



Empowering Educators In The Digital Era: Harnessing ICT Usefulness For Technostress Mitigation

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Abstract: The integration of Information and Communication Technologies (ICT) has transformed teaching and learning in educational institutions, offering benefits like improved communication, better resource access, and enhanced efficiency. However, this technological shift has also introduced significant challenges for teachers, notably in the form of technostress. Technostress, which refers to the psychological and physical strain caused by the complexities of ICT use, has become a major obstacle to effective technology adoption in education. Factors like information overload, techno-complexity, and techno-insecurity contribute to these challenges, often leading to burnout, anxiety, and decreased job satisfaction for educators. This article examines the impact of technostress on teachers, focusing on how the perceived usefulness of ICT can help reduce its negative effects. It looks into key moderators such as ICT literacy, technical support, and organizational support, which can alleviate technostress and create a more supportive teaching environment. Additionally, the study integrates models like the Technology Acceptance Model (TAM) and the Job Demands-Resources (JD-R) model to offer insights into how educational institutions can enhance teacher well-being through targeted interventions. The findings stress the importance of a balanced approach that addresses ICT-related challenges while also harnessing its potential to improve teaching and learning outcomes.

Index Terms - ICT Usefulness, Technostress, ICT Adoption, ICT Literacy, Technical Support, Organizational Support, Teacher Well-Being

I. INTRODUCTION

In the rapidly evolving digital landscape of educational institutions, Information and Communication Technology (ICT) has become a cornerstone for enhancing teaching efficiency, promoting creativity, and improving educational outcomes. The widespread adoption of ICT in schools and universities has revolutionized educational workflows by increasing communication speed, enhancing decision-making processes, and improving access to a wealth of digital resources. However, this technological transformation also brings significant challenges, particularly in the form of technostress—a psychological strain or discomfort caused by the complexities and demands of ICT use. For educators, technostress manifests in various forms, including techno-overload (excessive demands from ICT tools and systems), techno-complexity (difficulty in understanding or adapting to new technologies), and techno-uncertainty (stress caused by continuous technological changes and updates). These stressors can negatively affect teachers' mental health, job satisfaction, and productivity, creating a substantial challenge for educational institutions striving to leverage technology effectively (Tarafdar et al., 2007; Ayyagari et al., 2011).

One critical factor in reducing technostress in educational settings is the perceived usefulness of ICT—how much teachers believe that technology enhances their ability to achieve teaching goals. When teachers perceive

ICT as useful, it not only boosts task efficiency but also fosters greater confidence and reduces cognitive load, helping to mitigate the negative consequences of technostress. The Technology Acceptance Model (TAM) and the Job Demands-Resources (JD-R) Model provide valuable frameworks for understanding this relationship. TAM suggests that when teachers view ICT as beneficial, they are more likely to adopt it, which in turn reduces stress and enhances overall technology acceptance (Venkatesh & Davis, 2000; Venkatesh & Bala, 2008). The JD-R model complements this by emphasizing how organizational resources—such as support systems, training programs, and user involvement—can buffer the impact of ICT demands, leading to a more balanced and productive teaching environment (Bakker & Demerouti, 2007).

The rationale for this study arises from the need to bridge gaps in the current understanding of the relationship between ICT usefulness and technostress within the context of educational institutions. While the positive effects of ICT usefulness are well-documented, there remains limited research on the moderating factors that influence this relationship in educational settings. Moderators such as technical training, organizational support, and individual ICT literacy may significantly enhance the perceived usefulness of ICT, reducing stress and improving teaching outcomes. Understanding these factors is essential for educational institutions aiming to create stress-resilient, technology-enhanced environments where teachers can thrive in their roles.

The research objectives of this study are threefold: First, it seeks to examine how ICT usefulness influences technostress, specifically how the perception of ICT as useful affects stressors like overload, complexity, and uncertainty among teachers. Second, the study aims to identify key moderating factors—such as organizational support, training programs, and ICT literacy—that influence the relationship between ICT usefulness and technostress. Finally, the research intends to develop a comprehensive conceptual framework based on the TAM and JD-R models, offering both theoretical insights and practical strategies for improving ICT use and enhancing teacher well-being in tech-driven educational environments. By addressing these objectives, this study not only advances our theoretical understanding of technostress but also provides actionable recommendations for optimizing ICT adoption in educational institutions and fostering a positive digital culture for educators.

II. REVIEW OF LITERATURE

The literature on technostress and ICT usefulness in educational institutions reveals a complex relationship between the benefits and challenges of integrating technology into teaching and learning environments. Technostress, defined as the psychological strain caused by technology use, is a significant concern for educators. Teachers experience technostress as a result of factors like information overload, constant technological change, and the pressure to stay updated with new tools and systems (Saltan et al., 2024; Rey-Merchán & López-Arquillos, 2022). These stressors can lead to negative outcomes, such as burnout, anxiety, and reduced job satisfaction. The COVID-19 pandemic further exacerbated these challenges, as teachers were forced to rapidly adapt to online and hybrid learning environments, leading to heightened levels of stress and mental health issues (Zheng et al., 2022; Wang et al., 2023).

Despite these challenges, the perceived usefulness and ease of use of technology—key components of the Technology Acceptance Model (TAM)—play a critical role in teachers' adoption of ICT. The perceived usefulness of technology often outweighs demographic variables such as age or experience, influencing teachers' attitudes toward technology and their adoption intentions (Aurangzeb et al., 2024). However, the impact of technostress creators, such as techno-complexity and techno-insecurity, can negatively affect teachers' attitudes toward ICT adoption, while dimensions like techno-invasion and techno-overload can, paradoxically, have positive effects on teachers' motivation and performance (Wang & Zhao, 2023). This highlights the dual nature of technostress, where it can lead to techno-eustress—a positive form of stress that enhances teachers' well-being and job performance when managed effectively (Nascimento et al., 2024).

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Moreover, teachers' self-efficacy plays a crucial role in mitigating technostress. Higher levels of ICT integration skills are associated with both increased technostress and enhanced self-efficacy, suggesting that a balance between stress and competence is necessary for effective technology use (Yango, 2023). To reduce the adverse effects of technostress, it is essential to provide adequate training, technical support, and psychological counseling, as well as ensure a rational distribution of administrative tasks (Wang & Zhao, 2023; Rey-Merchán & López-Arquillos, 2022). Institutional support, particularly school support, is crucial in moderating the effects of technostress and improving teachers' ability to navigate the challenges posed by ICT (Wang et al., 2023). By fostering a supportive environment, schools can help teachers manage the psychological demands of ICT use and enhance their overall job satisfaction and productivity.

Theoretical Background for Technostress and ICT Usefulness

Technostress is a significant challenge faced by educators in the context of Information and Communication Technology (ICT) integration in education. Defined as the psychological and physical strain caused by the demands of using technology, technostress is particularly concerning among teachers, who are increasingly expected to adapt to and incorporate various ICT tools into their teaching practices. Research has identified several technostress creators that impact teachers' attitudes towards ICT and their willingness to adopt new technologies. These stressors include techno-complexity, techno-invasion, techno-overload, techno-insecurity, and techno-uncertainty (Saltan et al., 2024; Wang & Zhao, 2023). Techno-complexity refers to the challenges teachers face when trying to understand and effectively use complex educational technologies, leading to stress, feelings of inadequacy, and resistance to technology adoption. Similarly, techno-invasion involves the intrusion of technology into teachers' personal lives, particularly with the expectation of being constantly connected to their professional duties, which further increases their stress levels (Rey-Merchán & López-Arquillos, 2022). Techno-overload arises when teachers are overwhelmed by the sheer volume of information and tasks generated by ICT tools, often leading to burnout and fatigue (Wang & Zhao, 2023).

One of the most concerning dimensions of technostress is techno-insecurity, where teachers fear the rapid obsolescence of their skills due to the ongoing evolution of educational technologies. This fear of job displacement or professional irrelevance contributes significantly to stress and anxiety among educators, especially in environments where technological advancements are fast-paced and pervasive (Saltan et al., 2024). Techno-uncertainty, characterized by the constant changes and updates in ICT systems, creates anxiety and exacerbates stress as teachers struggle to keep up with evolving technology (Rey-Merchán & López-Arquillos, 2022). Despite the negative aspects of these stressors, there is also evidence of techno-eustress, a positive form of stress, which can enhance job satisfaction, engagement, and overall teacher performance when managed effectively (Nascimento et al., 2023).

The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is widely used to understand technostress in teachers, particularly in the context of digital education and online learning. Technostress, which refers to the negative psychological and physical effects of technology use, has become a major concern for educators, especially with the rapid shift to online teaching during the COVID-19 pandemic (Saltan et al., 2024; Khlaif et al., 2023). TAM, which includes factors like Perceived Usefulness (PU) and Perceived Ease of Use (PEU), is crucial in assessing teachers' acceptance and adoption of technology, helping to alleviate technostress (Azuddin et al., 2024; Akbarini, 2024). Research has shown that technostress creators such as techno-complexity and techno-insecurity can negatively impact teachers' attitudes toward ICT and their intention to adopt it, while techno-invasion and techno-overload have positive effects on ICT adoption (Wang & Zhao, 2023).

An expanded version of TAM, which includes factors like computer anxiety (CA), has been proposed to better understand the relationship between technostress and technology adoption. This version highlights the importance of ease of use over perceived usefulness in influencing teachers' decisions to use technology (Alshammari, 2024). Furthermore, organizational flexibility and support, such as end-user training and psychological counseling, are essential in mitigating the negative effects of technostress and improving teachers' quality of work life (Saleem & Malik, 2023; Wang & Zhao, 2023).

The concept of techno-eustress, which refers to the positive side of technostress, suggests that under certain conditions, technostress can improve teachers' performance and well-being. This provides a more nuanced understanding of how technostress impacts educators (Nascimento et al., 2024). Overall, integrating TAM with

technostress research offers valuable insights into the factors that influence teachers' adoption of technology and the strategies needed to manage technostress effectively in educational settings.

Job Demands-Resources (JD-R) Model

The Job Demands-Resources (JD-R) model provides a comprehensive framework for understanding how both job demands and resources affect teachers' experiences of technostress, which has become a growing concern in digital education. Technostress, defined as stress caused by technology use, can manifest in two ways: techno-distress, which negatively impacts well-being and performance, and techno-eustress, which can improve job satisfaction and productivity (Nascimento et al., 2023; Nascimento et al., 2024). According to the JD-R model, job demands such as workload, time pressure, and technological demands can lead to stress and burnout. On the other hand, job resources like support, autonomy, and organizational backing help buffer these demands, leading to higher job satisfaction and reducing the risk of burnout (Yoon, 2023; Lemmermeyer, 2023; Granziera et al., 2021).

In the specific context of technostress, stressors like techno-invasion and techno-insecurity have been linked to teacher burnout, especially when technology intrudes on personal time or when teachers fear becoming obsolete due to rapid technological change (Mahapatra & Pati, 2018). These stressors often lead to decreased motivation and job satisfaction. However, the JD-R model also suggests that the positive side of technostress—techno-eustress—can improve performance and well-being when managed well. Resources like IT mindfulness, coping flexibility, and a supportive school culture can turn technostress into an energizing force, boosting engagement and job satisfaction (Nascimento et al., 2023).

The model further stresses the importance of balancing job demands with adequate resources. Resources such as school support, psychological detachment, and training can buffer the negative effects of technostress, promoting teacher well-being and increasing engagement (Nuutinen & Bordi, 2024). Research shows that school support plays a critical role in moderating the effects of technostress, particularly during digital transitions, as seen in the COVID-19 pandemic (Rey-Merchán & López-Arquillos, 2022). When teachers have sufficient resources, they can better manage the challenges of ICT integration, turning stressors into opportunities for growth and performance improvement (Cramer & Hosenfeld, 2024; Corso-de-Zúñiga et al., 2020). Ultimately, the JD-R model provides a valuable lens for understanding the dual nature of technostress in teachers. It emphasizes the importance of strategic interventions to enhance job resources while managing job demands to optimize teacher outcomes in digitally enriched educational settings (Carlo et al., 2019).

Integrating TAM and JD-R in Technostress Research

The integration of TAM and JD-R offers a thorough framework for the assessment of technostress. The integration of the Technology Acceptance Model (TAM) and the Job Demands-Resources (JD-R) model offers a comprehensive view of the complexities surrounding technostress in education. TAM, which focuses on perceived ease of use and perceived usefulness, helps explain teachers' attitudes toward technology and their intent to continue using it in educational settings. Technostress creators, such as techno-complexity and techno-insecurity, negatively impact teachers' views of ICT, which can hinder both the initial adoption and sustained use of technology in teaching (Wang & Zhao, 2023). The difficulty teachers face in using and adapting to new technologies leads to frustration, making it harder for them to embrace ICT effectively.

On the other hand, the JD-R model highlights the balance between job demands and job resources and their influence on technostress and teacher well-being. High job demands—like heavy workloads and the constant need to adapt to new technologies—can lead to emotional strain and burnout. This is especially true in low-resource environments, such as Indian schools, where the introduction of smartphones has amplified technostress, increased anxiety and reducing productivity (Varanasi et al., 2021). However, the model also underscores the importance of job resources, such as school support, autonomy, and organizational flexibility, which can help mitigate the negative effects of technostress. Adequate support improves teachers' self-efficacy, reduces stress, and enhances their overall job satisfaction (Chou & Chou, 2021; Saleem & Malik, 2023).

By combining these models, we can see the dual nature of technostress, where both techno-distress and techno-eustress coexist. While techno-distress can harm teachers' mental health and job satisfaction, techno-eustress can improve teacher well-being and performance when factors like ICT usefulness, IT mindfulness, and coping flexibility are present (Nascimento et al., 2023). Effectively managing technostress requires providing teachers with the right training, technical support, and psychological counseling to help them navigate technological challenges (Amin et al., 2024; Kovács et al., 2024). Furthermore, fostering a supportive

school culture and ensuring an equitable distribution of administrative tasks can help protect against the negative impacts of technostress. This approach not only deepens our understanding of the challenges teachers face with technostress but also informs strategies to enhance ICT adoption, reduce stress, and improve overall job satisfaction (Cramer & Hosenfeld, 2024). By balancing job demands and resources in the context of technology use, educational institutions can create a more sustainable and productive environment for teaching.

The Impact of Technostress Among Teachers

The incorporation of technology in education to improve teaching and facilitate administrative tasks has introduced new challenges for teachers. Technostress, which refers to the stress and strain caused by adapting to new technology, significantly impacts teachers' job performance, satisfaction, and health. This section explores the effects of technostress on teachers based on the literature. Technostress can lead to a sharp decline in job performance due to factors such as techno-overload, techno-invasion, techno-complexity, techno-uncertainty, and techno-insecurity. These stressors increase cognitive load, reduce attention, and increase errors, all of which negatively affect overall performance (Saleem et al., 2021). Teachers experiencing high technostress report poor time management and inefficiency in managing their workload, which hinders their ability to teach effectively (Ayyagari et al., 2011). The constant need to adapt to new technologies can also exhaust teachers, reducing the time they can spend with students and on lesson planning, further lowering productivity (Wang et al., 2008).

Additionally, the ongoing introduction of new technological tools can overwhelm teachers, leading to frustration and helplessness, which in turn decreases their job satisfaction. Studies show that technostress negatively affects job satisfaction by placing stress on teachers' psychological well-being (Aktan & Toraman, 2022). Furthermore, failure to manage work-family conflicts alongside technostress can result in job dissatisfaction and higher turnover intentions among teachers (Tarafdar et al., 2011). The pressures from technological demands can also lead to physical and psychological health issues, affecting job performance and satisfaction. Teachers experiencing technostress may show signs of nervousness, depression, fatigue, and burnout, all of which harm their job performance and reduce satisfaction (Joo et al., 2016). These health problems can create a vicious cycle, where poor health makes it harder to meet work demands, leading to more stress and dissatisfaction with the job (Ayyagari et al., 2011). Additionally, work-family conflict intensifies when digital tools demand constant connection, blurring the lines between work and personal life, leading to increased stress and decreased life satisfaction (Saleem et al., 2021). Use of technology in learning environment as a tool to support teaching effectiveness and to facilitate administrative work has brought about new challenges among teachers. Technostress, a concept that refers to the stress and strain that individuals go through when trying to cope with new technologies, has significant impact on teachers' job performance, job satisfaction and health. This section aims at presenting the various effects of technostress on teachers based on a review of literature.

Techno-stress can cause a drastic decline in teachers' job performance because of techno-overload, techno-invasion, techno-complexity, techno-uncertainty, and techno-insecurity. These stressors lead to cognitive overload, decreased attention, and increased mistakes, which in turn decreases overall job performance (Saleem et al., 2021). Teachers who experience high levels of technostress have cited that they have poor time management in handling their workload which in turn hampers their efficiency in disseminating knowledge (Ayyagari et al., 2011). The constant demand to conform to new technologies can also wear out teachers, reducing the time they have to spend with students and in lesson planning, which degrades their performance even more (Wang et al., 2008).

Furthermore, the constant need to learn new technological tools and platforms, which are often introduced to the classroom, can lead to frustration and helplessness among teachers, thus reducing their job satisfaction levels. Studies show that teachers with technostress have lower job satisfaction because of the pressure exerted on their psychological well-being (Aktan & Toraman, 2022). The failure to manage the work and family conflict coupled with technostress results to overall job dissatisfaction and hence higher turnover intentions among teachers (Tarafdar et al., 2011). In addition, the pressure from technological expectations can result in critical physical and psychological disorders, which in turn influence job productivity and contentment in an indirect manner. Teachers who experience technostress may exhibit symptoms such as nervousness, depression, fatigue, and burnout, which negatively impact their job performance and decrease their job satisfaction (Joo et al., 2016). These health difficulties might have a reciprocal impact and worsen each other, creating a cycle where declining health makes it even harder to fulfil employment demands, resulting in stress and dissatisfaction with the job (Ayyagari et al., 2011). This cycle of stress is further compounded by work-family conflicts since teachers are unable to balance between work and family responsibilities. The integration

of digital tools demands constant connection, which results in the overlapping of work and personal life, thus, increasing stress levels and reducing the level of life satisfaction (Saleem et al., 2021). As a result, this conflict decreases job satisfaction and increases stress, which hinders teachers from executing their responsibilities efficiently (Aktan & Toraman, 2022).

Another factor that was identified to have an impact on technostress is support from the organization which is a factor that helps in moderating the effects of technostress on job performance and satisfaction. Therefore, schools and educational institutions that provide adequate technical support, training, and psychological services can reduce the impact of technostress on teachers' job performance and satisfaction (Dong et al., 2020). On the other hand, where there is no such support, the impact of technostress on the employees is higher and this leads to low satisfaction and poor performance among the employees (Ioannou et al., 2024). Technostress is also found to have a negative effect on quality of work-life (QWL) and therefore the general job satisfaction and performance. According to the literature, techno-complexity and techno-overload are some of the antecedents that negatively affect QWL and hence decrease job satisfaction and increase turnover intentions (Saleem et al., 2021). In addition, technostress can lead to a decrease in teachers' motivation to integrate new approaches to teaching and use of technologies. Lack of motivation may lead to reduced enthusiasm among teachers, which in turn affects the students and the quality of education provided to them (Estrada-Muñoz et al., 2021). This demotivation is usually accompanied by poor interpersonal relations among the employees. Stressed teachers may become less social and lonelier, which means that they will not be able to consult with other teachers and share knowledge. This isolation also reduces job satisfaction and performance even more because teachers are lonely in their working environment (Aktan & Toraman, 2022).

In conclusion, technostress presents a major concern to teachers because it hampers their performance, satisfaction, health, and interactions with other professionals. Solving these problems implies the effective institutional support, the continuous professional development, and the creation of a positive work climate to reduce the negative impact of technostress and improve the educational performance.

The Mitigating Role of ICT Usefulness

The integration of Information and Communication Technologies (ICT) has shown to play a vital role in mitigating technostress among teachers, primarily through enhancing their digital competencies and providing strong support systems. Research indicates that improving ICT skills among educators significantly reduces their stress levels. For instance, a study conducted in Peru revealed that digital competencies accounted for 62.2% of the variation in technostress among university instructors, suggesting that increased proficiency in ICT can effectively reduce stress (Bartra-Rivero et al., 2024). Similarly, in Spain, strategies such as distributing administrative tasks more rationally, alongside occupational safety training and technical support, were recommended to alleviate technostress among teachers (Rey-Merchán & López-Arquillos, 2022). These findings underscore the importance of both individual ICT competence and institutional support in reducing the negative impacts of technology on teachers' mental and physical well-being. The complexity and perceived usefulness of ICT are also key factors in how teachers experience technostress. Techno-complexity and techno-insecurity, which refer to the difficulty of understanding and adapting to new technologies, can negatively impact teachers' attitudes toward ICT and hinder its adoption (Wang & Zhao, 2023). Conversely, stressors such as techno-overload and techno-uncertainty can sometimes have a positive effect, motivating teachers to engage more actively with technology, leading to greater ICT adoption (Wang & Zhao, 2023). Additionally, techno-eustress, a positive form of technostress, suggests that when technology is perceived as useful, it can improve job satisfaction and performance, particularly in higher education settings (Nascimento et al., 2023).

Teachers' perceptions of their ICT competence are closely linked to their levels of technostress. Studies show that teachers who feel more competent with ICT report lower levels of stress, which emphasizes the importance of training programs to enhance digital literacy (Saltan et al., 2024). To effectively manage technostress, both its causes and mitigating factors must be addressed. Providing technical support, encouraging ICT involvement, and promoting coping strategies can help reduce the negative effects of stress on teaching performance (Li et al., 2021). Furthermore, factors like computer anxiety and the perceived ease of use of ICT tools are significant contributors to technostress, highlighting the need to improve ICT competency to reduce stress levels (Effiyanti & Sagala, 2018).

Organizational support, technical training, and ICT literacy are important factors in mitigating technostress among teachers. Research suggests that institutional support, such as school backing, is crucial for reducing the negative impacts of technostress. For example, stronger school support has been shown to buffer the effects of intense technology use, including work-family conflicts and health issues, by moderating technostress (Zhang et al., 2021; Wang et al., 2023). Additionally, social support from colleagues and the wider school community can help alleviate stress caused by the rapid integration of new technologies (Khlaif et al., 2022; Rahma & Rizal, 2023). Teachers who feel supported by their institutions are better equipped to navigate technological challenges, reducing stress and frustration often caused by new digital tools.

Technical training is another critical element in reducing technostress. When teachers receive training on ICT use, their anxiety and fatigue from feeling incompetent in using technology can be minimized. Extensive training programs aimed at improving digital skills are effective in mitigating technostress by helping teachers feel more confident in integrating technology into their teaching (Rey-Merchán & López-Arquillos, 2022). These programs are particularly beneficial for improving ICT literacy, which is directly linked to reduced levels of technostress. Teachers with higher ICT competence are better able to manage the demands of technology in the classroom, resulting in lower stress levels (Saltan et al., 2024; Syvänen et al., 2016).

Furthermore, literacy facilitation, which includes training, instructional manuals, and opportunities for knowledge sharing, has been shown to reduce the effects of techno-overload and techno-complexity, two significant stressors for teachers. These resources help reduce the perceived difficulty and cognitive load associated with using technology, further alleviating technostress (Malaquias & Júnior, 2023). In conclusion, a combination of supportive organizational culture, effective technical training, and high ICT literacy levels significantly mitigates the adverse effects of technostress, improving both teachers' occupational health and job satisfaction.

III. . METHODOLOGY

This study adopts a conceptual framework approach to investigate the relationship between ICT usefulness and technostress among teachers in educational institutions. As a conceptual paper, the methodology relies primarily on a comprehensive literature review and theoretical analysis to synthesize existing models, frameworks, and empirical findings. The purpose of this methodology is to provide a deeper understanding of how ICT integration impacts technostress and the role of moderating factors such as organizational support, technical training, and ICT literacy in shaping educators' experiences with technology.

The selection of the papers and journals included in this review was guided by their relevance to the core themes of technostress, ICT adoption, and teacher well-being in educational contexts. The study focused on peer-reviewed articles from high-impact academic journals. These sources were selected to ensure that the literature reviewed met rigorous academic standards and provided a strong foundation for understanding the relationship between ICT use and technostress. The selected papers were classified into four main categories: (1) Technostress in Education, (2) ICT Adoption and Acceptance Models, (3) Job Demands-Resources (JD-R) Framework in Education, and (4) Teacher Support and Professional Development. This classification allowed the study to address the different dimensions of technostress and how ICT adoption impacts teachers at both the individual and organizational levels.

The Technostress in Education category focused on studies that explored the negative psychological and physiological effects of ICT use among teachers. This included research that identified key technostress creators such as techno-complexity, techno-overload, and techno-insecurity. The ICT Adoption and Acceptance Models category encompassed literature that applied the Technology Acceptance Model (TAM) to understand teachers' attitudes toward ICT and how perceptions of ICT usefulness influenced their adoption intentions. The Job Demands-Resources (JD-R) Framework in Education category explored how job demands, such as the need for constant adaptation to new technologies, and job resources, like organizational support and training, interact to shape teachers' experiences with ICT. Finally, the Teacher Support and Professional Development category examined studies on how support systems, ICT training, and the development of ICT literacy contribute to mitigating the negative effects of technostress.

To collect the relevant literature, papers published between 2010 and 2024 were reviewed, capturing both recent developments and foundational studies in the field. The selected studies were analyzed based on their methodological rigor, conceptual clarity, and theoretical contribution. This involved categorizing each paper by its primary focus—whether it addressed technostress creators or moderators such as organizational support and ICT literacy. A thematic approach was used to identify recurring patterns and relationships across the studies, allowing for the integration of findings into a comprehensive theoretical framework.

The conceptual framework developed in this paper synthesizes insights from the Technology Acceptance Model (TAM) and the Job Demands-Resources (JD-R) model. It proposes that the perceived usefulness of ICT plays a critical role in mitigating technostress by fostering a positive attitude toward technology, which can enhance teacher productivity and well-being. Additionally, the framework highlights the moderating effects of ICT literacy, technical training, and organizational support in buffering the negative impacts of technostress. The analysis also points to gaps in the literature, particularly the limited exploration of sector-specific interventions and longitudinal studies that track the long-term effects of ICT adoption in education. These gaps suggest important areas for future research to further refine the conceptual framework and provide actionable recommendations for educational institutions.

IV. . DISCUSSION

The integration of Information and Communication Technology (ICT) in education has undeniably transformed teaching practices, offering vast potential for enhancing productivity, creativity, and learning outcomes. However, this technological shift has also introduced technostress, which has emerged as a significant challenge for educators. The study reinforces the findings of previous research, showing that technostress can manifest in various forms such as techno-complexity, techno-overload, techno-invasion, techno-insecurity, and techno-uncertainty (Wang & Zhao, 2023; Saltan et al., 2024). These stressors disrupt teachers' professional satisfaction and well-being, especially in high-pressure environments such as during the COVID-19 pandemic. Technological changes, including the sudden shift to online teaching, exacerbated technostress, leading to burnout, anxiety, and fatigue among educators (Rey-Merchán & López-Arquillos, 2021; Zheng et al., 2022). Despite these negative effects, the relationship between ICT and technostress is not entirely detrimental. When managed properly, technostress can lead to techno-eustress, a positive form of stress that boosts teachers' performance and engagement with ICT, particularly when teachers perceive technology as useful and easy to use (Nascimento et al., 2023). This duality underscores the importance of managing both the stress-inducing and stress-relieving aspects of ICT.

The Technology Acceptance Model (TAM) and the Job Demands-Resources (JD-R) model offer valuable theoretical frameworks for understanding how ICT usefulness influences technostress and its effects on teacher well-being. According to the TAM, teachers who perceive ICT as useful and easy to use are more likely to adopt it, which can reduce technostress by streamlining tasks and enhancing task efficiency (Venkatesh & Davis, 2000). However, stressors like techno-complexity and techno-insecurity, which arise from difficulties in using and adapting to new technologies, negatively impact teachers' attitudes toward ICT and reduce their willingness to embrace it (Wang & Zhao, 2023). On the other hand, the JD-R model suggests that job resources, such as organizational support, training programs, and school culture, play a key role in buffering the negative effects of ICT-related stressors. By providing sufficient support and resources, schools can help teachers cope with the demands of technology and reduce burnout (Bakker & Demerouti, 2007). For example, school support has been shown to reduce work-family conflicts and health issues caused by excessive ICT demands (Wang et al., 2023), highlighting the need for institutional backing to manage the stress-inducing effects of ICT.

The findings of this study also underscore the critical role of ICT literacy in mitigating technostress. Teachers who possess high levels of ICT competence report lower stress levels, as they feel more confident in using technology and less overwhelmed by its demands (Saltan et al., 2024). Technical training and digital literacy programs are essential for enhancing teachers' skills and reducing the cognitive load associated with complex ICT systems (Rey-Merchán & López-Arquillos, 2022). Additionally, literacy facilitation—such as providing instructional materials, training, and knowledge-sharing opportunities—has been shown to alleviate stressors like techno-overload and techno-complexity, further reducing technostress (Malaquias & Júnior, 2023). Schools that invest in improving ICT competencies and provide emotional support for teachers can significantly reduce technostress, thereby improving teacher well-being, job satisfaction, and productivity. In summary, while technostress remains a challenge, strategic interventions—such as ICT training, organizational support, and psychological counseling—can help educators navigate the demands of technology, transforming potential stressors into opportunities for growth and professional development (Nascimento et al., 2023; Wang & Zhao, 2023).

V. . LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This conceptual paper, while offering valuable insights into the relationship between ICT usefulness and technostress among teachers, faces several limitations. One key limitation is its reliance on secondary data and theoretical models, which restricts the ability to generate new empirical findings. Future research could address this gap by conducting empirical studies that collect primary data from teachers in different educational contexts. This would help to understand the unique experiences of teachers regarding technostress, especially in diverse institutional and cultural settings. Additionally, most of the studies reviewed are cross-sectional, meaning they cannot establish causal relationships between ICT adoption and its impact on technostress over time. Longitudinal research would provide more comprehensive insights into how the adoption of ICT impacts teachers' well-being and performance in the long run.

Another avenue for future research is the exploration of emerging technologies and their role in shaping technostress. With the increasing integration of artificial intelligence (AI), virtual reality (VR), and other advanced technologies in education, it is important to investigate how these innovations affect teachers' stress levels and their teaching practices. Studies should also explore the concept of techno-eustress, which reflects the positive outcomes of stress in technology adoption, and how it might balance or mitigate techno-distress in educational settings. Furthermore, investigating the moderating effects of personal characteristics, such as ICT competence, age, and personality traits, could help tailor interventions to better support teachers. By addressing these limitations, future research can provide more targeted strategies for improving ICT integration in education and promoting teacher well-being in the digital age.

VI. . CONCLUSION

This study examined the complex relationship between ICT usefulness and technostress among teachers, highlighting both the positive and negative aspects of technology integration in educational settings. Technostress, driven by factors such as techno-complexity, techno-overload, techno-invasion, and techno-uncertainty, significantly impacts teachers' well-being, job satisfaction, and productivity. However, the perceived usefulness of ICT, as framed within the Technology Acceptance Model (TAM), plays a critical role in mitigating these negative effects. When teachers view ICT as beneficial and user-friendly, it can reduce stress and enhance technology adoption. Additionally, the Job Demands-Resources (JD-R) Model emphasizes the importance of organizational support, training, and personal ICT competence as key factors that can buffer the negative effects of technostress.

The findings underscore the importance of institutional efforts to provide adequate support systems, such as technical training, psychological counseling, and school support, to reduce technostress and promote ICT literacy among educators. By fostering an environment where ICT is perceived as both useful and manageable, schools can improve teachers' engagement, productivity, and well-being. This paper also paves the way for future research, particularly empirical studies, that can validate and extend these theoretical insights. As technology continues to evolve, understanding the dynamic relationship between ICT and technostress will be crucial for creating sustainable, stress-resilient, and effective teaching environments in the digital age.

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