education sciences

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Systematic Review

Teaching Engagement and Technostress Among Primary and Secondary School Teachers: A Systematic Review

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Abstract

The accelerated integration of digital technologies in schools over the past decade has significantly increased levels of technostress among teachers, impacting their psychological well-being and professional engagement. In this context, engagement and technostress emerge as critical constructs for understanding the well-being and quality of teaching in primary and secondary school teachers. However, the available evidence is fragmented across rural and urban contexts, making it difficult to gain a comprehensive understanding of this relationship. A systematic review was conducted following the PRISMA 2020 guidelines, including 13 studies published between 2015 and 2025, with a total of 6630 participants. The PEC model was used to define eligibility criteria and search strategies in five databases (Web of Science (n = 18), Scopus (n = 734), PsycNet (n = 32), SciELO (n = 0), PubMed (n = 135)). Methodological quality was assessed using the EACSH Scale, and the analysis integrated qualitative and quantitative descriptive approaches. A consistent inverse relationship was found between technostress and teaching engagement, moderated by contextual factors, educational level, and technological infrastructure. Technostress was associated with digital fatigue, reduced vigor, and lower professional dedication. Protective factors supporting engagement included digital self-efficacy, institutional support, adaptive emotion regulation, and a sense of meaning in work. Teachers in digitally demanding environments maintained high engagement when they had adequate personal and organizational resources. These findings highlight the urgent need for training and psychosocial support policies that mitigate technostress and strengthen teaching engagement across diverse territorial contexts. Within the broader landscape of digital transformation, including emerging artificial intelligence applications in education, this review underscores the importance of preparing teachers not only for technical proficiency but for sustainable digital practice. This literature review identifies research gaps on rural dynamics and the longitudinal nature of the phenomenon.

Keywords: teaching engagement; technostress; teaching; digital society; digital technologies; primary education; secondary education

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Academic Editor: Jonathan Glazzard

Received: 15 January 2026
Revised: 3 March 2026
Accepted: 5 March 2026
Published: 10 March 2026

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1. Introduction

Over the past decade, the expansion of digital society has reshaped pedagogical practices across all school systems worldwide (Bitar & Davidovich, 2024; Bucăţa & Tileagă, 2024; Huang et al., 2024). Hence, teaching has gradually adapted to meet new requirements encompassing cognitive, emotional, and technological dimensions (Bitar & Davidovich, 2024; Bucăţa & Tileagă, 2024; Huang et al., 2024; Lazareva et al., 2024). The growing integration of digital technologies into teaching and learning processes, which was accelerated by the COVID-19 pandemic, has opened new opportunities to diversify instructional approaches, personalizing learning trajectories, and promoting more active student forms of participation (Matsieli & Mutula, 2024; Mena-Guacas et al., 2025; Rahimi & Oh, 2024; Zou et al., 2025). However, this educational transformation has affected teachers by increasing their levels of digital overload, technological pressure, and psychological stress associated with the intensified reliance on digital platforms and resources (Abdulkareem et al., 2024; Fernández-Arias et al., 2024; Ibrahim et al., 2025; Zivi et al., 2025). Beyond the classroom, this digital expansion has fundamentally altered core teaching tasks: planning now involves navigating multiple platforms, assessment is increasingly mediated by learning management systems, communication with families flows through instant messaging apps, and administrative duties have migrated to virtual environments—often blurring the boundaries between work and personal life. In essence, teaching has evolved from a primarily instructional role to one that requires constant digital management, coordinating tools, platforms, and data streams alongside traditional pedagogical responsibilities. In this context, two constructs have gained analytical relevance in contemporary educational research: teacher engagement and technostress.

In organizational psychology, work engagement is a positive motivational state that involves vigor, dedication, and absorption (W. Schaufeli & Bakker, 2003; W. B. Schaufeli et al., 2009; W. Schaufeli & Taris, 2014; W. Schaufeli, 2021). From this perspective, it triggers professional performance, pedagogical innovation, and the quality of educational interactions in teaching practices. To provide a comprehensive theoretical framework for understanding both the stressors and protective factors involved, this review integrates two complementary models. First, the Job Demands–Resources (JD-R) model (Bakker & Demerouti, 2007, 2017) conceptualizes technostress as a job demand that depletes personal resources, while engagement emerges from the availability of personal resources (e.g., digital self-efficacy, emotion regulation) and organizational resources (e.g., institutional support, school climate). Second, McAdams' generativity model (McAdams, 1992; McAdams & de St. Aubin, 1992) complements this perspective by explaining why certain teachers sustain engagement despite high demands: the adult desire to care for and contribute to future generations—expressed through perceived meaning in teaching, acts as a protective factor that transcends immediate working conditions. International research has identified shared characteristics among primary and secondary school teachers who display high levels of teaching engagement, such as experiencing a strong sense of purpose in their work, teaching sensitivity, feeling confident in their professional capabilities, and responding more flexibly to the ongoing and often unpredictable demands of school settings (Cai et al., 2023; Fan et al., 2023; Fei & Tien, 2024). Furthermore, findings from other studies indicate that highly engaged teachers worldwide tend to implement more student-centered and inclusive instructional approaches (Dilekçi et al., 2025; Lipscomb et al., 2022; Topchyan & Woehler, 2021). This pedagogical adaptability is increasingly tested in digital environments, where teachers must simultaneously manage content delivery, technological tools, and student engagement across physical and virtual spaces.

In a similar vein, research indicates that prolonged use of digital technologies for teaching can lead to adverse psychological reactions among educators, commonly referred to as

technostress (Kocak & Pawlowski, 2024; Z. Wang et al., 2023; D. Yang et al., 2025; Zivi et al., 2025). While technostress has been extensively studied in various occupational sectors, where it manifests through dimensions such as technology-induced overload, work–life intrusion, and the anxiety generated by constant technological change, its expression in educational contexts presents unique characteristics (Li et al., 2024; D. Yang et al., 2025). However, the current acceleration of digital transformation, particularly the integration of artificial intelligence in educational settings, has intensified technostress to unprecedented levels, making it a defining challenge of contemporary teaching (Z. Wang et al., 2023). For teachers, technostress often takes the form of technology anxiety, information overload, digital fatigue, resistance to adopting new digital resources, and tensions between professional demands and their personal capacity to manage ICT resources (Jesus & Rebolo, 2023; Rey-Merchán & López-Arquillos, 2022; Siddiqui et al., 2023). This strain manifests in daily work dynamics: teachers report spending significant time troubleshooting technical issues, responding to messages outside working hours, and constantly updating their digital skills to keep pace with institutional requirements. The nature of work has shifted such that digital management (monitoring multiple communication channels, tracking student progress across platforms, and maintaining digital records) now occupies a substantial portion of the working day, often at the expense of direct instructional time. From this standpoint, technostress constitutes a significant threat to teachers' well-being and mental health.

Teachers' experiences with technostress differ; they often depend on the specific educational context. The distinction between rural and urban contexts is particularly relevant, as it captures structural inequalities in infrastructure, technological access, and support systems that fundamentally shape teachers' digital experiences. Rural schools, for example, often face unstable Internet connectivity, limited infrastructure, restricted access to digital resources, and scarce opportunities for professional development—factors that intensify the psychological demands of teaching in technology-mediated environments (Aruleba & Jere, 2022; Olanrewaju et al., 2021; Timotheou et al., 2023). Here, the digital transformation often means added burden without adequate support, as teachers struggle with unreliable connections while trying to deliver online content. By contrast, teachers working in urban schools encounter different challenges that increase their digital burden, including the abundance of digital platforms, rapid technological change, diverse student populations, and institutional pressure to meet productivity and accountability requirements (Feng et al., 2025; Tu et al., 2025; Zhu et al., 2025). In these settings, the demand for constant digital availability and the expectation to master multiple tools simultaneously reshape the teaching profession into one of perpetual connectivity. Whether in rural or urban contexts, the common thread is that teaching now requires continuous digital management a meta-task that runs parallel to, and often competes with, the core work of instruction.

The intersection of teaching engagement and technostress constitutes a critical area of analysis for understanding the challenges currently confronting school systems. Recent studies highlight a concerning issue: many educational practices are leading to high levels of technostress among educators. This type of stress can progressively reduce job satisfaction, teaching engagement, and overall professional performance (Aktan & Toraman, 2022; Marrinhas et al., 2023; Oh et al., 2025; Qin et al., 2025). Teachers can manifest these effects in various ways, such as reduced commitment to lesson design and assessment, decreased enthusiasm for pedagogical innovation, and decreased emotional availability for student support (Cacciamani et al., 2022; Gabbiadini et al., 2023; Siddiqui et al., 2023). The cognitive load of constant digital management (switching between platforms, responding to notifications, and maintaining an online presence) can deplete the psychological resources teachers need for high-quality instruction. Comparative research across occupational groups has documented that technostress produces remarkably consistent consequences

regardless of the sector: increased work–family conflict, decreased life satisfaction, and adverse health outcomes such as burnout and sleep disturbances are commonly reported by professionals in healthcare, corporate, and educational settings alike (Bourlakis et al., 2023; Dutta & Mishra, 2024; Li & Wang, 2021). Additionally, technostress does not just impact work-related outcomes; it can also take a toll on educators' mental health. Issues such as anxiety, sleep issues, and affective problems become more pronounced, ultimately undermining the quality of instruction (Li & Wang, 2021; Rodriguez-Barboza, 2023). This interplay of stress and its repercussions paints a troubling picture for the well-being of education professionals and the environment in which they work.

From a socio-educational perspective, two challenges that teachers must overcome make this issue more complex: responding to institutional expectations for technological integration while adapting to the students' emerging cultural and communicational practices, which implicate a high familiarity with digital technologies, informational immediacy, and new forms of participation and learning in virtual communities that transcend schools' space and time (Alenezi et al., 2023; Mhlongo et al., 2023). This generational and cultural gap in digital fluency creates friction in daily interactions, as teachers must navigate between institutional mandates and student expectations for immediacy and connectivity. Here again, the nature of work is transformed: teachers are no longer solely content experts and pedagogues but must also function as digital managers, coordinating expectations and communication styles across generational divides. This tension creates gaps in pedagogical interaction when teachers lack the emotional, didactic, or technological resources needed to sustain teaching practices that are tailored to learners' interests (Radovan & Radovan, 2024). Therefore, examining the relationship between teaching engagement and technostress across diverse educational contexts offers a timely and significant contribution to the development of educational policies, teacher training programs, and school mental health prevention strategies.

Despite growing academic attention to this topic, empirical evidence remains limited. Notably, although our search strategy imposed no initial date restriction, the studies that met the inclusion criteria were all published from 2019 onward, indicating that research on the relationship between teaching engagement and technostress is a recent and rapidly evolving field, largely driven by the digital acceleration associated with the COVID-19 pandemic. Research findings appear to be strongly influenced by contextual factors, such as sociocultural settings, educational level, institutional type, and working conditions teachers face (Bourlakis et al., 2023; Cazan et al., 2024; Dutta & Mishra, 2024; Li et al., 2024). Additionally, there is a noticeable absence of systematic literature reviews that critically integrate research from the past decade on teaching engagement and technostress, particularly across rural and urban educational contexts. The focus on rural and urban contexts is not intended to exhaust all possible settings, but rather to capture significant structural differences in infrastructure, technological access, and support systems that fundamentally shape teachers' experiences of technostress. These categories serve as proxies for broader inequalities that modulate the relationship between digital demands and teacher well-being. Furthermore, while the trans-professional nature of technostress is increasingly recognized, comparative studies examining how its manifestations and consequences differ (or converge) across education, healthcare, and corporate sectors remain scarce, representing an important gap for future research. This disparity hinders the development of the frameworks needed to build school systems that are healthier, more sustainable, and technologically balanced.

Consequently, this systematic review (SR) aims to answer the following research question: What is the relationship between teaching engagement and technostress among primary and secondary school teachers working in urban or rural contexts within the digital society?

Specific research questions:

RQ1: What personal (e.g., digital self-efficacy, emotion regulation, perception of meaning) and organizational (e.g., institutional support, school climate) factors protect or sustain teaching engagement in the face of technostress?

RQ2: How does technostress manifest across different educational levels (primary vs. secondary) and territorial contexts (rural vs. urban), and what are its consequences for teacher well-being and performance?

Thus, the purpose of this study is to systematically analyze the existing scientific literature on the relationship between teaching engagement and technostress among primary and secondary school teachers in contemporary digital society.

2. Materials and Methods

The present study utilized a systematic review (SR) methodology, following the PRISMA 2020 guidelines (Page et al., 2021). This internationally recognized framework sets high methodological standards for transparency, rigor, and reproducibility in the synthesis of scientific evidence. Given the complexities of educational research, characterized by various theoretical perspectives, a multitude of methodological designs, and varied socio-educational contexts, the PRISMA framework offers a structured and coherent basis for organizing and reporting each stage of the review process, including study identification, screening, eligibility, and inclusion.

The stated purpose of the study justifies the application of PRISMA, as the subject matter presents fragmented and diverse scientific production, developed across different countries, with conceptual variability in the use of measurement instruments and significant differences in the contexts of assessment of teaching engagement and technological integration by teachers. Specifically, this SR rigorously adhered to the PRISMA 2020 guidelines, integrating the PEC framework to formulate eligibility criteria, search strategies, and selection procedures (Methley et al., 2014). In addition, specialized thesauri, the UNESCO Thesaurus and the ERIC Thesaurus, were applied to construct search terms and Boolean operators (see Table 1).

Table 1. PEC framework.

Dimension	Operational Description
Population (P)	Primary or secondary school teachers, regardless of gender or professional specialty, who work in schools. The researchers made no distinction based on years of professional experience.
Exposure (E)	Studies that explicitly examine teaching engagement (manifested in the vigor, dedication, and absorption that individuals show in their teaching work) and technostress (manifested in technological anxiety, digital fatigue, resistance, or information overload), and that explore their conceptual or empirical relationship.
Context (C)	Educational establishments offering primary or secondary education, located in rural or urban settings, that were part of national school systems. The researchers made no distinction based on the educational establishment's administrative affiliation (public, private, or subsidized).

Source: Own elaboration.

In addition, the protocol for this study was registered in the international database PROSPERO (Prospective International Register of Systematic Reviews) (ID = CRD420251265989) to ensure traceability, avoid duplication of effort, and provide transparency regarding methodological procedures (see Appendix A). The registration included the background,

research question, eligibility criteria, search strategy, data extraction and analysis methods, and expected results in terms of scientific and practical contribution.

2.1. Eligibility Criteria

The researchers rigorously defined eligibility criteria to ensure the relevance, validity, and comparability of the included studies (see Table 2). These criteria allowed the authors to precisely delimit the study's analytical scope and reduce the risk of bias arising from the conceptual and methodological heterogeneity in contemporary educational research.

Table 2. Eligibility criteria.

Inclusion Criteria	Exclusion Criteria
(a) Empirical articles that explicitly examined the relationship between teaching engagement (vigor, dedication, and absorption) and technostress (technological anxiety, digital fatigue, technological resistance, or information overload).	(a) Studies that addressed only one of the constructs without conceptually or empirically integrating its relationship with the other, or analyses of work stress without a technological component.
(b) Studies conducted with in-service primary or secondary school teachers working in public, private, or charter educational institutions.	(b) Studies with non-teaching populations (students, school administrators, teaching assistants, or other professionals), or those focused exclusively on higher education.
(c) Studies conducted in rural, urban, or mixed school contexts, with a clear description of the educational and territorial environment.	(c) Studies without contextual specification or conducted in non-school settings (community, organizational, corporate, or industrial).
(d) Quantitative, qualitative, or mixed-method designs, including cross-sectional, longitudinal, correlational, experimental, or descriptive studies. Systematic reviews and meta-analyses were not included.	(d) Conceptual articles, theoretical essays, academic opinions, editorial notes, narrative reviews, or documents without empirical data; gray literature (theses, books, book chapters, technical reports).
(e) Peer-reviewed publications indexed in WoS, Scopus, PsycNet, SciELO, or PubMed, with no restriction on initial publication date, published up to 2025, in Spanish, English, or Portuguese.	(e) Publications not indexed in WoS, Scopus, PsycNet, SciELO, or PubMed; non-peer-reviewed articles; incomplete publications or those without full text; and studies published in languages other than Spanish, English, or Portuguese.

2.2. Search Strategy

The search strategy was designed according to standards of comprehensiveness and precision, integrating controlled terms from the UNESCO and ERIC thesauri, together with keywords frequently used in the specialized literature. The search equations were adapted to the particularities of each database (WOS, Scopus, PsycInfo, SciELO, and PubMed), using Boolean operators, truncations, and specific search fields (see Appendix A).

The consistency of this strategy ensured the collection of a comprehensive, relevant, and representative corpus of research from the last decade. The search strategy was designed using UNESCO thesauri (terms: "teachers", "primary education", "secondary education", "occupational stress", "information technology") and ERIC (terms: "teacher engagement", "technostress", "digital stress", "work engagement"). Boolean equations were constructed by combining key terms, synonyms, and AND/OR operators. Gen-

eral example: ("teacher engagement" OR "work engagement") AND ("technostress" OR "techno-stress" OR "digital stress") AND ("primary school teachers" OR "secondary school teachers" OR) AND ("rural" OR "urban") (Appendix A).

2.3. Study Selection Procedure

The selection of studies strictly followed the four PRISMA phases, which are described as follows:

(a) Identification: The authors downloaded all records from each database and imported them into the Zotero bibliographic manager. This process automatically identified and removed any duplicates, which were then carefully reviewed by hand to ensure accuracy.
(b) Screening: Two researchers independently reviewed the titles and abstracts, using the PEC criteria as a guide. Any records that were deemed irrelevant or that did not explore the relationship between engagement and technostress were excluded. To maintain rigor in this process, the researchers utilized the Rayyan platform.
(c) Eligibility: The researchers performed a comprehensive review of the full texts of relevant studies. During this stage, they verified the methodological quality of the studies, confirmed that they used validated instruments, and ensured that the manuscripts clearly operationalized the constructs of engagement and technostress.
(d) Final inclusion: The researchers reached consensus on the final set of studies included. When disagreements arose, they brought in a third expert evaluator to provide an independent perspective, ensuring that the decision-making process remained objective and fair.

2.4. Quality Assessment Tools

The researchers assessed the quality of the selected studies using the Scale to Evaluate Scientific Articles in Social and Human Sciences (SSAHS) by López-López et al. (2019). This tool was specifically selected for its proven validity and reliability in assessing social science research, and its comprehensive approach, which makes it particularly suitable for assessing mixed-methods evidence. This comprehensive approach enabled a fair assessment of the quality of the various methodological approaches included in this review, ensuring that studies were assessed according to criteria appropriate to their research paradigms. The SSAHS measures eight dimensions: (a) cover and abstract (items 1–4); (b) introduction (items 5–7); (c) methodology (items 8–11); (d) results (items 12–14); (e) discussion (items 15–17); (f) references (item 18); (g) appendices (item 19); and (h) style and format (items 20–21). This instrument had an expert validity (Aiken's V) greater than 0.75 for all items. In addition, KMO values of 0.911 and a Cronbach's alpha of 0.937 were obtained, demonstrating the instrument's high reliability and validity.

The SSAHS was administered independently by two reviewers, and any discrepancies were resolved by consensus or by a third independent researcher. The results are presented in a summary table, which ensures transparent communication about the level of confidence in the evidence regarding the relationship between generativity and psychological well-being in primary and secondary school teachers.

2.5. Analysis and Synthesis of Information

The synthesis used a mixed-methods approach. First, the researchers conducted a systematic qualitative content analysis, using iterative coding of findings, thematic development, and comparing findings across studies to uncover key conceptual patterns. This process involved independent coding by two researchers, who developed the themes by consensus. Second, the researchers performed a descriptive quantitative analysis to summarize the available numerical data on publication trends, geographic distribution, and

methodological characteristics. Finally, through methodological triangulation, qualitative themes and quantitative patterns were integrated to develop a comprehensive understanding of the relationship between generativity and psychological well-being in different contexts. Whenever possible, trend analyses tracked the evolution of this field of research over the past decade.

3. Results

The initial search in Web of Science, Scopus, APA PsycNet, PubMed, and SciELO identified 919 records. After removing five duplicates, 914 records were reviewed, of which 670 were excluded based on their title and because they were not relevant to the study objective. The remaining 244 reports were evaluated based on their abstracts, leading to the exclusion of 209 studies for lack of thematic or methodological relevance. Subsequently, 35 full articles were evaluated, of which 22 were excluded for failing to meet the predefined inclusion criteria. Finally, 13 studies met all criteria and were incorporated into the qualitative synthesis. The selection process is summarized in the PRISMA 2020 flow diagram (Figure 1).

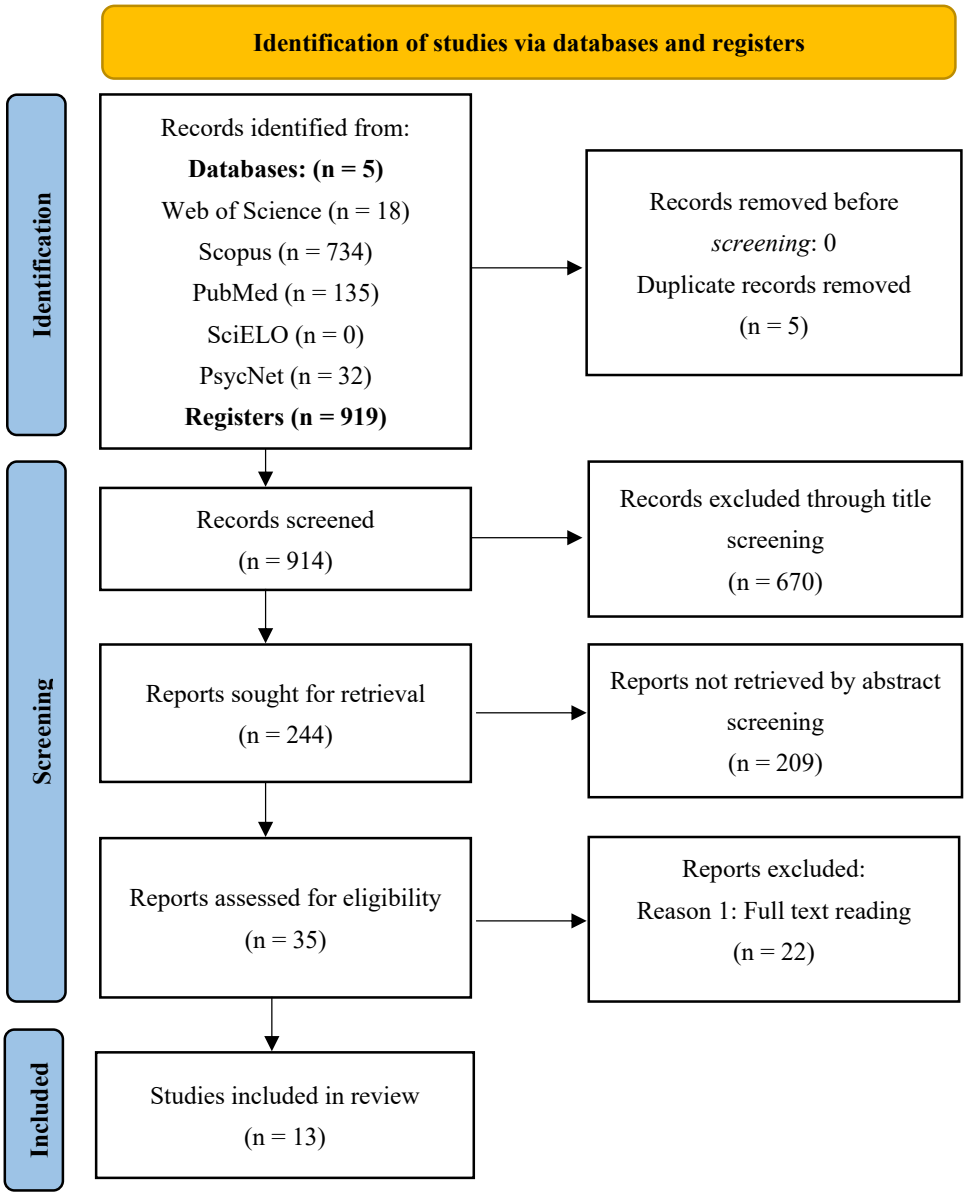


Figure 1. PRISMA Flow Diagram.

The analysis of the 13 studies included in this review allows us to identify results focused on key concepts and the relationship between technostress and teaching engagement. Although limited in number, these studies provide a robust foundation for synthesis given their high methodological quality (see Section 3.4). Of these 13 studies, 9 (69%) consistently report an inverse relationship between technostress and teaching engagement. One study (Hassan et al., 2019) finds that specific dimensions of technostress—techno-uncertainty and techno-insecurity—can be positively associated with organizational commitment. The remaining three studies report more complex, mediated relationships where the association between technostress and engagement depends on personal factors (e.g., digital self-efficacy, emotion regulation) or organizational resources (e.g., institutional support). Three dimensions emerged from the analysis of the results: (1) Prevalence of technostress and its relationship with teaching engagement; (2) Protective factors of teaching engagement in the face of technostress; and (3) Engagement as a key aspect of teacher well-being and performance (see Table 3).

3.1. Prevalence of Technostress and Its Relationship with Teaching Engagement

The selected studies confirm that technostress has become a common phenomenon among teachers since the transition to online or hybrid teaching modalities (Ali et al., 2023; Z. Wang et al., 2023). What is interesting about this case is that, despite this considerable technological pressure, teaching engagement can be sustained at high levels. Ali et al. (2023) documented that education professionals remained highly engaged in their work even under the stress of forced digitization, suggesting a resilience that warrants further analysis. In addition, some studies show that technostress is associated with variables that act as negative predictors of work engagement, particularly teacher burnout (Cacciamani et al., 2022; Trillo et al., 2024) and conflicts between work and family contexts (Z. Wang et al., 2023). The above can progressively affect the emotional and cognitive aspects that teachers require to develop a work commitment that is sustainable over time.

3.2. Protective Factors of Teaching Engagement in the Face of Technostress

Empirical evidence identifies a set of factors that not only cushion technostress but also act as fundamental pillars for sustaining work commitment in demanding digital contexts: first, digital self-efficacy emerges as a personal resource that reduces technostress (Zivi et al., 2025) and directly and positively predicts engagement. Moreira-Fontán et al. (2019) demonstrated that digital self-efficacy, in combination with institutional support, predicts autonomous motivation and positive emotions toward ICT, variables that together explain 69% of the variance in job commitment. Similarly, Ali et al. (2023) found that computer self-efficacy acts as a moderator, protecting active teacher involvement in stressful situations. Secondly, work resources and organizational climate represent another fundamental component. Engagement is not sustained solely by the individual. An innovative and supportive institutional environment is a work resource that directly nurtures engagement. In this regard, Z. Wang et al. (2023) documented that this climate moderates the relationship between technological demands and their adverse consequences, creating conditions that facilitate engagement characterized by vigor and dedication. Third, the perception of meaning at work has protective effects by reducing both burnout and techno-complexity, thereby facilitating more authentic teaching engagement (Trillo et al., 2024). At the same time, the use of adaptive emotional regulation strategies is linked to greater digital self-efficacy, establishing an indirect route to maintaining engagement by mitigating the generators of technostress (Zivi et al., 2025).

Table 3. Data extraction and synthesis.

Authors (Year)	Title	Country	Research Methodology/Design	Participants (N, Age, Gender)	Instruments for Data Collection	Main Findings
Zivi et al. (2025)	Protective factors against technostress in secondary school teachers	Italy	Quantitative/ Cross-sectional design (observational-analytical).	N = 348, mean age = 44.6 years, range 24–68. Women = 286, men = 58, non-binary = 1, did not disclose gender = 3	(a) Technostress Creators Scale (TCS) (b) Self-Efficacy Digital Competencies (SDC) (c) Cognitive Emotion Regulation Questionnaire-Short (CERQ)	Mediation analyses revealed that maladaptive strategies had a direct effect on the experience of technostress creators, whereas adaptive strategies influenced it indirectly through self-efficacy in digital competencies. The management of maladaptive emotions was positively linked to increased levels of technostress creators, while adaptive emotion regulation showed a positive relationship with self-efficacy in digital competencies. Additionally, self-efficacy in digital competencies was found to have a negative relationship with the experience of technostress creators.
Ali et al. (2023)	Impact of Techno Stress on Work Engagement with Mediating Role of Workload and Moderating Role of Computer Self-Efficacy	Pakistan	Quantitative/ Cross-sectional design. Mediation/moderation analysis using Structural Equation Modeling (SEM).	N = 169. Under 30 years old = 20; 31–35 years old = 109; 35–45 years old = 33; over 45 = 7. Women = 109, men = 60.	(a) Technostress scale (b) Computer self-efficacy scale (c) NASA TLX workload questionnaire (d) Work & Well-being Survey (UWES) scale	The research showed that teachers experienced technostress as they transitioned from traditional to online education. Technostress led to a greater workload, while computer self-efficacy helped individuals cope with it. However, professionals were highly committed to their teaching careers. The results indicate that workload does not affect work engagement.
Estrada-Muñoz et al. (2020)	Teacher Technostress in the Chilean School System	Chile	Quantitative/Cross-sectional design (observational-descriptive and analytical).	N = 428, mean age = 39.6 years, range 23–67. Women = 276, men = 152	(a) RED-TIC questionnaire (Psychosocial risks derived from ICT)	The findings indicated that 12% of the Chilean teachers involved in the study reported feeling techno-fatigued, while 13% experienced techno-anxiety, and 11% faced both issues. Male teachers demonstrated a higher prevalence of techno-anxiety and techno-fatigue compared to their female counterparts. The authors determined that the questionnaire used was a reliable instrument for assessing technostress, which prominently manifested as techno-anxiety and techno-fatigue among teachers in Chile.

Table 3. *Cont.*

Authors (Year)	Title	Country	Research Methodology/Design	Participants (N, Age, Gender)	Instruments for Data Collection	Main Findings
Q. Wang and Yao (2023)	The Impact of Technostress Creators on Novice Teachers' Job Satisfaction	China	Quantitative/Cross-sectional design. Regression analysis.	N = 304. Under 22 years old = 23; 23–26 years old = 247; 35–45 years old = 33; over 27 = 34. Women = 166, men = 138	(a) Techno-complexity scale (b) Techno-overload scale (c) Techno-invasion scale (d) Techno-insecurity scale (e) Challenge appraisal scale (f) Threat appraisal scale (g) Seeking technical help scale (h) Venting scale (i) Job satisfaction scale	The findings exhibited that, for novice teachers: (a) The connections between various technostress creators and the appraisal results were not consistent; (b) The pursuit of technical assistance mediated the relationship between challenge appraisal and job satisfaction; and (c) Venting did not significantly mediate the effect of threat appraisal on job satisfaction.
Araoz et al. (2023)	Exploring the relationship between technostress and psychological well-being in basic education teachers: a cross-sectional study	Peru	Quantitative/Cross-sectional design (observational-analytical).	N = 169. 21–40 years old = 79; 41–64 years old = 90. Women = 71, men = 98	(a) Technostress Questionnaire (b) Psychological Well-being Scale for Adults	Preliminary findings indicated that teachers had low levels of technostress and high levels of psychological well-being, with a significant inverse correlation between the two variables ($r = -0.465$, $p < 0.05$). Likewise, significant negative correlations were observed between technostress and the dimensions of well-being (acceptance, autonomy, relationships, and projects), and between psychological well-being and the dimensions of technostress (skepticism, fatigue, anxiety, and ineffectiveness), confirming an inverse and consistent relationship between higher levels of technostress and lower levels of psychological well-being in its multiple facets.
Trillo et al. (2024)	Beyond occupational exhaustion: exploring the influence of positive meaningful work on teachers' psychoemotional well-being in the digital age	Spain	Quantitative/cross-sectional and non-experimental	N= 213, mean age = 38.68 years, range 23–61. Women = 63.6%, men = 36.4%	(a) Work and Meaning Inventory (WAMI) (b) Maslach Burnout Inventory—General Survey (MBI-GS) (c) Technostress Creators Scale (TCS) (d) Work–family Conflict Scale	The findings revealed that engaging in meaningful, positive work was negatively correlated with emotional exhaustion, technological complexity, and conflicts between work and family. Additionally, this negative impact of meaningful positive work on work–family conflict was more pronounced among teachers with greater experience.

Table 3. *Cont.*

Authors (Year)	Title	Country	Research Methodology/Design	Participants (N, Age, Gender)	Instruments for Data Collection	Main Findings
Moreira-Fontán et al. (2019)	Teachers' ICT-related self-efficacy, job resources, and positive emotions: Their structural relations with autonomous motivation and work engagement	Spain	Quantitative/Cross-sectional design. Structural equation modeling (SEM).	N = 350, mean age = 48.40 years. Women = 54.9%, men = 39.7%	(a) Teachers' Knowledge about ICT and Internet subscale (b) Innovative Climate scale (c) ICT Positive Emotions scale (d) Satisfaction with Professional Context Scale (e) Work Task Motivation Scale for Teachers–WTMST (f) Utrecht Work Engagement Scale (UWES-9)	After testing the measurement model, the structural model indicated that all ICT-related variables significantly predicted autonomous motivation, explaining 26% of the variance. ICT-related variables and autonomous motivation explained 69% of the variation in work engagement. Emotional variables were also predicted by digital self-efficacy and institutional support. Autonomous motivation and emotional variables mediated the effects of digital self-efficacy and innovation support on work engagement.
Z. Wang et al. (2023)	Navigating Technostress in primary schools: A study on teacher experiences, school support, and health	China	Quantitative, non-experimental (observational), correlational, and cross-sectional design	N = 1172. Women = 941, men = 231	(a) Technology Intensity Scale (b) Adapted Technostress Creators Scale (c) School Support Scale (d) Work–family Conflict Scale (e) Personal Health Issues Scale	The findings showed that teachers experienced moderate to high levels of technostress during the pandemic, with variations based on gender, age, and their specific responsibilities. Additionally, there was a positive correlation between technostress and both work–family conflict and health issues related to technology use. The degree of technology use directly impacted work–family conflicts and personal health, as well as indirectly influenced them through the effects of technostress. Support from schools played a moderating role in the indirect connection between technology use intensity and work–family issues and health problems; increased school support resulted in a reduced impact of technology use intensity on work–family conflicts and personal health due to the influence of technostress.

Table 3. *Cont.*

Authors (Year)	Title	Country	Research Methodology/Design	Participants (N, Age, Gender)	Instruments for Data Collection	Main Findings
Cahapay and Bangoc (2021)	Technostress, Work Performance, Job Satisfaction, and Career Commitment of Teachers Amid COVID-19 Crisis in the Philippines	The Philippines	Quantitative/Cross-sectional design (observational-correlational).	N = 2272. Under 35 years old = 1071; 35–44 years old = 644; over 45 years old = 557. Women = 1849, men = 423	(a) Technostress Scale (b) Work Performance Scale (c) Job Satisfaction Scale (d) Career Commitment Scale	The results showed that teachers experience moderate technostress, very high levels of work performance and job satisfaction, and a high level of career commitment. In addition, it was revealed that technostress and its four components differed significantly according to age, gender, marital status, and teaching experience. Finally, it was found that technostress has a significant negative relationship with work performance.
Demboski et al. (2024)	A formação docente como estratégia para prevenir o tecnoestresse e a violação de limites trabalho-família em professores da educação básica	Brazil	Quantitative/non-experimental, descriptive and correlational, cross-sectional.	N = 455. Women = 407, men = 48	(a) Work–family Conflict (WFC) Scale (b) Technostress Scale	The results indicate that public school teachers had higher levels of technostress, while private school teachers had higher levels of inhibition of this technological stress. The findings of this study may help school administrators implement strategies such as flexible policies, support for digital self-monitoring, and training in the use of information and communication technologies to mitigate the effects of technological stress.
Pace et al. (2022)	Teachers' Work-Related Well-Being in Times of COVID-19: The Effects of Technostress and Online Teaching	Italy	Quantitative/non-experimental, descriptive and correlational, cross-sectional.	N = 219. Mean age = 47.6 years, range 22–67 years. Women = 76.3%, men = 23.7%	(a) Teachers' Online Education and Burnout Scale (b) Technostress Scale (c) Questionnaire on the Experience and Evaluation of Work 2.0—QEEW 2.0	The findings demonstrate negative correlations between technostress and job satisfaction, with this relationship varying depending on individuals' perceptions of meaning. Examining factors associated with teachers' perceptions of their jobs, both in general and throughout the pandemic, can aid in discovering new coping strategies and developing interventions for implementing innovative teaching methods.

Table 3. *Cont.*

Authors (Year)	Title	Country	Research Methodology/Design	Participants (N, Age, Gender)	Instruments for Data Collection	Main Findings
Cacciamani et al. (2022)	Teachers' Work Engagement, Burnout, and Interest toward ICT Training: School Level Differences	Italy	Quantitative/non-experimental (observational), correlational comparative.	N = 358, mean age = 49.25 years, range 32–66 years. Women = 88.3%, men = 11.7%	(a) Utrecht Work Engagement Scale (UWES) (b) Copenhagen Burnout Inventory (CBI) (c) Interest toward ICT Training Scale	The findings indicated that: (a) elementary school teachers demonstrate greater job commitment and a stronger interest in ICT training than their counterparts in secondary schools; (b) burnout is a predictor of job commitment across all levels of education; (c) the interest in ICT training affects job commitment solely in elementary and secondary schools. The results were interpreted with attention to cultural and contextual factors.
Hassan et al. (2019)	The Effects of Technostress Creators and Organizational Commitment among School Teachers.	Malaysia	Quantitative/non-experimental, correlational, and cross-sectional.	N = 173. 20–30 years old = 53; 31–40 years old = 73; 41–50 years old = 38; over 51 years old = 9. Women = 129, men = 44.	(a) Demographic data and profile questionnaire (b) Technostress Creators Scale (c) Organizational Commitment Scale	The results revealed that two aspects of technostress creators, techno-uncertainty and techno-insecurity, positively and significantly impacted organizational commitment. Conversely, the other three elements, which include techno-overload, techno-intrusion, and techno-complexity, did not predict teachers' commitment to the organization. Additionally, the findings suggested that a certain degree of technostress could enhance teachers' commitment.

3.3. Teaching Engagement as a Key Aspect of Teacher Well-Being and Performance

Work engagement is a fundamental aspect linked to multiple professional outcomes. Evidence shows that burnout negatively affects it at all educational levels (Cacciamani et al., 2022), confirming its antagonistic nature with burnout syndrome. On the other hand, interest in continuing ICT training has a positive effect, especially in primary and secondary education (Cacciamani et al., 2022), highlighting the importance of professional development as a motivational factor. Thus, the relationship between technostress and engagement has nuances that require careful consideration. Although some studies do not detect direct effects of technological burden on engagement (Ali et al., 2023), others reveal that technostress does impact variables closely linked to this construct, such as job satisfaction (Q. Wang & Yao, 2023) and psychological well-being (Araoz et al., 2023), both recognized as precursors to job commitment. For this reason, the findings of Hassan et al. (2019) should be highlighted, as they identified positive correlations between specific dimensions of technostress (techno-uncertainty, techno-insecurity) and organizational engagement. This result suggests that, in manageable amounts, technological challenges can be perceived as stimuli that mobilize teacher dedication rather than inhibit it.

In summary, the body of evidence found in this research forms an integrative model synthesized by the authors from the 13 reviewed studies, in which teaching engagement does not represent the absence of technostress, but rather the product of a balance between technological demands and a network of protective resources. This model (Figure 2) is not drawn from a single study but represents a conceptual integration of the common patterns identified across the included publications. Technostress acts as a demand that can deplete personal resources and, consequently, weaken engagement. However, positive digital self-efficacy, institutional support, the perception of meaningful work, and the use of adaptive strategies function as protective factors that reduce stress levels and nurture the energy and dedication that enhance the characteristics of a fully committed teacher (see Figure 2).

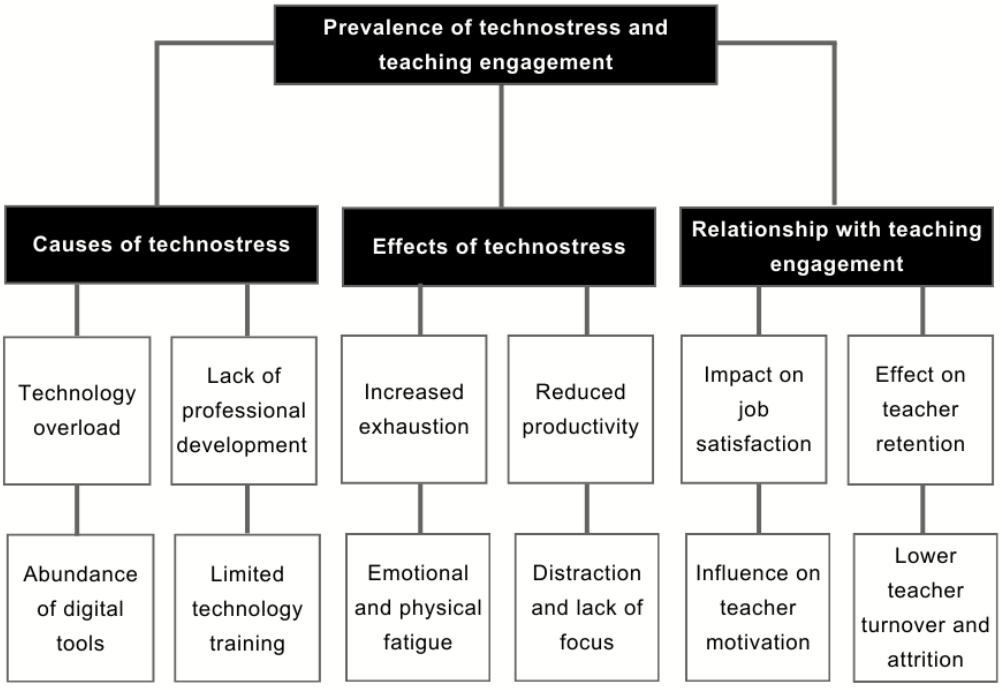


Figure 2. Integrative model of the relationship between technostress and teaching engagement, synthesized from the 13 studies included in this systematic review. Source: Own elaboration by using Canva.

3.4. Assessment of Methodological and Scientific Quality

The quality analysis of the 13 articles included in the review reflects the strength of the available evidence. In this regard, the scores range from 89 to 101 out of 105, with a mean of 96.6. This fact indicates that the studies analyzed constitute a reliable basis for our analysis. In this regard, it is important to note that ten of the thirteen articles exceeded 90% quality, with contributions such as those by Zivi et al. (2025), Estrada-Muñoz et al. (2020), and Moreira-Fontán et al. (2019) standing out for their methodological excellence. This reality allows us to approach the synthesis of findings with considerable confidence that the findings stem from well-designed and well-executed research (Table 4). However, the assessment also highlights a virtually universal limitation that warrants explicit mention. The dimension related to the provision of Appendix A, reveals a critical area for improvement: all thirteen studies received the minimum score here. This systematic absence of complete measurement instruments, interview guides, or other detailed protocols in Appendix A undermines transparency and, above all, the ability of other researchers to replicate the methodological procedures in as much detail as possible.

Table 4. Assessment of the quality of scientific articles.

Authors	Zivi et al. (2025)	Ali et al. (2023)	Estrada-Muñoz et al. (2020)	Q. Wang and Yao (2023)	Araoz et al. (2023)	Trillo et al. (2024)	Moreira-Fontán et al. (2019)	Z. Wang et al. (2023)	Cahapay and Bangoc (2021)	Demboski et al. (2024)	Pace et al. (2022)	Cacciamani et al. (2022)	Hassan et al. (2019)
ITEM 1	5	5	5	5	5	5	5	5	4	5	5	5	5
ITEM 2	5	5	5	5	5	5	5	5	5	5	5	5	5
ITEM 3	5	4	5	5	5	5	5	5	5	4	5	5	5
ITEM 4	5	4	5	5	5	1	5	5	5	5	4	5	4
ITEM 5	5	4	5	5	5	5	5	5	5	5	5	5	4
ITEM 6	5	4	5	5	5	5	5	5	5	5	5	5	4
ITEM 7	5	4	5	5	5	4	5	5	5	4	5	5	4
ITEM 8	5	4	4	4	4	4	4	4	5	5	5	5	5
ITEM 9	5	4	5	5	4	4	5	4	5	5	4	4	3
ITEM 10	5	5	5	5	5	4	5	4	5	4	4	4	4
ITEM 11	5	5	5	5	5	5	5	5	4	5	5	5	5
ITEM 12	5	5	5	5	5	5	5	5	5	5	5	5	5
ITEM 13	5	5	5	5	5	5	5	5	5	5	5	4	5
ITEM 14	5	5	5	5	4	5	5	5	4	5	5	5	5
ITEM 15	5	5	5	5	5	5	5	5	5	4	5	5	5
ITEM 16	5	5	5	5	4	5	5	5	4	4	5	5	4
ITEM 17	5	4	4	5	5	5	5	5	5	5	4	4	5
ITEM 18	5	4	5	5	5	5	5	5	5	5	5	5	4
ITEM 19	1	1	1	1	1	1	1	1	1	1	1	1	1
ITEM 20	5	3	5	5	5	5	5	5	5	5	5	5	5
ITEM 21	5	4	5	5	5	5	5	5	5	5	5	5	5
Total	101/105	89/105	99/105	100/105	97/105	93/105	100/105	98/105	97/105	96/105	97/105	97/105	92/105
%	96.2%	84.8%	94.3%	95.2%	93.4%	88.6%	95.2%	93.3%	93.4%	91.4%	93.4%	93.4%	87.6%

Note: Items correspond to the SSAHS scale dimensions: 1 = Title; 2 = Author metadata; 3 = Abstract; 4 = Keywords; 5 = Introduction, justification, and context of the topic; 6 = Introduction, citations; 7 = Objectives; 8 = Methodology, study design; 9 = Methodology, participants; 10 = Methodology, instruments; 11 = Methodology, statistical analysis; 12 = Results, description; 13 = Results, tables and/or figures; 14 = Data analysis; 15 = Conclusion; 16 = Contribution; 17 = Recommendations; 18 = References; 19 = Appendices (if applicable); 20 = Reference regulations; 21 = Format.

This assessment confirms that this research is based on methodologically sound scientific articles. The studies not only address the issue of interest in a relevant manner but also do so through rigorous designs, robust analyses, and generally clear communication

of their processes and findings. This overall soundness largely mitigates the impact of the main limitation identified (the lack of Appendix A).

4. Discussion

The findings of this SR, drawn from 13 high-quality studies, consistently show that teaching engagement and technostress have a predominantly inverse relationship across most studies analyzed among primary and secondary school teachers working in the digital society (9 of the 13 studies). While we acknowledge that the number of included studies is relatively small, it is crucial to contextualize this within the emergent nature of the research field. As noted in the introduction, all studies meeting our criteria were published from 2019 onwards, reflecting a recent and rapidly evolving area of inquiry, largely accelerated by the pandemic-driven digital transformation. Despite the limited number of studies, the consistency of findings across different contexts and the robustness of the quality assessment supports the validity of the observed patterns. In particular, the studies included in this SR show that higher levels of technostress, expressed in technological anxiety, techno fatigue, techno complexity, or digital overload, are associated with lower levels of vigor, dedication, and absorption in teaching work (Ali et al., 2023; Cacciamani et al., 2022; Pace et al., 2022; Z. Wang et al., 2023). However, there are also reports of situations in which teaching engagement remains high despite technological pressure, especially when digital self-efficacy is high and institutional support is strong (Moreira-Fontán et al., 2019; Zivi et al., 2025), revealing the coexistence of heterogeneous demands and resources in the professional teaching experience.

The relevance of these results lies in the fact that they help to respond accurately to the research question posed, confirming that the relationship between teaching engagement and technostress is neither linear nor homogeneous, but mediated by personal, pedagogical, historical-cultural, and organizational variables (Dekawanti et al., 2025; Solís et al., 2023; D. Yang et al., 2025). The inverse relationship identified means that higher levels of technostress are associated with lower levels of teacher vigor, dedication, and absorption. Conversely, the protective factors identified suggest that greater teaching engagement may mitigate technostress, although the cross-sectional nature of most studies prevents establishing causal direction. This bidirectional interpretation aligns with the Job Demands–Resources model, which posits that job demands and resources interact dynamically. However, it must be noted that the reviewed studies provide limited comparative data on rural versus urban contexts, which constrains a more nuanced understanding of how territorial inequalities—in infrastructure, access, and support—specifically modulate the technostress-engagement relationship. This gap is particularly significant given that our research question explicitly focused on this distinction. In digitized educational contexts, technostress functions as a structural demand inherent to teaching work (Ghanizadeh et al., 2025), whereas teaching engagement can be understood as a motivational resource that enables educators to sustain meaningful pedagogical practices under conditions of high and persistent demand (De Clercq et al., 2022; Shu, 2022; Zhao, 2024). From this perspective, teaching engagement should not be interpreted as the absence of technological stress. Rather, it reflects teachers' capacity to manage and regulate technostress in functional ways, integrating digital demands into their pedagogical practice without undermining professional well-being or the quality of education (Beyranvand & Mohamadi Zenouzagh, 2021; Han et al., 2021; Lammassaari et al., 2022).

Furthermore, when comparing these findings with previous studies, such as those by Chen et al. (2024) and Valiao (2025) documenting adverse effects of technostress on psychological well-being and job satisfaction; Aktan and Toraman (2022), Bourlakis et al. (2023), and Gabbiadini et al. (2023) on emotional exhaustion and weakened professional

motivation; and Khlaif et al. (2023), Kotherja and Skilja (2025), and Pimenta et al. (2023) on technostress as a psychosocial risk factor in education, there is apparent convergence with the international literature, which has documented the adverse effects of technostress on psychological well-being, job satisfaction, and teaching performance (Chen et al., 2024; Valiao, 2025). Research across different education systems indicates that the intensification of digital technology use increases emotional exhaustion and weakens professional motivation, thereby indirectly affecting teaching engagement (Aktan & Toraman, 2022; Bourlakis et al., 2023; Gabbiadini et al., 2023). The results of this review confirm these patterns at the primary and secondary education levels, reinforcing the idea that digitization, when not accompanied by adequate pedagogical and organizational support, can become a psychosocial risk factor for teachers (Khlaif et al., 2023; Kotherja & Skilja, 2025; Pimenta et al., 2023).

However, the evidence analyzed also introduces elements that broaden and complicate traditional interpretations of these constructs. Some studies show that specific dimensions of technostress, such as techno-uncertainty or techno-insecurity, can be positively associated with organizational engagement when they occur at manageable levels (Hassan et al., 2019). This finding suggests that technological challenges can be reframed as opportunities for learning and professional development, especially for teachers with greater digital self-efficacy and a sense of pedagogical purpose. Likewise, studies that highlight the mediating roles of autonomous motivation, positive emotions toward ICT, and institutional support (Moreira-Fontán et al., 2019; Trillo et al., 2024) help understand teaching engagement as a dynamic process of pedagogical adaptation rather than a static state of well-being.

From a pedagogical standpoint, the implications of these findings are particularly relevant for teaching in the post-pandemic digital society. The evidence suggests that educational policies for technology integration must transcend approaches focused exclusively on developing technical skills (Trenerry et al., 2021), incorporating strategies aimed at strengthening the meaning of life, generativity, emotional regulation, or digital self-efficacy (Lu et al., 2024; Sandoval-Obando et al., 2025; Shi et al., 2025; X. Yang & Du, 2024). Likewise, the importance of promoting supportive school climates, pedagogical leadership, and professional recognition is reinforced, as these act as key resources for sustaining teacher engagement in highly technologized environments (Al-Zu'bi et al., 2024; Oduro et al., 2025). In this context, teaching engagement stands out as a key indicator of educational quality, pedagogical sustainability, and teacher well-being in the digital society.

Consequently, this review establishes relevant projections for future research in the field of education sciences. It is a priority to develop longitudinal studies that allow for the analysis of the temporal evolution of the relationship between technostress and teaching engagement, overcoming the limitations of the predominant cross-sectional designs. Likewise, it is necessary to deepen comparative analyses of rural and urban contexts, accounting for inequalities in infrastructure, technological access, and institutional support. This would directly address the identified gap in rural dynamics, moving beyond mere acknowledgment toward a systematic investigation of context-specific patterns. Finally, future research should integrate mixed methods approach to understand how teachers construct pedagogical meaning about technology, thereby contributing to a more comprehensive, contextualized, and empathetic understanding of teaching work in contemporary digital society.

Limitations

This SR had several limitations. First, the relatively small number of included studies (n = 13) may limit the generalizability of the findings. However, this likely reflects the emergent state of the literature on this specific relationship in K-12 settings, as all included

studies were published from 2019 onwards. Second, the included studies exhibited considerable heterogeneity in their conceptualization and measurement of key constructs. While all studies examined technostress and teaching engagement, they employed different instruments, focused on different dimensions of these constructs, and reported findings using varied metrics.

This methodological and measurement heterogeneity, combined with the predominance of cross-sectional designs, limits the possibility of conducting a meta-analysis and complicates the synthesis of standardized conclusions, as direct comparisons between studies must be made cautiously. Furthermore, the predominance of cross-sectional designs—and the consequent lack of longitudinal studies—prevents the establishment of causal relationships or an understanding of the temporal evolution of the dynamics between engagement and technostress. Third, the studies do not report comparative data that would allow analysis of the contextual variable (urban/rural), leaving an important gap for future research anticipated in our research questions but not fulfilled due to limitations in the primary evidence.

Regarding the literature reviewed, the quality evaluation using the SSAHS revealed high overall methodological soundness. However, a universal limitation was the lack of Appendix A in the published articles, which reduces transparency and the possibility of detailed replication. Finally, this review did not include a formal risk-of-bias assessment of the included studies. Although the SSAHS was used to assess overall methodological quality, it does not identify or weight specific types of bias that affect the internal validity of observational studies, which predominate in our sample.

5. Conclusions

Through the mediation of contextual and personal factors, this SR demonstrates a largely inverse link between technostress and teaching engagement. The revised studies demonstrate that technostress reduces teachers' vigor, commitment, and motivation in their careers. However, in challenging digital contexts, education professionals can maintain, and even enhance, engagement through key protective factors, such as perceived meaning of teaching, digital self-efficacy, institutional support, and adaptive emotional regulation. Thus, teacher engagement does not represent the absence of technological stress, but rather the result of a dynamic balance between digital demands and personal and institutional resources. Regarding educational level, the evidence suggests that elementary teachers may show greater engagement and interest in ICT training than secondary teachers (Cacciamani et al., 2022), though limited comparative data constrain broader conclusions. Concerning rural and urban contexts, while studies identify distinct challenges, infrastructural deficits in rural schools versus platform overload and accountability pressures in urban settings, systematic comparisons remain absent from the literature

Consequently, the teaching profession itself must evolve in response to these challenges. This evolution requires reimagining teacher training beyond instrumental tool use toward the cultivation of digital resilience, understood as the capacity to adapt, recover, and thrive amid continuous technological change. Such an approach implies fostering skills in boundary-setting in digitally saturated environments, critical reflection on technology's pedagogical role, and sustainable practices that integrate digital tools without compromising well-being. Teacher preparation should thus move from episodic technical training to continuous professional development addressing the emotional, ethical, and relational dimensions of teaching in the digital age.

This finding has important implications for educational policy and practice, highlighting the need for systemic approaches that combine technological investment with psychosocial support. Specifically, policymakers should consider: (a) establishing clear

regulations that limit digital communication outside working hours, safeguarding teachers' right to disconnect; (b) integrating mental health services into school systems, including access to counseling and regular technostress screenings; and (c) providing schools with dedicated technical support staff to reduce the burden on teachers to troubleshoot technological problems. These measures would transform protective factors, such as institutional support and work–life balance, into structural realities that sustain teacher engagement.

Future research should prioritize longitudinal studies and comparative analyses across rural and urban contexts to inform sustainable, context-specific educational interventions in the digital age. Specifically addressing the gaps identified, studies are needed that explicitly compare how technostress manifests and is mitigated in rural versus urban school settings, capturing the structural inequalities that shape teachers' digital experiences. Moreover, given the trans-professional nature of technostress, comparative studies with other high-demand sectors could yield valuable insights for teacher well-being.

Author Contributions: Conceptualization, E.S.-O.; methodology, E.S.-O., G.F.-V. and L.C.-A.; software, E.S.-O. and P.E.-P.; validation, E.S.-O. and G.F.-V.; formal analysis, E.S.-O. and M.L.-A.; investigation, E.S.-O. and G.F.-V.; resources, E.S.-O.; data curation, L.C.-A. and P.E.-P.; writing—original draft preparation, E.S.-O. and G.F.-V.; writing—review and editing, E.S.-O. and L.C.-A.; visualization, G.F.-V. and M.L.-A.; supervision, E.S.-O.; project administration, E.S.-O.; funding acquisition, E.S.-O. All authors have read and agreed to the published version of the manuscript.

Funding: Fondo Nacional de Desarrollo Científico y Tecnológico Regular Nº 1250213/Agencia Nacional de Investigación y Desarrollo (ANID), Chile.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Search Strategy

Database	Search Strategy	N	Search Date
Web of Science (WOS)	TS = ("teacher engagement" OR "work engagement") AND TS = ("technostress" OR "techno-stress" OR "digital stress") AND TS = ("primary school" OR "secondary school" OR "school teachers") AND TS = ("rural" OR "urban")	18	15 December 2025
Scopus	TITLE-ABS-KEY("teacher engagement" OR "work engagement") AND TITLE-ABS-KEY("technostress" OR "techno-stress" OR "digital stress") AND TITLE-ABS-KEY("primary education" OR "secondary education" OR "school teachers") AND TITLE-ABS-KEY("rural" OR "urban")	734	15 December 2025
SciELO	("compromiso docente" OR "engagement docente" OR "work engagement") AND ("tecnoestrés" OR "stress tecnológico" OR "tecnología digital") AND ("educación primaria" OR "educación secundaria" OR "profesores de escuela") AND ("rural" OR "urbano")	0	15 December 2025
PsycInfo	("teacher engagement" OR "work engagement") AND ("technostress" OR "techno-stress" OR "digital stress") AND ("primary school teachers" OR "secondary school teachers") AND ("rural schools" OR "urban schools")	32	16 December 2025
PubMed	("teacher engagement"[Title/Abstract] OR "work engagement"[Title/Abstract]) AND ("technostress"[Title/Abstract] OR "techno-stress"[Title/Abstract] OR "digital stress"[Title/Abstract]) AND ("primary school"[Title/Abstract] OR "secondary school"[Title/Abstract] OR "school teachers"[Title/Abstract]) AND ("rural"[Title/Abstract] OR "urban"[Title/Abstract])	135	16 December 2025

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