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ORIGINAL

How Digital Competence Reduces Technostress

¿Cómo las competencias digitales reducen el tecnoestrés?

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ABSTRACT

This research examined the link between digital competencies and technostress among university instructors in remote settings in Peru, with the goal of identifying if improving digital skills could help mitigate technostress. A non-experimental, quantitative methodology was employed, gathering data via standardized surveys such as the DigCompEdu Check-In and RED TIC. The participant group comprised 120 teachers, whose responses were analyzed using logistic regression in SPSS v27. Descriptive findings indicated that 55,6 % of the teachers demonstrated a high level of professional commitment, and 58,9 % showed proficient digital pedagogical skills. Inferential analysis showed a significant correlation between digital competencies and technostress, with a Nagelkerke index of 0,622, suggesting that about 62,2 % of the variation in technostress could be explained by differences in digital competencies. The study concludes that enhancing digital competencies among teachers could substantially reduce their technostress, emphasizing the need to effectively integrate these skills into teaching practices to improve the educational experience in virtual settings.

Keywords: Digital Competencies; Technostress; Remote Modality; University Education; Digital Pedagogy.

RESUMEN

Esta investigación examinó el vínculo entre las competencias digitales y el tecnoestrés entre los instructores universitarios en entornos remotos en Perú, con el objetivo de identificar si la mejora de las competencias digitales podría ayudar a mitigar el tecnoestrés. Se empleó una metodología cuantitativa no experimental, recopilando datos a través de encuestas estandarizadas como el DigCompEdu Check-In y RED TIC. El grupo participante estaba formado por 120 profesores, cuyas respuestas se analizaron mediante regresión logística en SPSS v27. Los resultados descriptivos indicaron que el 55,6 % de los profesores demostraron un alto nivel de compromiso profesional, y el 58,9 % mostraron competencias pedagógicas digitales competentes. El análisis inferencial mostró una correlación significativa entre las competencias digitales y el tecnoestrés, con un índice de Nagelkerke de 0,622, lo que sugiere que alrededor del 62,2 % de la variación en el tecnoestrés podría explicarse por las diferencias en las competencias digitales. El estudio concluye que la mejora de las competencias digitales entre los profesores podría reducir sustancialmente su tecnoestrés, haciendo hincapié en la necesidad de integrar eficazmente estas habilidades en las prácticas docentes para mejorar la experiencia educativa en entornos virtuales.

Palabras clave: Competencias Digitales; Tecnoestrés; Modalidad A Distancia; Enseñanza Universitaria; Pedagogía Digital.

INTRODUCTION

This comprehensive study examines the intricate relationship between digital competencies and technostress among university educators in Peru, focusing on how these competencies impact educators' mental health and efficacy. The integration of digital skills across different generations and their vital and professional contexts. [1,2] International institutions emphasize the essential role of digital competencies in education and sustainable development respectively, while highlighting regional disparities in implementation.[3,4]

Global efforts to transition to virtual educational environments,[5] advocating for enhanced support for teachers. In technologically advanced societies like South Korea, the constant demand for digital adaptation can induce higher levels of technostress, which can be mitigated through adequate training and institutional support.[6,7]

In Peru, variations in digital competency development among teachers have been significant identified such as resistance to change and evaluation criteria.[8,9,10,11] The legal framework surrounding remote work [12] and subsequent health reports [13] reflect the pressing issues arising from prolonged digital exposure.

The study utilizes tools such as RED-TIC and DigCompEdu to explore how digital engagement, resources, and pedagogy affect technostress dimensions like anxiety and inefficacy.[14,15,16,17] It highlights the pressing need for effective technological management policies within educational settings to mitigate the adverse effects of such stress, exacerbated by the pandemic's imposition of remote work practices.

Theoretical framework

This comprehensive study explores the intricate relationships among digital competencies, technostress, and emotional intelligence within educational contexts, particularly focusing on the implications for university educators in Peru. The research is thematically divided into understanding digital competencies, examining technostress, and investigating the interplay between emotional intelligence and digital competencies, following categorizations.[18]

In the realm of digital competencies, it is highlighted the variance in ICT management skills among Lima professors based on gender, age, and experience, suggesting the necessity for targeted diagnostic training. A positive relationship between digital skills and ICT mastery despite gaps in competency development, emphasizing the benefits of virtual training environments.[19] It is linked motivation with digital competency development,[20] advocating for community-driven learning in virtual settings. Digital competencies correlates with enhanced pedagogical performance.[21]

Addressing technostress, it has been found that transformational leadership styles in educational settings can effectively mitigate technostress levels.[22] Additionally, perceptions of service quality at a university in Lima are influenced by technological mastery and its impact on teacher well-being.[23] Furthermore, the role of working conditions in technostress in virtual modalities is emphasized,[24] highlighting the significant effect of digital competency management on technofatigue.[25]

The relationship between emotional intelligence and digital competencies has been significantly explored by Ruiz, who identifies a strong connection indicating that emotional skills, particularly stress management, enhance the utilization of digital resources.[26] Additionally, Méndez and Cuéllar, along with Romero et al., emphasize the importance of platforms such as ZOOM and Google MEET, coupled with gamification techniques, in developing organizational and motivational skills essential for dynamic learning environments.[27,28]

Furthermore, the theoretical foundations provided by Piaget's cognitive development theories and Vygotsky's sociocultural theories [29] offer valuable frameworks for understanding how digital competencies are acquired and applied. These theories suggest that effective educational strategies should accommodate cognitive development stages (Piaget) and emphasize the importance of social interactions and cultural tools (Vygotsky) in learning processes.

This study uses the RED Model and the Person-Environment Fit Theory to further dissect how digital tools and work environments interact to pose psychosocial risks, highlighting the necessity of aligning technological demands with individual and environmental resources to optimize educational outcomes and teacher well-being. This multifaceted approach provides a deep understanding of the psychosocial dynamics at play in technology-rich educational settings, paving the way for more effective interventions and policies to enhance digital competencies and manage technostress effectively.

Digital Competencies

The concept of digital literacy is increasingly acknowledged as crucial in contemporary workplaces and educational settings. It is defined as a multifaceted set of skills that equips individuals to function competently within technological environments.[30] These skills are essential not only for performing basic technical tasks but also for enabling collaboration, communication, content creation, and the upkeep of online security and privacy. Such competencies are vital for efficient communication, research, and the management of information through digital media.

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Highlighting the need to mitigate psychosocial risks associated with technology use at work, digital literacy emerges as a critical competency. This necessity is well-supported by theoretical frameworks such as the RED and Person-Environment Fit models, which assess and improve how people interact with technology in their work environments. The European Commission [3] has also elaborated on digital competencies as encompassing safe and reflective ICT use, both in professional and leisure contexts, crucial for navigating the Information Society.

Table 1. International Frameworks on Teacher Digital Competencies (TDC) According to Expert Judgment Evaluation

Assigned Order for International Frameworks on Teacher Digital Competencies (TDC)		Puntuación media
1°	European Union Framework for Digital Teacher Competence.	5,62
2°	Common Framework for Digital Teacher Competence from the "National Institute of Educational Technology and Teacher Training".	5,41
3°	ICT Competencies for Teacher Professional Development from the National Ministry of Education of Colombia.	5,40
4°	UK Digital Teaching Framework.	5,40
5°	UNESCO ICT Competency Framework for Teachers.	5,37
6°	ICT Skills and Standards for the Teaching Profession from the Ministry of Education of Chile.	5,27
7°	"International Society for Technology in Education" (ISTE) Framework for Teachers.	5,25

Moreover, these competencies include managing computer operations for acquiring, evaluating, storing, producing, presenting, and exchanging information. They also involve capabilities for effective communication and active participation in collaborative networks.[31] These researchers have also explored various international frameworks for measuring digital skills, placing the DigCompEdu of the European Union and the ISTE for US teachers at significant rankings based on expert evaluations.

Structured by the National Institute of Educational Technologies and Teacher Training,[32] digital competence involves several dimensions crucial for the effective use of technologies in education. These include professional engagement, digital resources management, digital pedagogy, assessment and feedback, and digital empowerment—all vital for educators committed to continual adaptation and learning new technologies to enhance their teaching practices.

Each dimension, from selecting and managing digital resources securely [33] to employing digital technologies for collaborative and self-directed learning,[32] plays a critical role. Other aspects such as providing constructive feedback,[34] facilitating media and information literacy,[35] and promoting responsible use and digital well-being [36] are also emphasized. Additionally, capabilities like digital content creation,[37] problem-solving,[38] and active participation in digital projects [39] are essential for educators to master in order to effectively navigate and utilize digital platforms.

Technostress

The concept of technostress, first identified by Broad in 1984, has evolved significantly over the decades. Initially defined as a form of stress stemming from the inability to cope with the technological demands of the workplace, it has grown into a multifaceted phenomenon impacting various aspects of human well-being. This broader perspective [40,41,42] views technostress as a complex condition manifesting negative effects on attitudes, behaviors, thoughts, and physical health of individuals interacting with technology.

Recent studies have further refined the understanding of technostress by examining its impact across cognitive, affective, behavioral, and physiological dimensions.[43] The COVID-19 pandemic has exacerbated these issues, leading to technological overload as many operations moved online, highlighting the imbalances between external demands and internal capabilities, alongside dependencies on technology and varying levels of computer self-efficacy.

Technostress arises from perceived discrepancies between the demands of technology and the resources available to manage them.[44] This misalignment can trigger adverse psychophysiological responses and cultivate negative attitudes towards information and communication technologies (ICTs). Specific symptoms of technostress such as anxiety, fatigue, skepticism, and inefficacy, particularly afflict individuals in tech-intensive environments.[45]

The real-world implications of these theories are evident in the contemporary workplace, where anxiety over technological obsolescence, fatigue from continuous digital engagement, skepticism about the utility of new tech, and feelings of inefficacy due to insufficient digital skills are prevalent. These issues are often intensified by factors like information overload and work pressure yet can be mitigated through digital literacy

and robust organizational support.

Finally, the dimensions of technostress are—anxiety, fatigue, skepticism, and inefficacy—serve as critical indicators for assessing its impact on both professional and personal life.[46] Understanding and addressing these dimensions, alongside recognizing the factors that generate and inhibit technostress, are essential for developing strategies that enhance technological adaptation and mitigate the adverse effects of this increasingly common workplace phenomenon.

Methodological design

This research is categorized as basic,[47] and focuses on enriching scientific theory without immediate practical applications. It employs a non-experimental design which does not manipulate variables but rather observes reality to analyze it subsequently.[48] This quantitative study adopts a deductive approach to verify hypotheses regarding the causal correlational relationships between digital competencies and technostress among university teachers in remote settings, in line with the positivist paradigm.[49]

The variables include digital competencies as the independent variable, operationally defined through the Digital Competence Reference Framework for Teachers,[50] and technostress as the dependent variable, characterized in dimensions such as anxiety and fatigue, measured using a Likert scale.

The study population comprises teachers from all undergraduate faculties of a Peruvian university in remote modalities, with a sample of 120 teachers selected non-probabilistically for convenience.[51] Data collection was performed using structured surveys, employing standardized questionnaires: DigCompEdu Check-In for digital competencies and RED TIC for technostress,[52] both validated by experts.

The methodological analysis, supported by a strong theoretical foundation and a quantitative methodology, enables a detailed and objective examination of the relationships between variables without altering the natural conditions of the subjects studied, providing valuable insights for future research and educational practices in advanced digital contexts.[53,54]

Table 2. Reliability Results of Instruments

Instrument	Reliability Coefficient	Reliability Result	Number of Participants
Digital Competencies	Cronbach's Alpha	0,897	25
Technostress	Cronbach's Alpha	0,943	25

The research examines the influence of digital competencies on technostress among teachers in a remote setting, starting with a thorough literature review through databases such as Scielo, Web of Science, and Scopus, and using boolean operators for efficient filtering, as guided by the theoretical frameworks in existing scientific literature. The study population was defined, and the necessary ethical permissions were secured for data collection, ensuring all participants provided informed consent.

Data was processed using SPSS software version 27, with an initial descriptive analysis followed by inferential analysis using the Kolmogorov-Smirnov test to validate the non-parametric distribution of data, and then ordinal logistic regression to test the hypotheses and assess the fit of the model.[55]

Ethical considerations were strictly followed,[56] ensuring respect for participant autonomy, non-maleficence, beneficence, and justice. Confidentiality and ethical data usage were prioritized, affirming that results would be strictly for academic purposes as per the standards.[57,58,59]

This methodological and ethical rigor enhances the study's scientific integrity and its applicability in improving digital competencies and mitigating technostress in remote educational environments.

RESULTS

In the results chapter of the study, a thorough examination of the data collected provides insights into the impact of digital competencies on technostress among university teachers working remotely in Peru. The analysis is twofold: descriptive measurements reveal the current state of digital competencies and technostress levels among the teachers, while inferential analyses delve into the causal relationships between these variables. This dual approach is illustrated through charts and detailed statistics, offering a quantitative perspective on the realities faced by teachers in today's digital educational landscape.

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

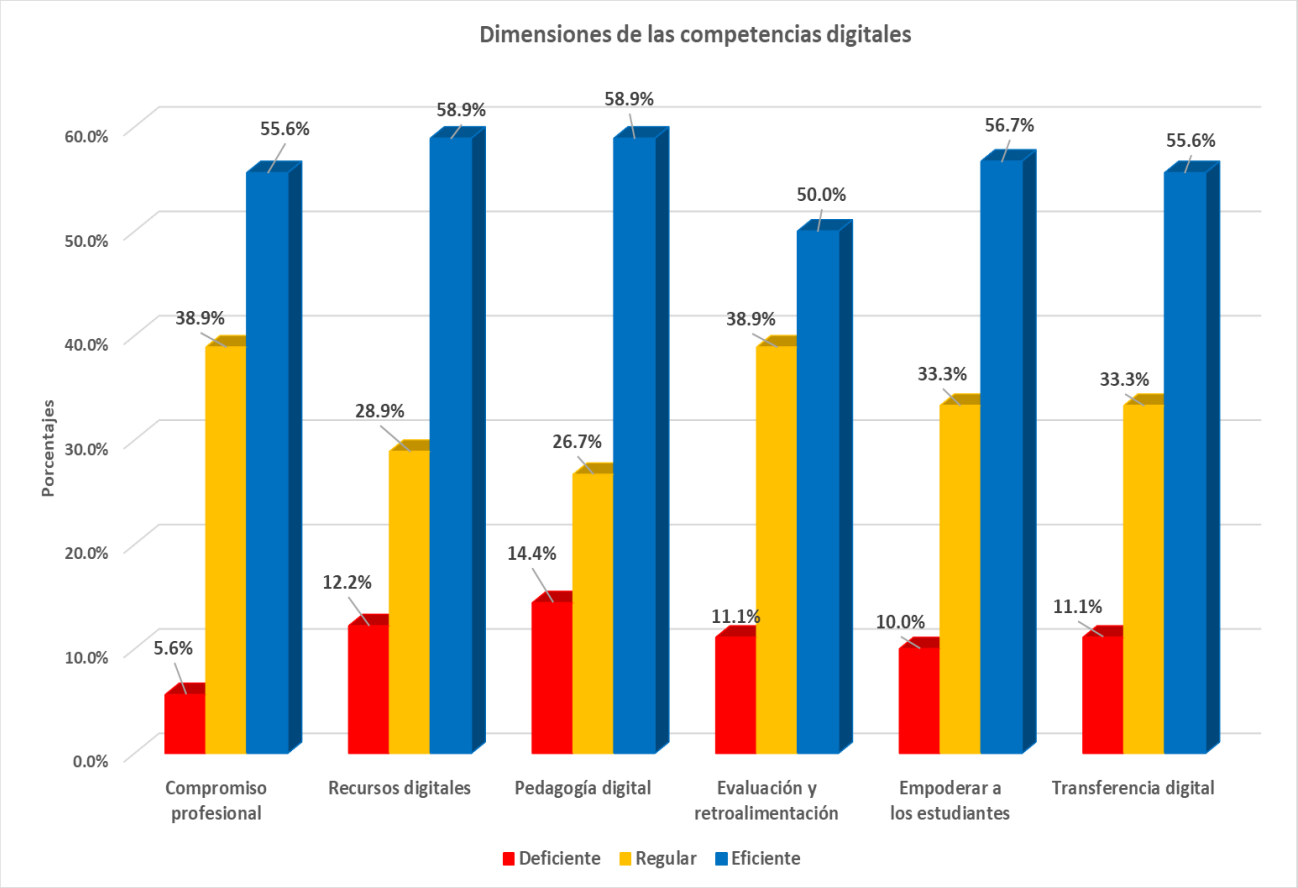

Figure 1. Levels of Digital Competencies Dimensions

Figure 1 provides a comprehensive view of the distribution of digital competencies among the teachers surveyed, reflecting various proficiency levels across six key dimensions. The following is a detailed descriptive analysis of each dimension:

- 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.

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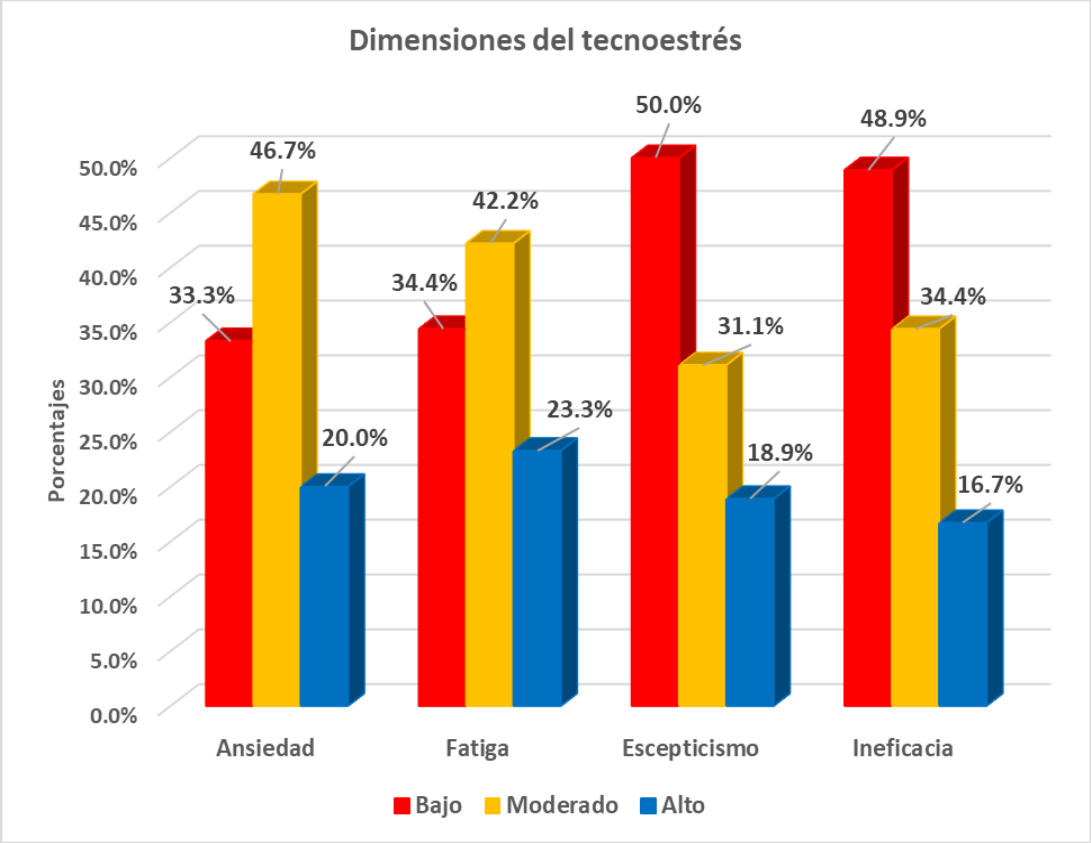

Figure 2. Levels of Technostress Dimensions

Figure 2 displays 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.

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Table 3. Logistic Regression Analysis for the General Hypothesis

Description	Log Likelihood -2	Chi-Square	Degrees of Freedom (df)	Significance (Sig.)	Pseudo R-squared Nagelkerke
Model Only Intercept	93,130	-	-	-	-
Final Model	22,571	70,559	2	0,000	-
Goodness of Fit - Pearson	-	19,186	2	0,000	-
Goodness of Fit - Deviance	-	8,461	2	0,015	-
Pseudo R-Squared - Nagelkerke	-	-	-	-	0,622

Note: The significance of the models and the goodness of fit tests indicate that digital competencies significantly impact the technostress of teachers in a remote modality, validating the logistic regression model used

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 4. 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 4 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.[19,21] 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.[60,61] 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.[62,23] This supports the Constructivist theory and the Job Demands-Resources model.[63,64]

Digital pedagogy appears as a significant factor in reducing technostress, particularly inefficacy.[65,66] 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,[67,26] with theoretical backing from Conectivism.[68,69,70,71]

However, there are noted discrepancies. The impact of professional commitment on technostress is debated [72,73] suggesting a higher incidence among older teachers, possibly due to methodological differences. Similarly, while some studies report that digital resources increase anxiety,[60,74] the current findings show a lesser impact,

potentially reflecting variations in tool usage or teacher competencies.

In digital pedagogy, Bustillos[20] 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 [62] 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.

REFERENCES

1. García F, Portillo J, Romo J, Benito M. Nativos digitales y modelos de aprendizaje. In: SPDECE; September 2007.

2. Caro MS, Soto MDCS, Millán NDCO. Envejecimiento activo. Las TIC en la vida del adulto mayor. RIDE Revista Iberoamericana para la Investigación y el Desarrollo Educativo. 2015;6(11).

3. European Commission. DigCompOrg. Digitally Competent Educational Organisations. 2016. Available from: https://ec.europa.eu/jrc/en/digcomporg

4. United Nations. Sustainable Development Goals Report 2023: Special Edition. 2023. Available from: https://unstats.un.org/sdgs/report/2023/The-Sustainable-Development-Goals-Report-2023_Spanish.pdf

5. UNESCO. 1.370 millones de estudiantes ya están en casa con el cierre de las escuelas de COVID-19, los ministros amplían los enfoques multimedia para asegurar la continuidad del aprendizaje. 2020. Available from: https://es.unesco.org/news/1370-millones-estudiantes-ya-estan-casa-cierre-escuelas-covid-19-ministros-amplian-enfoques

6. Kim S, Lee Y. Understanding Technostress in Faculty: An Exploratory Investigation. The Journal of Higher Education. 2018;89(5):843-869.

7. Ayyagari R, Grover V, Purvis R. Technostress: Technological Antecedents and Implications. MIS Quarterly. 2019;43(3):831-858.

8. MINEDU. RVM N°165-2019-MINEDU: Disposiciones para la ejecución del Programa de Inducción Docente 2019. Ministerio de Educación, Perú. 2019. Available from: https://cdn.www.gob.pe/uploads/document/file/341517/RVM_N__165-2019-MINEDU__reducido_.pdf

9. Pérez J. Evaluación de las competencias digitales en docentes universitarios en Perú. Journal of Digital Education and Knowledge Management. 2020;8(3):120-136.

10. Gómez A. Competencias digitales docentes en el contexto peruano. Revista de Investigación Educativa. 2019;24(2):245-262.

11. Torres R. Retos y perspectivas de la integración de competencias digitales en la educación superior en Perú. Revista Internacional de Educación Superior. 2018;12(3):87-103.

12. Diario Gestión. Trabajo remoto y teletrabajo, sus principales diferencias y similitudes. Comunicado de prensa; 18 de marzo 2020. Available from: https://gestion.pe/economia/management-empleo/trabajo-remoto-y-teletrabajo-sus-principales-diferencias-y-similitudes-noticia/?ref=gesr

13. Ministerio de Salud. Uso excesivo de aparatos electrónicos causa miopía en escolares. Comunicado de prensa; 07 de agosto 2021. Available from: https://www.gob.pe/institucion/minsa/noticias/510143-ministerio-de-salud-uso-excesivo-de-aparatos-electronicos-causa-miopia-en-escolares

14. Salanova M, Llorens S. Towards an Explanation of ICT Users' Healthy and Positive Behavior: An Extension of the Technology Acceptance Model. Computers in Human Behavior. 2019;90:642-654.

15. Alejo MIV. La accesibilidad, una clave para la inclusión educativa: Accesibilidad e inclusión educativa. Journal of Neuroeducation. 2022;3(1). Available from: https://doi.org/10.1344/joned.v3i1.39660

16. Montilva J, Montilva W. Un método ontológico-sistémico para el aprendizaje conceptual de tecnologías digitales. Ciencia e Ingeniería. 2018;39(3):269-278. Available from: https://www.redalyc.org/journal/5075/507557607007/html/

17. Ruiz Aquino M, Borneo Cantalicio E, Alania Contreras RD, García Ponce ES, Zevallos Acosta U. Actitudes hacia las TIC y uso de los entornos virtuales en docentes universitarios en tiempos de pandemia de la COVID-19. Publicaciones: Facultad de Educación y Humanidades del Campus de Melilla. 2022;52(3):111-137. Available from: https://dialnet.unirioja.es/servlet/articulo?codigo=8079490

18. Wilson C, Grizzle A, Tuazon R, Akyempong K, Cheung C-K. Media and information literacy: curriculum for teachers. UNESCO. 2011. Available from: https://repositorio.minedu.gob.pe/handle/20.500.12799/4586

19. Dávila Morán RC, Pasquel Cajas AF, Cribillero Roca MC, Arroyo Vigil VM, Bustamante Paredes RM. Competencia digital docente y tecnologías de información y comunicaciones en profesores universitarios. Revista Conrado. 2023;19(90):146-156.

20. Bustillos Villalta KP. Motivación y competencias digitales en docentes de posgrado de una universidad pública de Lima, 2022. [Tesis de Maestría, Universidad César Vallejo]. 2023. Available from: https://repositorio.ucv.edu.pe/handle/20.500.12692/109178

21. Huamanlazo Cuba JT, Tapia Acho YL. Competencias digitales y desempeño docente en la facultad de ciencias de gestión de una universidad privada de Lima Sur - 2021. [Universidad Autónoma del Perú]. 2023. Available from: http://repositorio.autonoma.edu.pe/handle/20.500.13067/2235

22. Torres Quinto PJ. Liderazgo transformacional y tecnoestrés en docentes de instituciones educativas de jornada escolar completa de la provincia de Tarma. 2021. Available from: http://repositorio.uncp.edu.pe/handle/20.500.12894/7444

23. Alcas Zapata N, Alarcón Diaz H, Venturo Orbegoso C, Alarcón Diaz M, Fuentes Esparrell A, López Echevarría T. Teaching Technostress and Perception of the Quality of Service in a Private University in Lima. Propósitos y Representaciones. 2019;7(3):231-239. Available from: https://dx.doi.org/10.20511/pyr2019.v7n3.388

24. Malaver Dionicio EV. Efectos del tecnoestrés en las condiciones laborales en una institución educativa de San Juan de Lurigancho en el año 2021. Repositorio Institucional - UCV. 2021. Available from: https://repositorio.ucv.edu.pe/handle/20.500.12692/70306

25. Chamorro-Atalaya O, Morales-Romero G, Trinidad-Loli N, Caycho-Salas B, Guía-Altamirano T, Auqui-Ramos E, Rocca-Carvajal Y, Arones M, Arévalo-Tuesta JA, Gonzales-Huaytahuilca R. Gamification in Engineering Education during COVID-19: A Systematic Review on Design Considerations and Success Factors in its Implementation. International Journal of Learning, Teaching and Educational Research. 2023;22(6):301-327. Available from: https://doi.org/10.26803/ijlter.22.6.17

26. Ruiz Ríos J. La inteligencia emocional y su relación con las competencias digitales del personal docente permanente de la Facultad de Educación de la Universidad Nacional Mayor de San Marcos en tiempos de confinamiento y pandemia 2021. Universidad Nacional Mayor de San Marcos. 2023. Available from: https://cybertesis.unmsm.edu.pe/handle/20.500.12672/19669

27. Méndez LMC, Cuéllar YFV. Tecnoestrés en docentes universitarios en tiempos de pandemia. Academic Disclosure. 2021;4(2):47-64. Available from: https://revistascientificas.una.py/index.php/rfenob/article/view/2633

28. Romero Corella SI, Ramírez Montoya MS, Hernández Carranza EE. Evaluación de competencias digitales didácticas en cursos masivos abiertos: contribución al movimiento latinoamericano. Comunicar (Huelva, Spain). 2015;44(22):81–90. Available from: https://doi.org/10.3916/C44-2015-09

29. García JG. El constructivismo en la educación y el aporte de la teoría sociocultural de Vygotsky para comprender la construcción del conocimiento en el ser humano. Dilemas contemporáneos: Educación, Política y Valores. 2020. Available from: https://doi.org/10.46377/dilemas.v32i1.2033

30. Martínez RA, Fernández RL, Iglesias MC, Acosta HÁ, Romero JFG, Freire FMO. Evolución de la alfabetización digital: nuevos conceptos y nuevas alfabetizaciones. MediSur. 2013;11(4):450-457. Available from: https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=44800

31. Cabero-Almenara J, Barroso-Osuna J, Palacios-Rodríguez A, Llorente-Cejudo C. Marcos de Competencias Digitales para docentes universitarios: su evaluación a través del coeficiente competencia experta. Revista Electrónica Interuniversitaria de Formación del Profesorado. 2020;23(2). Available from: https://doi.org/10.6018/reifop.413601

32. INTEF. Marco Común de Competencia Digital Docente. Madrid: Instituto Nacional de Tecnologías Educativas y Formación del Profesorado; 2017.

33. Freundt-Thurne Ú, Bossio J, Tomás-Rojas A, Gallardo-Echenique E. Validez y confiabilidad del DigCompEdu CheckIn en una muestra nacional de docentes de Educación Superior en el Perú. Revista de Estilos de Aprendizaje. 2023;16(31):82-91. Available from: https://doi.org/10.55777/rea.v16i31.5314

34. García G, Acuña K. Estrategias de evaluación del proceso de aprendizaje de estudiantes durante la nueva normalidad. Revista Innova Educación. 2022;4(3):102-114. Available from: https://doi.org/10.35622/j.rie.2022.03.006

35. García-Tudela PA, González-Calatayud V, Montiel-Ruiz FJ. Aprendizaje autodirigido y emprendimiento: una aproximación desde la realidad universitaria. Educar. 2022;58(2):405-425. Available from: https://doi.org/10.5565/rev/educar.1518

36. Torres Hernández N. Evaluación de la competencia digital de futuros docentes para el uso seguro y responsable de Internet. [Tesis doctoral]. Universidad de Granada; 2023. Available from: https://digibug.ugr.es/handle/10481/80668

37. Ferrando Rodríguez L, Gabarda-Mendez V, Marín Suelves D, Ramón-Llin Mas J. ¿Crea contenidos digitales el profesorado universitario? Un diseño mixto de investigación. Pixel-Bit: Revista de Medios y Educación. 2023;66:137-172. Available from: https://doi.org/10.12795/pixelbit.96309

38. Centurión ECP. Competencias tecnológicas en los docentes. Ciencia Latina Revista Científica Multidisciplinar. 2023;7(3):7628-7654. Available from: https://doi.org/10.37811/cl_rcm.v7i3.6751

39. Palacios J, Cadenillas V. Competencias digitales en docentes de colegios públicos en tiempos de pandemia COVID 19. In: Venturo C, Ocaña Y, editors. Educación Holística para afrontar entornos BANI. Fondo editorial Universidad César Vallejo; 2023. p. 84-97. Available from: https://repositorio.ucv.edu.pe/bitstream/handle/20.500.12692/106756/LB_Venturo_OC-Oca%C3%B1a_FY.pdf?sequence=1#page=84

40. Sánchez Gómez M, Cebrián B, Ferré Esteller P, Navarro M, Plazuelo N. Tecnoestrés y edad: Un estudio transversal en trabajadores públicos. Cuadernos de Neuropsicología. 2020;14(2):25-33. Available from: https://

dialnet.unirioja.es/servlet/articulo?codigo=7682392

41. Martínez Álvarez LA, López Laverde J, Rojas Peña OM. Ergonomía y tecnoestrés en el trabajo remoto en casa. Corporación Universitaria Minuto de Dios - UNIMINUTO; 2022. Available from: https://repository.uniminuto.edu/handle/10656/16174

42. Buforn Ruiz L. Influencia de la presencia de pensamientos intrusivos en la hipocondría. 2021. Available from: http://dspace.umh.es/handle/11000/26578

43. Carabel TC, Meneghel I, Martínez NO, García SA. Nuevos retos asociados a la tecnificación laboral: el tecnoestrés y su gestión a través de la Psicología Organizacional Positiva. Aloma: revista de psicologia, ciències de l'educació i de l'esport Blanquerna. 2020;38(1):21-30. Available from: https://doi.org/10.51698/aloma.2020.38.1.21-30

44. Salanova Soria M. Working with technologies and coping with technostress: the role of efficacy beliefs. Journal of Work and Organizational Psychology. 2003;19(3):225-246. Available from: https://journals.copmadrid.org/jwop/art/02a32ad2669e6fe298e607fe7cc0e1a0

45. Cárdenas Velásquez AJ, Bracho Paz DC. El Tecnoestrés: Una consecuencia de la inclusión de las TIC en el trabajo. CIENCIAMATRIA. 2020;6:295-314. Available from: https://dialnet.unirioja.es/servlet/articulo?codigo=7390786

46. Ventura M, Llorens Gumbau S, Salanova M. El tecnoestrés: un estudio del desarrollo de diferentes instrumentos de medida. 2005. Available from: https://repositori.uji.es/xmlui/handle/10234/78748

47. Luna RO. Investigación pura e investigación aplicada. Revista de Química. 1989;3(1):73-81. Available from: https://revistas.pucp.edu.pe/index.php/quimica/article/view/4976

48. Sautu R, Boniolo P, Dalle P, Elbert R. Manual de metodología: construcción del marco teórico, formulación de los objetivos y elección de la metodología. Editorial Clacso; 2005.

49. Meza Cascante LG. El paradigma positivista y la concepción dialéctica del conocimiento. Revista Digital: Matemática, Educación E Internet. 2015;4(2). Available from: https://doi.org/10.18845/rdmei.v4i2.2296

50. Cabero-Almenara J, Palacios-Rodríguez A. Marco Europeo de Competencia Digital Docente «DigCompEdu». Traducción y adaptación del cuestionario «DigCompEdu Check-In». EDMETIC. 2020;9(1):213-234. Available from: https://doi.org/10.21071/edmetic.v9i1.12462

51. Velasco MLYP, Martínez M. Muestreo probabilístico y no probabilístico. Licenciatura en. 2017;3.

52. Patiño Alarcón LM, Siccha Vivas SV. Adaptación del cuestionario del Tecnoestrés Red Tic en colaboradores de empresas públicas y privadas de Lima Metropolitana. Repositorio Institucional - UCV. 2021. Available from: https://repositorio.ucv.edu.pe/handle/20.500.12692/73119

53. Bryman A, Cramer D. Quantitative Data Analysis with SPSS 12 and 13. Routledge; 2004. Available from: https://doi.org/10.4324/9780203498187

54. Agudelo Viana LG, Aigneren Aburto JM. Diseños de investigación experimental y no-experimental. 2008. Available from: https://bibliotecadigital.udea.edu.co/handle/10495/2622

55. Hernández Sampieri. 2018. Available from: https://www.metared.org/content/dam/metared/pdf/Check_In_DigCompEdu_Self_Reflection_Tool.pdf

56. Sánchez-Chero M, Sifuentes FAP, Santisteba LJC, Valverde KSG. Ética, ciencia e investigación: El rol del investigador en el contexto actual. 2023. Available from: https://doi.org/10.5281/ZENODO.8270801

57. Pontificia Universidad Católica del Perú. Módulo 3: Beneficencia y no maleficencia. Pontificia Universidad Católica del Perú. Vicerrectorado de Investigación. Oficina de Ética de la Investigación e Integridad Científica; 2017.

58. Prats Cuevas J, Salazar-Jiménez RA, Molina-Neira J. Implicaciones metodológicas del respeto al principio de autonomía en la investigación social. Andamios. 2016;13(31):129-154. Available from: http://www.scielo.org.mx/scielo.php?script=sci_abstract&pid=S1870-00632016000200129&lng=es&nrm=iso&tlng=es

59. Diario Gestión. Trabajo remoto y teletrabajo, sus principales diferencias y similitudes. Comunicado de prensa; 2020 Mar 18. Available from: https://gestion.pe/economia/management-empleo/trabajo-remoto-y-teletrabajo-sus-principales-diferencias-y-similitudes-noticia/?ref=gesr

60. Vivar SAM, Villalta DAT, Guamán CRS, Rivera DPP. Hiperconectividad digital y tecnoestrés. Efectos en los docentes de educación superior en Santo Domingo. Revista Conrado. 2022;18(S2)

61. Pancorbo Figueroa Z. Gestión de competencias digitales y estrés tecnológico en docentes de una red educativa de Cusco, 2021. Repositorio Institucional - UCV. 2022. Available from: https://repositorio.ucv.edu.pe/handle/20.500.12692/78278

62. Martínez-Garcés J, Garcés-Fuenmayor J. Competencias digitales docentes y el reto de la educación virtual derivado de la covid-19: Digital teaching competences and the challenge of virtual education arising from COVID-19. Educación y Humanismo. 2020;22(39):1–16. Available from: https://doi.org/10.17081/eduhum.22.39.4114

63. Carretero M. Constructivismo y Educación. Buenos Aires: Paidós; 2009. Propuesta Educativa. 32:112-113. Available from: https://www.redalyc.org/articulo.oa?id=403041704015

64. Chamorro-Atalaya O, Morales-Romero G, Trinidad-Loli N, Caycho-Salas B, Guía-Altamirano T, Auqui-Ramos E, Rocca-Carvajal Y, Arones M, Arévalo-Tuesta JA, Gonzales-Huaytahuilca R. Gamification in Engineering Education during COVID-19: A Systematic Review on Design Considerations and Success Factors in its Implementation. International Journal of Learning, Teaching and Educational Research. 2023;22(6):301-327. Available from: https://doi.org/10.26803/ijlter.22.6.17

65. Mendoza Castro AM. Pedagogía y tecnología, el binomio de la educación del presente y el futuro. [Doctoral Thesis, Universidad del Azuay]. 2023. Available from: http://dspace.uazuay.edu.ec/handle/datos/13042

66. Goldemberg Vargas AN. El tecnoestrés y su incidencia en la satisfacción laboral, compromiso organizacional, compromiso de continuidad y el rendimiento organizacional, en usuarios finales de tecnologías de información y comunicación. 2022. Available from: http://repobib.ubiobio.cl/jspui/handle/123456789/3912

67. Gómez WOA. La Inteligencia Artificial y su Incidencia en la Educación: Transformando el Aprendizaje para el Siglo XXI. Revista Internacional de Pedagogía e Innovación Educativa. 2023;3(2):217-229. Available from: https://doi.org/10.51660/ripie.v3i2.133

68. Sáez MR. La educación constructivista en la era digital. Revista Tecnología, Ciencia y Educación. 2019:111-127. Available from: https://doi.org/10.51302/tce.2019.244

69. Siemens G. Conectivismo: Una teoría de aprendizaje para la era digital. 2004.

70. Siemens G. Learning analytics and open, flexible, and distance learning. Distance Education. 2019;40(3):414-418. Available from: https://doi.org/10.1080/01587919.2019.1656153

71. López De La Cruz ECI, Escobedo Bailón FE. Conectivismo, ¿un nuevo paradigma del aprendizaje? Desafíos. 2021;12(1):73–79. Available from: https://doi.org/10.37711/desafios.2021.12.1.259

72. Concha CES. El tecnoestrés y su efecto sobre la productividad individual y sobre el estrés de rol en trabajadores chilenos: un estudio psicométrico y predictivo. [Universitat Oberta de Catalunya]. 2019. Available from: https://dialnet.unirioja.es/servlet/tesis?codigo=292972

73. Huerta Soto RM, Guzmán Avalos M, Flores Albornoz JI, Tomas Aguilar SJ. Competencias digitales de los profesores universitarios durante la pandemia por covid-19 en el Perú. Revista Electrónica Interuniversitaria de Formación del Profesorado. 2022;25(1):49–60. Available from: https://doi.org/10.6018/reifop.500481

74. Manyari Del Carpio SE, Vargas Manyari JH, Cruz Oyola IE. Recursos digitales favorecen el proceso de enseñanza y aprendizaje en tiempos de pandemia. Horizontes Revista de Investigación en Ciencias de la Educación. 2023;7(27):397-402. Available from: https://doi.org/10.33996/revistahorizontes.v7i27.524

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