- Digital Transfer: Over half (55.6%) demonstrated the ability to help students apply digital knowledge across various contexts, a vital skill in modern education. Nevertheless, a substantial group (33.3% at regular and 11.1% at deficient levels) needs to improve their capability to extend digital learning beyond the classroom.

The levels of technostress across its various dimensions among a group of teachers in a remote setting. This descriptive analysis reveals the following:

The analysis of technostress among teachers reveals nuanced effects of digital competencies on their psychological well-being in a remote educational environment. This section explores various dimensions of technostress, including anxiety, fatigue, skepticism, and perceived inefficacy, and discusses their prevalence among teachers at a Peruvian university.

- Anxiety: Anxiety levels among the teachers indicate a mixed comfort with technology. A third (33.3%) experience a low level of anxiety, suggesting comfort and adaptability in using ICT for teaching. However, the majority (46.7%) report moderate anxiety, reflecting some underlying challenges or reservations with technology use. A concerning 20% of teachers face high anxiety levels, which likely impairs their effectiveness in a virtual classroom setting.

- Fatigue: Similar to anxiety, fatigue from technology use is significant but varies in intensity. About 34.4% of teachers feel low levels of fatigue, indicating that they do not find the use of technology overly tiring. Yet, 42.2% experience moderate fatigue, and 23.3% report high fatigue, both of which can diminish their well-being and teaching performance.

- Skepticism: Skepticism towards technology adoption shows that half of the teachers (50%) have a low level of skepticism, which implies a general acceptance or positive view towards integrating ICT in their practices. Nevertheless, 31.1% maintain moderate skepticism, and 18.9% are highly

skeptical, indicating resistance or doubts about the efficacy of technology in education.

- Inefficacy: In terms of perceived inefficacy, nearly half of the teachers (48.9%) believe they use technology effectively in their teaching, showing a low level of inefficacy. However, 34.4% view themselves as only moderately effective, and 16.7% consider themselves highly ineffective, highlighting a need for enhanced technological training.

- The predominant moderate levels of anxiety and fatigue suggest that while teachers are coping with technostress, the presence of these stressors could be better managed through targeted interventions. The lower levels of skepticism and inefficacy reflect a generally positive orientation towards technology, but also underscore the importance of supporting teachers to fully capitalize on digital tools. These insights point to critical areas for further training and professional development initiatives aimed at reducing technostress and enriching the remote educational experience for both instructors and their students.

The Logistic Regression Analysis for the study provides crucial insights into the relationship between digital competencies and technostress among remote teachers. Initially, the model only including an intercept (the null model) showed a "-2 Log Likelihood" of 93.130, establishing a baseline fit. The inclusion of digital competencies as predictors significantly improved the model fit, with a final "-2 Log Likelihood" of 22.571, indicating a better predictive accuracy.

The final model's Chi-square value of 70.559, with a significance level practically at zero ($p < 0.0001$), robustly rejects the null hypothesis, affirming that digital competencies are significantly related to technostress. This suggests that enhancements in digital competencies can effectively reduce technostress among teachers.

Goodness of fit tests—Pearson and Deviance—also support the model's validity, with significance values indicating a good fit to the observed data. Moreover, the Nagelkerke Pseudo R-Squared value of 0.622 explains about 62.2% of the variability in technostress, underscoring the substantial impact of digital competencies on mitigating technostress. This comprehensive analysis confirms the predictive capacity of the model and highlights the importance of digital skills in managing technostress in educational environments.

Table 2 Correlation between the Dimensions of Digital Competence and the Dimensions of Technostress (Nagelkerke Pseudo R-squared)

Digital Competence Factor	Technostress Dimension	Nagelkerke Index
Digital Resources		
	Anxiety	0.139
	Fatigue	0.136
	Skepticism	0.125
	Inefficacy	0.129
Digital Pedagogy		
	Anxiety	0.248
	Fatigue	0.262
	Skepticism	0.254
	Inefficacy	0.326
Assessment and Feedback	Anxiety	
	Fatigue	0.323
	Skepticism	0.363
	Inefficacy	0.331
	Anxiety	0.368

	Fatigue	
Empowering Students	Skepticism	0.302
	Inefficacy	0.351
	Anxiety	0.297
	Fatigue	0.302
Digital Transfer	Skepticism	
	Inefficacy	0.263
	Anxiety	0.333
	Fatigue	0.270
	Skepticism	0.296

Note: We observe which combinations show higher correlations and might, therefore, represent priority areas for intervention or further study.

Table 2 details how different dimensions of digital competence impact the various facets of technostress, as reflected in the Nagelkerke indexes. Interpreting these values, we encounter an interesting narrative about the interaction between teachers' digital skills and their well-being in virtual educational environments.

The statistical analysis reveals specific numerical relationships between various digital competencies and technostress components among teachers, as captured by Nagelkerke index values:

Digital Resources

Anxiety: Nagelkerke index of 0.139 indicates a moderate correlation with how digital resources affect teacher anxiety.

Fatigue: Nagelkerke index of 0.136 suggests a similar moderate relationship with teacher fatigue due to digital resource usage.

Skepticism: Nagelkerke index of 0.125 shows a slightly less pronounced impact on skepticism towards technology.

Inefficacy: Nagelkerke index of 0.129 points to a moderate effect on teachers' perceptions of their efficacy in using digital resources.

Digital Pedagogy:

Anxiety and Fatigue: Higher impacts with Nagelkerke indexes suggesting that effective digital pedagogical practices can notably mitigate these forms of technostress.

Inefficacy: A substantial Nagelkerke index of 0.326 indicates a significant relationship, highlighting the importance of pedagogical competence in reducing feelings of inefficacy.

Assessment and Feedback

These aspects demonstrate strong correlations with technostress, particularly in terms of inefficacy and fatigue, with Nagelkerke indexes ranging between 0.323 and 0.368. This underscores the critical role of digital assessment and feedback in influencing teacher experiences.

Empowering Students

Indexes above 0.297 show a significant positive impact on reducing technostress by promoting student autonomy and competence in digital settings.

Digital Transfer

Fatigue: Nagelkerke indexes from 0.263 to 0.333 suggest that the ability to teach transferable digital skills also moderately influences technostress, particularly affecting fatigue.

Discussion

The study investigates the influence of digital competencies on technostress among teachers, revealing that these competencies moderately affect technostress, supported by findings from Dávila et al. (2023) and Huamanlazo and Tapia (2021). These studies align with the Job Demands-Resources (JDR) theory, emphasizing the predictive power of ICT skills on technostress.

Professional commitment significantly impacts stress-related variables such as anxiety and fatigue, as highlighted by Vivar et al. (2022) and Pancorbo (2022). This relationship is contextualized within the Person-Environment Fit theory and the RED model, suggesting that high commitment can increase technostress due to hyperconnectivity and inefficient digital management.

The role of digital resources in mitigating technostress is underscored as being low but crucial, with proficient management linked to reduced stress (Martínez and Garces, 2020; Alcas et al., 2019). This supports the Constructivist theory and the Job Demands-Resources model as posited by Carretero (2009) and Chamorro-Atalaya et al. (2023).

Digital pedagogy appears as a significant factor in reducing technostress, particularly inefficacy, with substantial support from the work of Mendoza (2023) and Goldemberg (2022). These studies leverage Connectivist theory and Vygotsky's educational principles, affirming the positive impact of technologically enhanced pedagogy.

The effectiveness of digital assessment and feedback is corroborated by the results and the studies of Gomez (2023) and Ruiz (2023), with theoretical backing from Conectivism (Sáez, 2019; Siemens, 2004; Siemens, 2019; López & Escobedo, 2021).

However, there are noted discrepancies. The impact of professional commitment on technostress is debated, with studies like Concha (2019) and Huerta et al. (2022) suggesting a higher incidence among older teachers, possibly due to methodological differences. Similarly, while some studies report that digital resources increase anxiety (Vivar et al., 2022; Maryari et al., 2023), the current findings show a lesser impact, potentially reflecting variations in tool usage or teacher competencies.

In digital pedagogy, Bustillos (2023) warns of the risks of ineffective implementation, which could lead to increased technostress, contrasting with the generally positive findings of other research.

Lastly, the universally positive views on technology-mediated assessment and feedback are tempered by concerns from Martínez and Garcés (2020) about potential overdependence on such technologies, suggesting a need for balanced integration.

These insights not only align and diverge from existing literature but also pave the way for future research to address these inconsistencies and further explore the technological impacts on education.

Conclusion

The inferential analysis of the study reveals significant findings regarding the relationship between digital competencies and technostress among remote teachers at a Peruvian university. It was observed that a higher level of digital competencies reduces adverse effects such as technostress, directly impacting the

psychological and physical health of the teachers. Specifically, professional commitment, which includes communication and collaboration in digital environments, has a particularly notable influence on anxiety.

Regarding digital resources, their impact is primarily observed in how the digital strategies employed by teachers affect their levels of anxiety. Digital pedagogy significantly influences all dimensions of technostress, especially inefficacy, highlighting the importance of guiding and teaching effectively in virtual environments. Assessment and feedback exert the greatest influence on perceived inefficacy, suggesting that assertive feedback techniques and the use of technology in assessment can raise doubts among teachers about their effectiveness.

Empowering students significantly affects all dimensions of technostress, with a special emphasis on fatigue, reflecting how promoting student autonomy through digital platforms can cause physical and mental stress in teachers. Lastly, the ability to transfer digital skills to students particularly impacts teacher fatigue, indicating that digital education, when carried out with deep mastery and planning, can have an emotional cost. Overall, these results underline the complex interaction between the mastery of educational technology and faculty well-being, emphasizing the need for targeted support strategies for educators in the digital age.

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