Digital Competencies and Techno-Stress in Teachers at a Public University in Ancash, Peru

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In the digital era, integrating digital competencies in teaching has become crucial. However, this change is challenging, and techno-stress is a relevant concern. This research aimed to determine the relationship between digital competencies and the technostress of remote teachers at a public university in Ancash, Peru. The study was basic, descriptive correlational, non-experimental, and cross-sectional. The population included 168 remote-mode teachers at the undergraduate level and the sample consisted of 90 teachers, with non-probabilistic convenience sampling. The results showed that digital competencies are at a regular level (48.90%) while technostress is at a moderate level (45.60%). Finally, it is concluded that digital competencies are significantly related to technostress. In addition, the value of Spearman's Rho coefficient (-0.702) confirms that the degree of correlation is negative and high.

Keywords: digital competencies, techno-stress, online learning, higher education

INTRODUCTION

Currently, digital competencies are essential in various fields such as scientific production, education, technological advances, and social interaction, being a key factor in all societies and ages (Suárez et al., 2019). Therefore, the 2030 Agenda highlights the importance of digital competencies as an innovative

resource, especially after the virtuality generated by the pandemic, influencing the economic and social sphere (UN, 2023). In this sense, the education system assumes the responsibility of preparing the new generations to face the challenges of Web 4.0. The promotion of digital identity in students facilitates their coexistence in social networks, with the idea of almost native learning (Fonseca & Ahumada, 2021). In contrast, the adult population, which has had to adapt to new technologies, is experiencing a cognitive revolution, with positive or negative effects depending on the age group, being more demanding for older adults (Colombo-Ruano & González-González, 2022).

Internationally, digital competencies are essential in university education, where teachers must be prepared for technological challenges and opportunities in the classroom (Sarell, 2020). The situation varies between countries, with teachers in developed nations showing advanced levels thanks to investments in training (Záhorec et al., 2021). In contrast, in developed countries, lack of access to resources and training limits these competencies (Vásquez et al., 2021). In addition, the rapid uptake of technologies in education poses substantial challenges, giving rise to the phenomenon of techno-stress, which includes manifestations such as anxiety, fatigue, and resistance to technology in academic and work environments (Carrión-Bósquez et al., 2022). In countries with rapid technology implementation, teachers may face higher levels of techno-stress, but technology training, institutional support, and time management can mitigate these effects (Wang & Li, 2019). Therefore, it is important to promote a work-life balance.

The current situation of digital competencies among Peruvian university teachers is a cause both for concern and study. There is variability in the level of digital competence among teachers in Peru, evidencing a gap between those who have received training in educational technology and those who have not (Laurente-Cárdenas et al., 2020). Educators encounter resistance to change and lack of time to adapt to new technologies and methodologies (Dávila, 2021). There is also limited availability of a quality internet connection and a lack of modern computer equipment, especially in the context of public universities (Huerta-Soto et al., 2022). Likewise, university professors show a pressing need to strengthen their digital competencies, oriented towards the acquisition of knowledge about available digital resources and the effective incorporation of these in their daily work (Pozú-Franco et al., 2021). Therefore, institutional and governmental policies play a crucial role in promoting digital competencies training (Herrera et al., 2023).

At the local level, the research focuses on a public university in Ancash, highlighting a teaching team with extensive experience and scientific production, which includes teachers who develop their work in the virtual mode, which leads them to remain connected to the screen for periods close to six hours per course, also having to develop in the various platforms and use digital applications in those periods for the distance learning process, so that their activities are meaningful. In this context, deficiencies have been detected in the handling of Information Technologies (ICT) and the resolution of problems related to virtual environments. In addition, there is a scarce capacity to transmit knowledge to students through virtual spaces. This reality has highlighted the generation of negative emotions among the teaching staff and has been reflected in the work environment, since only in the last academic semester there were nine absences from work due to health problems, excluding those caused by the COVID-19 topic. Given this, the following research question has been formulated: what is the relationship between digital competencies and the technostress of teachers, in remote mode, of a public university in Ancash, 2023?

The motivation for this study was based on the need to address specifically and adapt to the Latin American and Peruvian context the phenomenon of technostress in university teachers, particularly in the context of the transition to remote teaching modalities, which was intensified by the pandemic (Vilela et al., 2021). From a practical approach, the recommendations that emerged from this study were valuable to sensitize educational organizations about the importance of digital competencies of teaching staff. These recommendations transcended the mere mastery of platforms, addressing crucial aspects such as assessment competencies in virtual environments, effective transfer of knowledge to students, and effective management of working with technology. In addition, given the topicality of remote work in the university environment, the need for an in-depth analysis of digital competencies and technostress due to long hours in front of computers was recognized. For this reason, the general objective was: to determine the relationship between digital competencies and the technostress of teachers, in remote mode, of a public university in Ancash, 2023. Likewise, the general hypothesis was also stated as follows: There is a negative

and significant relationship between digital competencies and the technostress of teachers, in remote mode, of a public university of Ancash, 2023.

LITERATURE REVIEW

Regarding previous works, Jwaifell et al. (2019) were considered who indicated that ICT has experienced remarkable development due to the expansion of digitization and the rise of electronic technologies. They result in the performance of digital competencies at an intermediate level, which raises the importance of understanding the perceptions of academics and the professional use of these technologies in higher education. Miloradov & Eidlina (2022) found that the implementation of digital innovations requires regular improvement of the content of educational and methodological materials. Therefore, digital competencies should be updated regularly, paying special attention to software, cloud services, and big data management tools. Similarly, Turcios-Peraza & Arguello-Lagos (2023) highlighted the imperative need for teaching competencies to use these tools correctly and effectively, specifically in the field of digital security. This approach includes activities such as protecting personal information and data, safeguarding digital identity, safeguarding digital content, applying security measures, and the responsible and safe use of technology.

Likewise, Pérez-Rivero et al. (2023) highlighted the significant influence of the digital revolution and the consequences of the COVID-19 pandemic in higher education. The need to develop digital competencies, especially among educators and in the university system as a whole, has emerged as a key priority. The transition to digitization has represented a considerable effort on the part of professors, especially due to the changes in habits imposed by technology. The results of their study indicate a positive adaptation and substantial progress in the integration of digital competencies. Therefore, Sánchez-Macías et al. (2023) indicated that teachers' digital competencies should be addressed through a comprehensive training plan, considering the pedagogical approach and contextual elements such as generational aspects. This highlights the importance of considering the variety of experiences and attitudes towards technology, as well as providing ongoing support to ensure an effective integration of digital competencies into educational practice.

Penado et al. (2021) argued that the transition to online teaching had an impact on the work activities of university professors due to techno-stress. The reasons highlighted the mismatch between demands and resources, as well as lack of instructions and feelings of techno-efficacy. Likewise, Li & Wang (2021) found that while complexity and insecurity negatively affected job performance, overload showed a positive association. Both digital literacy and facilitation of participation positively influence job performance. Nascimento et al. (2023) noted that factors such as technology usefulness, synergistic literacy, full attention to IT, and flexibility in coping positively impact techno-stress. In turn, positive technostress has a direct association with both job satisfaction and job performance. This suggests that adopting certain technological, individual, and organizational characteristics may contribute to a positive experience dealing with techno-stress and, ultimately, improve their work-related outcomes.

Consistent with Khlaif et al. (2023), technology features and their complexity and benefits, along with privacy concerns, significantly shape techno-stress experiences. In addition, peer support and open educational resources mitigate techno-stress. Thus, it is relevant to develop resources and support structures to alleviate techno-stress, particularly in evolving educational environments. Furthermore, Gabbiadini et al. (2023) identified techno-stress as an important factor negatively affecting the adoption of digital learning tools. The frequency of distance learning technology use during the pandemic increased technostress, subsequently decreasing perceived ease of use. However, organizational support emerged as a protective factor against technostress. Therefore, public institutions need to develop effective strategies to effectively traverse technological changes. Marrinhas et al. (2023) indicated that higher education teachers predominantly experience moderate levels of technostress, with an association between burnout and technostress. Given this, Ramirez (2023) emphasized the importance of addressing mental health challenges and promoting well-being in the context of education for sustainable development.

According to Nina-Cuchillo et al. (2021), digital competencies are defined as an individual's comprehensive ability to effectively use digital technologies, ensuring safe and efficient handling of information and communication technologies. For Morze & Buinytska (2019) this involves understanding how digital tools work, proficiently navigating virtual environments, critically evaluating online information, and actively participating in the digital society. According to Skakun (2021) these competencies encompass not only technical use, but also ethical awareness and the ability to contribute meaningfully in the digital age. Likewise, Centeno-Caamal (2021) points out that digital competencies encompass the critical and safe use of ICTs, involving technical competencies, understanding of information, competence to communicate, collaborate, and create digital content, as well as awareness of related ethical and social aspects. Mancha et al. (2022) argue that digital competencies comprise the ability to access, manage, integrate, and evaluate digital information, communicate and participate in online social networks, solve technological problems, and use digital tools to learn, work, and participate in society.

In the case of techno-stress, according to Camacho & Barrios (2022), it is defined as the psychological and physiological stress resulting from the inability to deal effectively with ICTs in the work environment. According to La Torre et al. (2020), it is associated with feelings of overload, anxiety, and burnout due to constant connectivity and pressure to keep up with technological demands. In that sense, Harris et al. (2022) assert that technostress encompasses the negative reactions, both emotional and physical, that arise due to inappropriate or prolonged use of technology. Becker et al. (2022) argue that this is evidenced by the perception of loss of control, increased anxiety, and imbalance between technological demands and the individual's ability to handle them. Likewise, Ly & Ly (2022) point out that technostress manifests itself when technological demands exceed an individual's ability to handle them, generating a sense of imbalance. To Pfaffinger et al. (2022) this can result in emotional and physical symptoms, such as anxiety, frustration, exhaustion, and agitation, negatively affecting overall well-being causing a stressful work environment, and affecting the employee's health and well-being. Nang et al. (2022) indicate that in the case of teachers, it reflects the struggle to keep up with technological demands while trying to fulfill their traditional responsibilities.

METHODOLOGY

The study presents a quantitative approach. In this approach, according to Arroyo (2020), the verification of previously established hypotheses is carried out through the collection of numerical data and the use of inferential statistical analysis. Furthermore, the paradigm is the positivist one, of which Hernández-Sampieri & Mendoza (2018) argue that reality is singular and can be decomposed into parts for individual examination, with the ability to manipulate these parts independently, posing the possibility of establishing general laws that maintain their validity constantly, regardless of the course of time. Likewise, the research is of a basic type and non-experimental design. Concerning this, Cohen (2019) emphasizes that it is characterized as a process aimed at advancing the scientific field by enriching theoretical knowledge, where there is no deliberate manipulation of variables and only phenomena are observed in their natural environment. In the case of the level is descriptive correlational and cross-sectional, performing the measurement and analysis of the association that exists between variables at a particular time.

Population, Sample, and Sampling

The population included 168 teachers from a public university in the city of Huaraz, Ancash, Peru. Likewise, the sample consisted of 90 teachers, with non-probabilistic convenience sampling. Among the inclusion criteria, it was considered that the teachers should be at the undergraduate level, teach remotely, and give courses in blocks of up to six hours per curricular experience.

Instruments

The technique used was the survey and the instrument for both variables was the questionnaire. In the case of digital competencies, the Digital Competence Questionnaire "DigCompEdu Check-In" (Cabero-Almenara & Palacios-Rodríguez, 2020) was used, which consisted of 22 items, distributed in 6 dimensions:

digital engagement (1-4), digital resources (5-7), digital pedagogy (8-11), evaluation and feedback (12-14), student empowerment (15-17), digital transfer (18-22). Regarding technostress, the RED ICT Technostress Questionnaire (Salanova, 2004) was used, which consisted of 16 items, distributed in 4 dimensions: anxiety (1-4), fatigue (5-8), skepticism (9-12), inefficacy (13-16). In both cases the Likert scale was used, being for the questions of the digital competencies questionnaire the options: (1) Never, (2) Rarely, (3) Sometimes, (4) Almost always, (5) Always. And for the technostress questionnaire the options: (0) Not at all, (1) Almost not at all, (2) Rarely, (3) Sometimes, (4) Quite often, (5) Frequently, (6) Always.

Validity and Reliability

The validity of the instrument was carried out using expert judgment. The instruments for each variable were carefully reviewed by education professionals who work in undergraduate and graduate schools, specifically in the development of research projects, and who have curricular experiences in the remote modality, which gives them a more complete view of the dimensions, indicators, and scales considered in the questionnaires. These specialists ruled that the instruments applied to the study. Likewise, for reliability, a pilot test was conducted with a sample of 30 individuals, and the Cronbach's Alpha coefficient for the instrument measuring digital competencies was 0.971 and for technostress 0.878. In both cases high values were obtained, demonstrating that the instruments were reliable.

Data Collection Procedure

The data were collected through the application of a questionnaire designed in a Google form, which was sent to the teachers through their e-mails. Once the participants completed the forms, a database was created using an Excel spreadsheet to store the collected responses. These data were subsequently analyzed using SPSS V.26 statistical software. During the statistical analysis, descriptive statistics were used to present the results of the research, while inferential statistics were used to verify the hypothesis using the correlation test. Since the variables were qualitative in nature, ordinal, and with a nonparametric distribution, this test was chosen. In addition, Spearman's Rho coefficient was used to measure the relationship between digital competencies and technostress.

RESULTS

After applying the instruments, data analysis was carried out to assess the levels of digital competencies and technostress of teachers. We also sought to determine the relationship between digital competencies and techno-stress.

Descriptive Analysis

TABLE 1
LEVELS OF DIGITAL COMPETENCIES

Level	Deficient	Regular	Efficient	Total
Frequency	15	44	31	90
Percentage	16.70%	48.90%	34.40%	100%

From Table 1 and Figure 1, it was observed that 16.7% of the participants achieved a deficient level of digital competencies, 48.9% obtained a regular level and 34.4% showed an efficient level. From these findings, it was possible to deduce that undergraduate teachers have a regular performance in terms of their digital competencies.

TABLE 2
LEVELS OF THE DIMENSIONS OF THE DIGITAL COMPETENCIES VARIABLE

Dimension	Level	Deficient	Regular	Efficient	Total
Professional Commitment	f	5	35	50	90
	%	5.60%	38.90%	55.60%	100%
Digital resources	f	11	26	53	90
	%	12.20%	28.90%	58.90%	100%
Digital pedagogy	f	13	24	53	90
	%	14.40%	26.70%	58.90%	100%
Assessment and feedback	f	10	35	45	90
	%	11.10%	38.90%	50.00%	100%
Student empowerment	f	9	30	51	90
	%	10.00%	33.30%	56.70%	100%
Digital transfer	f	10	30	50	90
	%	11.10%	33.30%	55.60%	100%

Note. f=frequency

From Table 2, it could be observed that in the case of professional commitment 5.6% of the respondents reached a deficient level, 38.9% obtained a regular level and 55.6% showed an efficient level. For digital resources, 12.2% of the participants had a deficient level, 28.9% evidenced a regular level and 58.9% showed an efficient performance. Regarding digital pedagogy, 14.4% of the respondents had a deficient level, 26.7% showed a regular performance and 58.9% showed an efficient level. Meanwhile, for evaluation and feedback, 11.1% of the respondents achieved a deficient level, 38.9% obtained a regular level and 50.0% demonstrated an efficient level. Regarding student empowerment, 10.20% of the participants had a deficient level, 33.3% evidenced a regular performance and 56.7% demonstrated an efficient level. Regarding digital transfer, 11.1% of the respondents had a deficient level, 33.3% showed a regular performance and 55.6% showed an efficient level. From these findings, it could be deduced that in all cases of the dimensions of digital competencies, they were at an efficient level.

The results evidenced a moderate performance in digital competencies, so it is necessary to continue strengthening the digital preparation of university teachers for more effective integration of technology in their teaching (Jwaifell et al. 2019). Likewise, the importance of comprehensive training and constant updating of digital competencies reflect progress toward efficient levels in specific dimensions (Miloradov & Eidlina, 2022). In the case of professional engagement, most teachers show an efficient level, aligning with the importance of considering the pedagogical approach and contextual elements. This indicates a solid connection between digital competencies and professional engagement, supporting the notion that comprehensive training contributes to effective integration (Sánchez-Macías et al., 2023). In digital resources, digital pedagogy, evaluation and feedback, student empowerment, and digital transfer, efficient levels predominate, supporting the idea that teachers have developed competencies in these areas. These results coincide with the need for technical skills, information comprehension, and competence to communicate, collaborate, and create digital content (Centeno-Caamal, 2021). The low proportion of deficient levels in all dimensions suggests that teachers have managed to overcome technological challenges during the post-COVID-19 stage (Gabbiadini et al., 2023)

TABLE 3
LEVELS OF TECHNOSTRESS

Level	Low	Moderate	High	Total
Frequency	33	41	16	90
Percentage	36.70%	45.60%	17.80%	100%

From Table 3, it was observed that 36.7% of the participants showed a low level of technostress, 45.6% had a moderate level and 17.8% showed a high level. From these findings, it was possible to deduce that technostress reached a moderate level.

TABLE 4
DISTRIBUTION OF LEVELS OF THE DIMENSIONS OF THE TECHNO-STRESS VARIABLE

Dimension	Level	Low	Moderate	High	Total
Anxiety	f	30	42	18	90
	%	33.30%	46.70%	20.00%	100%
Fatigue	f	31	38	21	90
	%	34.40%	42.20%	23.30%	100%
Skepticism	f	45	28	17	90
	%	50.00%	31.10%	18.90%	100%
Inefficiency	f	44	31	15	90
	%	48.90%	34.40%	16.70%	100%

Note. f=frequency

From Table 4, it could be observed that in the case of anxiety, 33.3% of the respondents evidenced a low level, 46.7% had a moderate level and 20.0% reached high levels. For fatigue, 34.4% of the participants had a low level, 42.2% evidenced moderate levels and 23.3% showed a high level. Regarding skepticism, 50.0% of the respondents had a low level, 31.1% showed a moderate level and 18.9% showed a high level. Finally, in the case of ineffectiveness, 48.9% of the teachers showed a low level, 34.4% obtained a moderate level and 16.7% had a high level. From these results, it could be deduced that moderate levels were obtained for anxiety and fatigue, while low levels were reached for skepticism and inefficacy.

These findings highlight the relationship between factors such as technology usefulness and IT mindfulness in mitigating technostress while emphasizing the need for ongoing organizational support strategies to address the challenges associated with technostress (Wang & Li, 2019). In the case of moderate levels of anxiety and fatigue may be linked to the mismatch between demands and resources, as well as to work overload derived from technological complexity (Penado et al., 2021). Likewise, the positive association between overload and job performance is reflected in the fact that fatigue, although moderate, shows a more positive association with performance compared to anxiety (Li & Wang, 2021). Regarding skepticism and inefficacy, low levels suggest a positive adaptation that was not present during the pandemic period (Khlaif et al., 2023). Furthermore, the presence of a low level of skepticism can be attributed to the importance given to factors such as digital literacy and participation, which positively influence job performance and, therefore, could act as mitigators of skepticism towards technology (Nascimento et al., 2023). In that sense, although the frequency of technology use may initially generate stress, there are protective factors such as organizational support, which is consistent with the low levels of skepticism and ineffectiveness observed (Gabbiadini et al., 2023). Thus, the association between moderate levels of technostress and burnout is reflected in anxiety and fatigue scores, highlighting the need to address mental health and promote well-being (Ramirez, 2023).

Inferential Analysis

The inferential analysis was carried out to verify the research hypotheses, establishing as an acceptance criterion that the significance value should be less than 0.05 to validate the hypothesis. For this purpose, the general hypothesis was examined, defining both the null hypothesis and the alternative hypothesis.

Ho: There is no negative and significant relationship between digital competencies and the technostress of teachers, in remote mode, of a public university in Ancash, 2023. Ha: There is a negative and significant relationship between digital competencies and the technostress of teachers, in remote mode, of a public university of Ancash, 2023.

TABLE 5
VARIABILITY TEST OF THE RESEARCH HYPOTHESIS

Hypothesis	Variables	Bilateral sig.	Correlation degree
General hypothesis	Digital competences Technostress	0.000	-0.702

As shown in Table 5, it is evident that the correlation test calculates a significance value (bilateral sig.= 0.000) lower than 0.05. This rejects the null hypothesis and infers that digital competencies are significantly related to the technostress of remote teachers. In addition, the value of Spearman's Rho coefficient (-0.702) confirms that the degree of correlation is negative and high.

Similarly, the inferential analysis was performed for the specific hypotheses. Ho: There is no negative and significant relationship between the dimensions of digital competencies and the technostress of teachers, in remote mode, of a public university in Ancash, 2023. Ha: There is a negative and significant relationship between the dimensions of digital competencies and the technostress of teachers, in remote mode, of a public university of Ancash, 2023.

TABLE 6
CORRELATION TEST OF THE SPECIFIC HYPOTHESES

Hypothesis	Variables	Bilateral sig.	Correlation degree
Specific hypothesis 1	Digital competencies Anxiety	0.000	-0.648
Specific Hypothesis 2	Digital competence Fatigue	0.000	-0.696
Specific Hypothesis 3	Digital competence Skepticism	0.000	-0.648
Specific Hypothesis 4	Digital competence Inefficiency	0.000	-0.625

Table 6 shows that the significance value (Bilateral)=0.000 is less than 0.05 for all cases. This rejects the null hypothesis and proves that competencies are significantly related to remote modality teachers' technostress. In the case of the specific hypotheses, the value of Spearman's Rho coefficient (digital competencies and anxiety = -0.648, digital competencies and fatigue = -0.696, digital competencies and skepticism = -0.648, digital competencies and inefficacy = -0.625) shows that the degree of correlation is negative and moderate for all cases.

The results highlighted the importance of understanding academics' perceptions and professional use of digital technologies in higher education (Miloradov & Eidlina, 2022). Improving digital competencies,

especially in aspects such as digital security, is crucial to face the challenges of digitization and the implementation of digital innovations (Turcios-Peraza & Arguello-Lagos (2023). Technostress is affected by factors such as technological complexity, lack of resources, overload, and lack of instructions (Penado et al., 2021). In this context, digital competencies emerge as a key factor that can positively influence teachers' experience (Skakun, 2021). Technology training, institutional support, and time management can mitigate the negative effects of techno-stress, supporting the results obtained in the study. Thus, it is confirmed that digital competencies are not only essential for the effective integration of technology in educational practice but also play a crucial role in the management of techno-stress (Pérez-Rivero et al., 2023). Positive adaptation and substantial progress in the integration of digital competencies not only reflect an improvement in teaching and learning but are also related to a lower incidence of technostress.

CONCLUSIONS

It is concluded that there is a negative and significant relationship between digital competencies and the technostress of teachers, in the remote modality, of a public university in Ancash. In addition, competencies are negatively and significantly related to anxiety, fatigue, skepticism, and ineffectiveness. This means that while the performance of digital competencies is higher, the levels of technostress are lower. In the same way, anxiety, fatigue levels, skepticism, and ineffectiveness of university teachers decrease.

Finally, some practical implications are highlighted. It is suggested that educational institutions design continuing education programs focused on the development of digital competencies, addressing specific areas such as digital pedagogy, resource management, and effective adaptation to virtual environments. It also emphasizes the importance of providing institutional support and adequate tools to minimize technostress and thus optimize remote teaching.

ACKNOWLEDGEMENT

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