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Stress Factors in Technical Education: Digital Transformation as a Source of Emerging Challenges and Strategic Interventions

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Abstract

INTRODUCTION: Technical educators face both long-standing and emerging stressors amplified by the digital transformation of industrial processes. The introduction of Industry 4.0/5.0 technologies (AI tools, VR/AR labs, digital platforms) increases cognitive and administrative burdens.
OBJECTIVES: This study aims to identify shared and technology-specific stressors in technical education and propose evidence-based strategies to mitigate them.
METHODS: We performed a systematic review of peer-reviewed articles and conducted a focus groups with 60 technical educators. Data were analyzed using thematic coding.
RESULTS: The most frequently reported stressors were administrative overload, curriculum volatility, safety responsibilities, and insufficient digital training. Digital tools like VR and AI systems present both stress-inducing and stress-reducing potential.
CONCLUSION: Supporting educators through targeted digital interventions and training programs is vital to sustaining quality technical education during ongoing digitalization.

Keywords: technological education, teacher well-being, digitalization, resilience, intervention programs

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1. Introduction

Education in technical fields represents a key prerequisite for the development of an innovative and competitive society in the context of the current digital transformation of industry. Technical educators bear essential responsibility for the quality and effectiveness of this education, as they shape the future professionals in technology, engineering, and industrial production. Their role is therefore not only extremely important, but also exposed to a range of specific professional challenges.

1.2. Teacher´s stressors

The role of technical educators is pivotal in shaping the future workforce. However, the profession is increasingly characterized by high levels of stress and burnout. In the United States, a Gallup [1] poll reported that 44% of K-12 teachers often or always feel burned out, the highest among all professions surveyed. Similarly, in the United Kingdom, 75% of education staff reported being stressed, with 78% experiencing mental health symptoms due to their work [2].

These stressors are particularly pronounced in vocational-technical education, where educators contend

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with unique challenges such as evolving technological demands and safety concerns.

Although new methods, such as digital twins, represent innovative tools in pedagogical and technological environments, they can also introduce stressors that are not fundamentally different from traditional professional stressors, but rather change their form and the way they manifest.

In the Czech Republic, studies [3] indicate that secondary vocational schoolteachers experience considerable stress due to excessive workloads, administrative requirements, and frequent curriculum changes requiring constant adaptation. Academic staff at Czech universities face similar issues, with over one-third reporting mental health challenges linked to job-related stress and administrative burdens. Addressing these issues requires targeted, evidence-based interventions to promote teacher well-being and resilience.

The aim of this paper is to analyze and address the stressors affecting technical educators in vocational-technical schools and universities and identify key challenges associated with technical education, and assess their impact on teacher well-being, job satisfaction, and burnout rates. We ask what differentiates the work of a technical teacher from that of teachers in other disciplines in terms of stressors and workload. Another objective of this paper is to propose actionable recommendations.

2. Methods

This study utilized a two-pronged methodological approach to comprehensively explore educator stress and burnout, which is related to the rapidly evolving digital transformation.

First, we conducted an extensive literature review, systematically evaluating data from peer-reviewed journals, educational reports, and authoritative publications Search terms included 'technical education', 'teacher stress', and 'digital transformation'. Articles from 2013–2024 were screened based on relevance to vocational and technical contexts.

Through this process, we identified a selection of evidence-based programs and digital tools that have shown measurable effectiveness in alleviating educator stress.

To complement and validate our findings from the literature, we carried out a focus group with participants from the Practical Teaching program at the Institute of Education and Counselling during the 2024/2025 academic year. The focus group included both in-service teachers and students preparing for teaching careers, allowing for a multi-perspective discussion of stressors and coping strategies. Focus groups are a qualitative research technique widely used in the social sciences to gain in-depth insight into participants' experiences, opinions, and attitudes. By facilitating interactive group dialogue, researchers can capture shared themes, contrasting viewpoints, and nuanced personal accounts that may not emerge through surveys or individual interviews. The focus group discussions were transcribed and manually coded, enabling the identification of key thematic categories and recurrent issues, which were then used to corroborate and refine the findings presented in the literature review.

2.1. European Pedagogical Staff

Recent international data confirm that participation in digitalization-related professional development significantly varies across national contexts and affects educators' readiness for innovation [4]. A Eurydice report [5] revealed that nearly half of teachers across Europe encounter substantial stress within their professional roles. This stress is particularly intensified in classrooms characterized by disruptive behavior or when educators feel inadequately prepared to manage and motivate students.

On the other hand, studies show that stress levels are often reduced in school cultures that foster collaboration, provide educators with professional autonomy, and ensure access to high-quality training opportunities. Recently, the academic community has placed increasing emphasis on supporting the well-being of university staff, acknowledging its importance for overall institutional effectiveness.

Multiple research studies highlight the persistent high stress and psychological burden faced by academic staff, underlining an urgent need for targeted interventions to protect and enhance their well-being [6, 7].

One major source of educator stress arises from working with students who display low motivation and insufficient vocational maturity, presenting ongoing challenges for teachers in both daily practice and long-term planning. A systematic review of higher education stressors has further underscored the heightened vulnerability of young female educators within academic settings.

The working conditions of teachers are consistently identified as central to their well-being, with factors such as overall workload, quality of the work environment, feelings of safety, support from colleagues and institutions, and the nature of relationships with students and parents all playing crucial roles. Negative experiences in any of these areas can lead to physical and emotional exhaustion, increased stress, and ultimately burnout, which detrimentally affects teachers' mental and physical health [8].

Moreover, educators in vocational education frequently perceive their professional status as lower than that of their peers in general education, which may further contribute to psychological strain. Additionally, the constant demand to adapt to frequent curriculum changes adds to their workload and exacerbates stress. Technology self-efficacy among vocational teachers plays a mediating role in how digital tools are adopted and perceived as stressors or supports [9].

2.2. Improving Programs

These findings highlight the urgent need to address work-related stressors among technical educators to secure their well-being and sustain the quality of technical education. Evidence-based interventions are essential in mitigating the negative impact of occupational stress, supporting teacher resilience, and creating positive school environments.

CARE. One of the most recognized programs addressing teacher stress is CARE (Cultivating Awareness and Resilience in Education) [10]. CARE aims to enhance teachers' mindfulness, emotional self-regulation, and compassion, equipping them with practical tools for coping with daily stress. The program includes interactive workshops and exercises—such as deep breathing, reflective journaling, and self-compassion practices—which help teachers reduce burnout, improve emotional well-being, and foster healthier teacher-student relationships.

CARE's effectiveness has been demonstrated in various educational contexts, indicating its adaptability across diverse school environments. Incorporating mindfulness-based approaches like CARE into professional development can empower teachers to navigate complex and challenging classroom situations with greater calm and resilience.

RULER. Another widely implemented intervention is the RULER program, developed by Brackett [11], which centers on building emotional intelligence skills in both educators and students. Through structured curriculum activities, RULER helps participants develop emotional awareness, self-regulation, and interpersonal skills. Components such as mood meters and collaborative charters support teachers and students in recognizing, labeling, and constructively addressing emotions. Evidence shows that RULER leads to improved classroom climate, enhanced teacher self-efficacy, and better student outcomes. Introducing RULER into technical and vocational settings may help educators address behavioral challenges and create more positive and supportive learning environments.

VR. The integration of virtual reality (VR) into teacher training offers an innovative strategy for preparing educators to handle real-world classroom challenges. VR simulations provide a safe and controlled environment in which teachers can practice responding to scenarios such as student conflicts or critical incidents with parents. Cardenas [12] underscores that VR-based training increases teacher confidence and reduces anxiety when managing stressful events. By engaging in immersive, scenario-based exercises, technical educators can build resilience and enhance their ability to cope with demanding situations in practice.

ERASE-Stress program. The ERASE-Stress program, originally developed to support students coping with trauma, has also been adapted for teachers, particularly in high-stress environments. In Israel, ERASE-Stress helps educators recognize and address stress triggers through a combination of group workshops, individual counselling, and relaxation techniques. Research by Gelkopf and Berger [13] demonstrated that participating teachers reported lower overall stress and greater emotional stability after completing the program. Adapting this intervention to address context-specific challenges in technical schools—such as cyberbullying or safety management—could offer further benefits.

Peer support programs. Peer mentoring and collegial support play a critical role in bolstering teacher well-being. Programs that pair experienced educators with less experienced colleagues create opportunities for practical guidance, emotional support, and knowledge sharing. These initiatives reduce feelings of isolation, facilitate problem-solving, and foster a stronger sense of professional community. Digital platforms, such as online teacher forums or virtual staff rooms, further enable collaboration and access to resources, as evidenced by successful peer-support systems implemented in Finland and the UK.

Mindfulness-based programs. Dedicated mindfulness programs tailored to the technical education context are showing promise. As Huo [14] points out, specialized workshops address issues unique to technical teachers, such as equipment safety, rapid decision-making, and managing classroom discipline. Practical techniques include progressive muscle relaxation, visualization exercises, and scenario-based role plays. Embedding these interventions in regular teacher training would not only support educators' mental health but also improve professional effectiveness and classroom management.

Digitalization and Organizational Support. To reduce administrative overload, educational systems should digitize routine tasks, streamline reporting obligations, and free up time for direct teaching and student engagement. This change is especially relevant for technical educators, who face additional record-keeping related to safety and equipment. Simplified processes and accessible digital tools make the work environment more manageable and support overall well-being.

Counselling Services and Training. It is vital that every school ensures access to psychological counselling and mental health professionals for its staff, as noted by Rothì et al. [15]. In addition, stress management, emotional intelligence, and conflict resolution should be integrated into both pre-service and ongoing professional training. Workshops targeting classroom conflict and disruptive behavior equip teachers with concrete strategies for challenging moments. Developing personal resilience,

self-efficacy, and intrinsic motivation further strengthens educators' capacity to withstand stress.

Building resilience. Improving teacher training is another essential component in tackling stress and building resilience. Pre-service and in-service teacher education programs should incorporate specialized training modules on stress management, emotional intelligence, and conflict resolution. For example, workshops and courses on managing classroom conflicts and addressing disruptive behavior would equip teachers with practical tools to handle stressful situations effectively. Furthermore, self-efficacy, intrinsic motivation, and personal resilience strategies are also critical factors that contribute substantially to this process

Peer mentoring and support networks. Peer mentoring and support networks are also crucial for fostering a supportive professional environment. Experienced teachers can play a vital role in mentoring their less experienced colleagues, sharing strategies for stress management, and providing emotional support. Establishing structured peer-mentoring programs within schools would create opportunities for collaboration and mutual learning. Furthermore, online communities specifically designed for educators could provide a platform for sharing experiences, seeking advice, and fostering a sense of belonging. Successful examples of such platforms abroad, like Slack or Microsoft Teams, could serve as models for the Czech educational context.

Mobile Applications and Wearables. The use of mobile applications linked with wearable devices enables real-time stress monitoring and immediate access to guided relaxation or mindfulness interventions and exercises [16]). Such digital solutions provide technical educators with personalized strategies to manage stress during the workday. Virtual workshops and AI-driven mental health tools further augment teachers' well-being, offering scalable support that adapts to individual needs. AI-based systems offer both administrative relief and pedagogical opportunities, though their impact on teacher stress remains under-researched [17].

2.3. Focus Groups

To verify the findings of the literature review, we conducted three focus groups, each with 20 participants, as part of the Practical Education Program at the Institute of Education and Counselling during the academic year 2024/2025. The groups comprised both practicing teachers and students. The discussions were transcribed and manually coded, allowing for the identification of thematic categories and recurring viewpoints. This qualitative analysis was used to examine and verify the findings presented in chap. 3.4.

Focus groups are a qualitative research method widely used in social sciences to explore participants' attitudes, experiences, and perspectives on a given topic through facilitated group discussion. They enable researchers to gain deeper insight into complex phenomena, identify common themes, and generate rich, context-specific data that may be difficult to capture through quantitative methods alone.

3. Results and Discussion

3.1. Number of Students

Even though the number of students is changing, we can find a certain trend where the number of sufficiently high-quality students interested in technical fields is decreasing. However, the composition of students is changing, with an increasing number of foreign students and students with special educational needs. All of this places additional demands on technical teachers.

The graph presents the longitudinal development of student enrollment at selected European technical faculties between 1990 and 2024 (see Fig. 1). Czech University of Life Sciences Prague (CZU) exhibits a declining trend in student numbers, stabilizing in recent years.

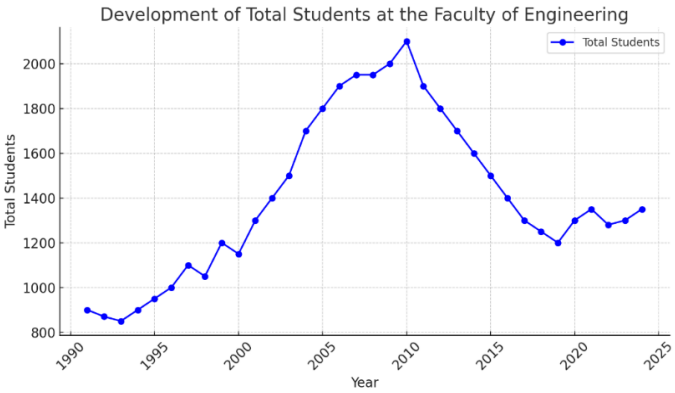

Fig. 1. Development of Total Students at the Faculty of Engineering. Source: Annual report, Faculty of Engineering, Czech University of Life Sciences Prague, 2024.

In contrast, Denmark, Germany and Italy demonstrate a consistent upward trajectory in student enrollment (see Fig. 2). The variations reflect differing national education policies, demographic shifts, and sectoral interest in engineering disciplines.

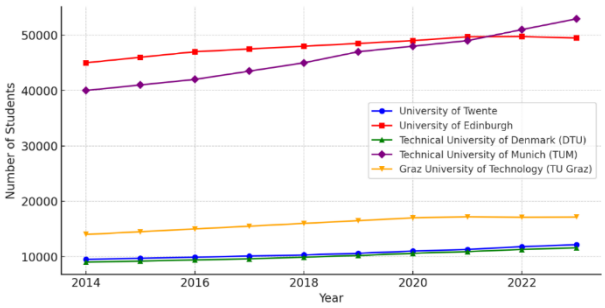

Fig. 2. Trends in Enrollment at European Technical Universities. (Source: Annual reports 2014 - 2023: University of Twente (Netherlands), University of Edinburgh (UK), Technical University of Denmark DTU, Technical University of Munich TUM (Germany), Graz University of Technology (Austria). Source: the data comes from publicly available annual reports of individual universities.

3.2. Core Stressors

The analysis of published studies shows that educators across various disciplines encounter similar primary stressors.

A systematic review by Ormiston [18] reveals that teachers often suffer from compassion fatigue as a result of the emotional demands associated with supporting students who have experienced trauma. Additionally, a qualitative study of U.S. K-12 educators published in March 2024 [19] found that 24% of teachers reported a strain on relationships with family or friends, including being short with their children, particularly on stressful days. Another pressing issue is cyberbullying, which also has been identified as a major stressor for educators.

These findings suggest that core stressors, including emotional demands, workload, and evolving educational environments, are prevalent among teachers universally (see Fig. 3).

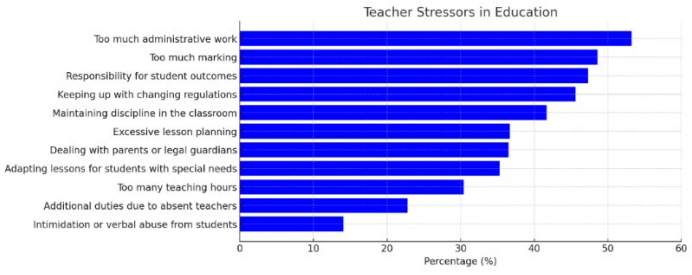

Fig. 3. Teacher Stressors in Education. Source: Career, Development and Quality of Life. Eurydice Report, 2023.

Recent research demonstrates that university staff and students across different European countries face very similar stressors impacting their mental health, regardless of local specifics or historical circumstances. This has been confirmed by a recent multicenter study conducted in Germany, Spain, and Italy, which identified shared sources of stress, overload, and psychological strain among academics in these countries—even during challenging periods such as the COVID-19 pandemic [20]. It is therefore highly likely that our findings can also be generalized and applied to the broader European context of technical education

3.3. Stressors Unique to Technical Educators

Teachers across disciplines experience significant stress due to administrative burdens, student behavior, and cyberbullying. However, technical educators face additional challenges unique to their field. They must continuously update their skills to keep pace with rapid technological advancements while ensuring students receive industry-relevant training.

Moreover, they bear responsibility for expensive equipment and the heightened safety risks associated with hands-on technical instruction. From a sociomaterial perspective, vocational teachers navigate complex entanglements between digital tools, institutional expectations, and pedagogical goals, which directly shape their stress experiences [21]. Motivating students in technical subjects further adds to their stress, as engagement often depends on balancing theoretical knowledge with practical application.

3.4. Focus Group Outputs

As part of validating the literature outputs, focus groups were conducted at the Institute of Education and Counselling. During a guided discussion, several key statements were confirmed. The data presented bellow are based on teachers' responses to the question: "To what extent are the following sources of stress present in your work?" The stress factors were identified from recurring themes observed in the participants' responses.

In the focus group discussions, general teachers across various subjects identified a wide range of stressors that negatively impact their professional well-being. The most frequently mentioned issues included excessive administrative burden and an overall high workload, which often hinder adequate lesson preparation. Significant sources of stress also encompassed student behavior issues, cyberbullying, and frequent curriculum changes, requiring constant adaptability without sufficient institutional support. The three focus groups involved 60 participants. Among them, 37% were in-service teachers with more than 10 years of experience, 18% had between 5–10 years, and 45% were pre-service trainees in their final year. The

specializations represented included mechanical engineering, electrical engineering, and agriscience. Recruitment was done via departmental invitation and voluntary participation. The top five stressors reported were: administrative overload (92%), curriculum changes (82%), student disengagement (73%), safety management (63%), and lack of digital support tools (63%).

Teachers highlighted the lack of professional development opportunities and limited institutional backing, contributing to feelings of stagnation and job insecurity. Additional stressors included the pressure to meet performance metrics, high parental expectations that frequently lead to conflicts, and concerns regarding job stability. Furthermore, many participants emphasized the mental health challenges associated with their profession, including exhaustion and psychological distress, underscoring the urgent need for systemic changes and enhanced support mechanisms for educators.

In contrast, teachers in technical fields reported a distinct set of stressors specific to their disciplines. A primary concern was the limited funding available for specialized equipment, which often restricted the quality of practical training. Additionally, they emphasized the need for continuous technological upskilling to keep pace with rapidly evolving industry standards, further increasing their workload. Low student motivation and the rising complexity of subject matter were also cited as significant challenges, particularly in cases where students had not chosen technical education voluntarily. Many teachers expressed difficulties in maintaining industry partnerships, which are essential for providing students with hands-on learning experiences.

Moreover, they highlighted the heavy responsibility **associated** with managing and maintaining expensive equipment, alongside persistent safety concerns in technical instruction. Another major source of stress was the declining number of students enrolling in technical programs and the ongoing struggle to recruit and retain them, raising concerns about the future viability of these fields.

These findings resonate with prior research from Sweden, where vocational teachers identified similar digital barriers and insufficient institutional infrastructure [22].

These findings underscore the unique pressures faced by technical educators, necessitating targeted support measures to address their specific professional challenges.

4. Conclusion and Recommendations

Technical educators are exposed to a wide range of stressors that directly affect their mental health, job satisfaction, and professional effectiveness. With the rise of Industry 4.0 and 5.0 technologies, educators must navigate rapidly evolving demands including AI tools, VR training platforms, and digital reporting systems. These technologies, while offering opportunities, also introduce new stressors that require adaptive capacity and institutional support. These challenges can manifest as emotional exhaustion, decreased performance, and even teacher attrition. Implementing targeted, evidence-based interventions is therefore crucial—not only to address these issues but also to create a healthier work environment and to support improved educational outcomes.

As Sharma and Sharma [23] demonstrate, digital transformation without adequate psychosocial support can deteriorate educator well-being.

By prioritizing teacher well-being through a combination of mindfulness-based interventions, emotional intelligence development, the use of technological tools, and peer support networks, educational institutions can contribute significantly to building a resilient, motivated, and effective teaching workforce. Such measures not only benefit individual educators, but also help ensure long-term institutional stability and better learning experiences for students.

Our research revealed several additional stressors particular to technical educators. Among these are the continual need to stay abreast of rapidly changing technologies, the responsibility for student safety during hands-on practical activities, and the complex management of specialized equipment and resources. Technical educators also face constant pressure to update their technical skills and knowledge, which, together with the necessity to maintain a safe learning environment, adds to their cumulative stress. Despite these specific burdens, there is a notable shortage of studies focusing specifically on the mental health and well-being of technical educators. Future research should thus pay greater attention to the unique characteristics and needs of this professional group.

Based on our findings, we propose the following recommendations to support and enhance teacher well-being:

- **Reduce Administrative Burden and Improve Support Systems:** Streamline and digitalize administrative tasks to minimize excessive workload and bureaucracy. Simplify reporting procedures and ensure that educators have easy access to on-site counseling and mental health support.
- **Enhance Teacher Training and Peer Support:** Incorporate stress management, emotional intelligence training, conflict resolution, and time-management workshops into teacher education programs. Establish structured peer mentoring systems and support networks to facilitate ongoing professional development and mutual support.
- **Manage Technology and Cyber Challenges:** Provide regular training for teachers on the integration of digital tools and artificial intelligence to reduce technology-related anxiety. Implement preventative programs addressing cyberbullying, offer legal support, and supply practical guidance on digital safety and best practices in online communication.
- **Utilize Technology to Reduce Stress and Enhance Teaching:** Integrate innovations such as virtual

reality (VR) Support teachers with wearable devices and mobile applications that monitor stress levels or offer relaxation exercises, and provide online mindfulness and emotional regulation courses. Mitigating stress through technological solutions (e.g., workflow automation, AI-enabled administrative support).

- **Create a Healthier Work Environment and Work-Life Balance:** Cultivate a positive organizational culture that values open communication, mutual recognition, and support for a balanced division between professional and personal life.

Implementing these recommendations would enable educational institutions and systems to take major steps toward reducing educator stress and fostering a more supportive and sustainable professional environment. In doing so, we not only support the mental health of teachers, but also contribute significantly to the effectiveness, stability, and long-term quality of technical education as a whole.

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