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Research Article

Struggling or Thriving With Technology at Work: A Mixed-Method Analysis of Personal and Organizational ICT Resources

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In the modern work landscape, technology and digitalisation are ubiquitous. The rise of hybrid work alone has dramatically increased workers' exposure to and dependence on information and communication technology (ICT) tools. While technology enables people to work faster and smarter, it can also restrict and induce technostress. Therefore, it is necessary to identify ICT-related resources that may help prevent these harmful effects. To this end, we adopted a mixed-method approach. In Study 1, using the critical incident technique, we collected accounts of positive and negative situations of ICT usage in the workplace from 95 individuals. Content analyses were performed on these data to define resource categories that were relevant for dealing with the technological side of work. The results revealed that, depending on the valence of the critical incident, workers tended to rely on somewhat different personal resources. These findings highlight the importance of various sources of personal efficacy, including technical literacy and nontechnical knowledge and skills. On the organizational-level, several categories emerged, encompassing aspects of IT infrastructure and technical literacy facilitation. Furthermore, in Study 2, a two-wave panel survey ($N = 335$) was conducted to investigate longitudinal relationships between selected personal and organizational resources (respectively, ICT self-efficacy and technical literacy facilitation) and burnout via the satisfaction of basic psychological needs. The results suggested an indirect effect, as both types of ICT resources positively predicted autonomy need satisfaction, and the latter was associated with a lower risk of burnout over time. However, this effect seems to be mostly applicable to hybrid but not office-based workers. Theoretical and practical implications are discussed based on these findings.

Keywords: basic psychological needs; burnout; ICT in the workplace; mixed-methods study; personal and organizational resources; technostress

1. Introduction

Technology has become an essential part of the workplace, significantly changing organizational life. Scholars seek to understand how adopting different technologies may impact the organization of work [1, 2]. In parallel, there is growing interest in the implications of digitalization for individual employees. However, this strand of research has typically focused more on intensified job demands (e.g., [3]), whereas knowledge about the resources necessary for people to adapt and cope with technological changes is rather fragmented. To address this gap, there is a need to shift the focus towards the human-centric side of technology [4], and the present study is aimed at employing this approach.

While the expansion of new technologies in the workplace helps improve efficiency, from an individual perspective, it also introduces new challenges related to techno-complexity and overload [5–7]. These challenges are especially likely among knowledge workers, whose work setup almost inevitably exposes them to frequent ICT use. Research on technostress clearly shows that digitalisation may carry the risk of adverse outcomes (e.g., strain reactions) if employees

are unprepared to integrate the techno element into their working lives [8, 9]. Therefore, resources that enable individuals to effectively manage the technological side of work are of key importance [10]. First, in the constantly evolving and digitally permeated world, individuals need various resources to be able to adapt to the changing work environments. Hence, prioritising one's agency over technology and maintaining a human-centric perspective is of utmost importance (e.g., [4]). Second, in the recent decade and especially in the last few years, researchers and policymakers have focused on the critical need for lifelong learning and upskilling. The constant need to adjust to the technological changes requires that employees gain new competences and upskill the current ones (e.g., [11, 12]).

The present mixed-methods study is dedicated to exploring the relevance of organizational and personal resources for maintaining employee well-being in the new world of work. In Study 1, we draw on information collected via the critical incident technique (CIT) [13, 14]. Using participant answers to open questions, we seek to identify what resources emerge as the most salient in situations (critical incidents (CIs)) related to (in)effective utilization of technologies at work. In doing so, we aim to enhance the understanding of how work design can be better adapted by modern organizations and how humans can better adapt to advancing technologies in their work environment [4].

In Study 2, we further quantitatively investigate the role of two specific examples of ICT resources [15, 16]—namely, organizational ICT literacy support and ICT self-efficacy—in preventing employees from experiencing strain by facilitating the basic needs of autonomy and competence. Here, we specifically focus on burnout as a strain outcome. Burnout is a widespread issue [17], reportedly affecting 13% of the EU workforce, with an additional 4% experiencing emotional exhaustion and 22% experiencing physical exhaustion [18]. It is also common in the United States, with 25% of people reporting emotional exhaustion when asked about the negative outcomes at work during the preceding month [19]. These numbers are concerning because systematic reviews indicate that burnout may significantly impair well-being, affecting its physical, occupational, and psychological aspects, such as pain, fatigue, insomnia, mental disorders, absenteeism, low job satisfaction [20], heart and cardiovascular diseases [21], and reduced job performance [22]. Burnout is becoming a recurrent concern in the new world of work, characterized by technological acceleration and change [3]. Therefore, it is crucial to better understand its antecedents and preventive mechanisms. Responding to the call for more fine-grained answers about how burnout develops over time [23] and how resources may prevent such adverse outcomes [24], we inspect potential explanatory pathways that inform about why and when the beneficial effects of ICT resources occur among knowledge workers. Our study adds to contextualized theory testing, as we investigate ICT resource mechanisms in traditional office-based and ICT-enabled hybrid work settings. As a result, we also contribute practical implications to practitioners on ways to maintain employee well-being in changing times.

2. Research Questions and Hypotheses

2.1. Resources for Adapting to the Changing Work Environment. Resulting from the popularity of telework and digital innovations, modern knowledge workplaces are particularly permeated by technology. ICT triggers changes in work processes, affects how people communicate, contributes to constant updates of tools used at work, and can change the core of how (and even if) some tasks are done [25, 26]. The literature agrees that such changes can not only alleviate work burden but also create technological overload and technostress [27], which is often observed among individuals in knowledge occupations [28]. As described by Ragu-Nathan et al. [6], technostress is a type of stress that people experience due to ICT, and it is related to poor adaptation to the presence of technology. There is a concern that technology may create "two worlds," where the advanced and technologically savvy persons are enabled by technology, whereas the less advantaged groups, poorly adapted to technology, have less access to good-quality jobs, hence expanding the gap between high and low skilled persons [29]. This issue requires particular attention, as knowledge work is witnessing an increase in technologically complex and cognitively demanding tasks [28, 30]. Virtually, all jobs with an ICT component include the so-called *new* job demands related to the use of technological tools [6, 31]. Thus, to ensure optimal employee functioning and reduce the risks of adverse outcomes, the provision and development of specific, ICT-related resources are crucial in organizations [6].

By definition, resources are those characteristics that offset the harmful effects of job demands, helping to achieve positive work outcomes [32]. ICT resources are organizational or personal ICT-related aspects that help diminish the negative effects of job demands and facilitate employees' growth and goal achievement, also having motivational potential for the staff [15, 16]. Resources can be defined based on the source: organization- or person-supplied [15]. Since organizations significantly impact work design and determine how much involvement their staff has in technology implementation, they share the responsibility of creating new job resources. Indeed, organizations can make important decisions, such as whether employees are allowed to choose and decide on the implementation of new technology, the extent of employee choice in an automated process, or the amount of literacy training provided for new technology [29]. As a result, employers dispose a range of measures, also known as technostress inhibitors that may prevent technostress [6]. In turn, personal resources are understood as the beliefs individuals hold about the extent of control they have in their work environment [33]. Personal resources play a central role in the self-regulation processes, helping to deal with job demands and reduce strain [24]. A lack of personal resources to control or cope with ICT demands is considered a significant cause of technostress (e.g., [10, 34]). In light of the above, the present study is aimed at examining the utility of these two types of resources—organizational and personal—for effectively navigating the technological aspects of work.

To do so, we opted for a two-study approach. Since the concept of ICT resources was first introduced in the literature a few decades ago, the world of work has witnessed a significant expansion of the digital component due to the COVID-19 pandemic (as illustrated by the integration of virtual tools for telework; [35, 36]) and the rise of artificial intelligence applications (such as GPT-3; [37]), raising questions about employees' well-being and highlighting the need for upskilling [11, 38]. Arguably, as technologies become more and more integral to knowledge work, people are likely to become more tech-aware and tech-savvy. As a result, their needs for ICT supportive measures may have also evolved. It is thus crucial to better understand what resources are deemed essential among the current workforce for effectively dealing with digital challenges they are facing at work. Drawing on prior literature on ICT demands and supports [6, 39], in Study 1, we were particularly interested in whether employees still place a high value on ICT literacy initiatives from their organizations and see their ability of ICT control as important means of adapting to the new job demands and thereby countering technostress. To do so, we relied on a qualitative investigation of the utility of diverse resources when using ICT, raising the following research question.

RQ1: What personal and organizational resources, or a lack thereof, emerge in employees' accounts of their (in)effective ICT usage situations at work?

In the second step (Study 2), we further aimed to inspect how specific examples of organizational and personal resources—namely, ICT literacy support and ICT self-efficacy—translate into adaptive outcomes among knowledge workers. Here, we tested formal hypotheses regarding the utility of these resources in preventing burnout for office-based versus hybrid-mode employees who are particularly likely to rely on ICTs.

2.2. The Strain-Preventive Role of ICT Resources

2.2.1. Burnout as a Strain Outcome. Burnout is an indicator of strain and ill-being [40], arising from the overwhelming demands people encounter at work [17]. Systematic reviews point to ICT use as a correlate of strain [41]; thus, heavy reliance on ICT and the intensification of work expose workers to even higher risks. Burnout refers to the inability and unwillingness to exert effort at work, and its core symptoms comprise exhaustion, emotional and cognitive impairment, and mental distance [23]. Burnout is not only a serious concern in itself, but it may also relate to further issues, such as anxiety, depression, low self-esteem, absenteeism, decreased productivity, turnover intentions, and lack of job satisfaction [42, 43]. It is, therefore, vital to find means for counteracting it in accelerated work environments. Recently, there has been a growing interest in technostressors that increase this occupational health risk over time (e.g., [44–46]). However, except for some prior work in the field (e.g., [47, 48]), empirical evidence about the role of ICT resources in reducing burnout is less systematic. This gap particularly concerns explanatory mechanisms that inform about why and when the beneficial effects of such resources are likely to emerge.

To address this gap, we draw on self-determination theory (SDT) and its propositions about the central role of basic needs in human functioning [49, 50]. As posited within this theory, basic needs are universal and enable natural self-motivation, development, and mental health [49]. Meta-analytic findings indicate that basic need satisfaction is associated with optimal functioning at work and general well-being [51]. Moreover, longitudinal evidence shows that these positive effects occur over time [52, 53]. In contrast, when basic needs are thwarted, people experience deprivation, resulting in diminished motivation, passivity, and defensiveness [49, 54]. It has been found that continuous experience of such situations and overly intensified work can lead to ill-being [51, 52]. Therefore, the satisfaction of basic psychological needs may represent an important intermediary factor linking ICT resources and reduced burnout, which we elaborate on in the current study.

2.2.2. The Indirect Effects of ICT Resources. Notably, basic need satisfaction is determined by the interaction between the individual and the environment [54]. While technology-related changes can support and enable, these changes also frustrate and demotivate if they hinder employees' basic needs [4]. For example, algorithms and constant connectivity shape workers' decision making, limiting true autonomy, while increasing techno-complexity, techno hassles, and reliance on technology may reduce employees' sense of competence [28, 29]. We thus propose that ICT resources are key for basic need satisfaction among knowledge workers, as these resources allow employees to adapt and effectively navigate the increasingly digitalized work environments. Attending to the needs for *autonomy* and *competence* should be especially subject to the two types of ICT-related resources tested in this study (i.e., ICT literacy support and ICT self-efficacy). Central to SDT's concept of autonomy is volition, integrated self-regulation, and willingness [55]. When this need is satisfied, one will feel integrity in their actions, thoughts, and feelings. When it is frustrated, people might feel pressure or even conflict with their desired line of action [54]. Competence reflects the sense of mastery and being an expert at work. If this need is thwarted, a feeling of being ineffective and helpless may occur [54].

Arguably, when companies encourage the growth of ICT literacy, employees better understand how their work can benefit from the use of technologies. Organizational ICT literacy support encompasses activities and mechanisms that promote IT knowledge sharing, such as providing training programs and educational materials to facilitate the mastery of technologies [56, 57]. As such, ICT literacy support may reduce the likelihood of adverse outcomes [57] and can be considered one of the key organizational-level resources that promote adaptation to digitalized work settings [6]. Additionally, ICT literacy support can respond well to the need to reskill and upskill their staff so that employees can maintain their workability. The opportunity to develop ICT literacy not only makes employees feel more competent but can also strengthen the feeling of autonomy by enabling the staff to decide about the best ways of integrating technologies into their work routine (e.g., [58]). Therefore, we hypothesize

that ICT literacy support may reduce burnout by facilitating these basic needs.

H1: ICT literacy support at T1 predicts (a) autonomy need satisfaction and (b) competence need satisfaction at T2.

In parallel, self-efficacy is a personal resource consistently reported as a determinant of positive functioning at work [59, 60]. ICT self-efficacy is domain-specific and defines the extent to which individuals are confident about their ability to effectively deal with technology-related task demands [61, 62]. Findings from prior studies suggest that ICT self-efficacy relates to reduced techno-insecurity and lower stress towards ICT [6, 63], as well as better adoption of advanced technology [64]. Therefore, ICT self-efficacy may be posited as an adaptive resource, reducing the perceived burden of new work demands and facilitating basic need satisfaction. When individuals believe they are able to use technology without relying on others, they feel more in control and empowered. Those with higher ICT self-efficacy can troubleshoot technical problems independently (e.g., [61]), which reinforces a sense of autonomy. Confidence in using technology also enables individuals to customize the technological tools to better meet their preferences and needs. As it often leads to a more efficient completion of tasks (e.g., [61]), this may bolster individuals' belief in their own competence. Moreover, individuals with high ICT self-efficacy adapt more easily to new technologies and innovate in their use [65, 66], which is also a marker of competence. Therefore, ICT self-efficacy may be expected to reduce burnout through the satisfaction of these basic needs.

H2: ICT self-efficacy at T1 predicts (a) autonomy need satisfaction and (b) competence need satisfaction at T2.

H3: Autonomy (a) and competence (b) need satisfaction at T1 predict lower burnout at T2.

2.2.3. The Role of Work Context. Last but not least, we consider the contextual component in the above-hypothesized relationships by testing them separately in office-based and hybrid-mode workers. While most knowledge workers are affected by digitalization [28, 67], research shows that hybrid-mode and office-based workers might have different access to social job resources, such as colleague and supervisor support, ad hoc information sharing, and information integration possibilities with teammates [68, 69]. Typically, office workers have more immediate collegial feedback and help when exposed to demanding situations (including technological demands) (e.g., [70]). Instead of just turning one's head towards a colleague to ask for help, a remotely working person has to dial a support line or contact someone using ICT. Feedback and support deterioration risks arise from at least two additional aspects: Firstly, in remote communication, social cues are less available or reliable, making feedback more impoverished and less engaging, and secondly, virtual communication can be of lower quality because of scheduling issues or interruptions, providing less space for feedback and support, increasing uncertainty, and even intensifying loneliness [29]. Therefore, office employees might need to rely less on personal ICT resources for achieving positive results than those individuals who telework on a regular basis.

Moreover, dependence on technologies might differ between the two modes of work. ICT use is somewhat indispensable for hybrid workers—while teleworking, a person usually needs an internet connection, e-communication channels, specialised software, and similar tools. Therefore, the utility of ICT literacy support should be particularly increased in this group.

Although this is not sufficient to formulate specific hypotheses about the role of ICT resources in reducing burnout across the two subpopulations, one can still assume that some differences may arise due to variations in the psychosocial work environment and potentially different ICT setups, each with specific technological demands (e.g., telework may involve a more prominent virtual component than an office-based setting). Consequently, we posed an open research question to account for this possibility.

RQ2: Do ICT literacy support and ICT self-efficacy show similar utility for reducing burnout via autonomy and competence need satisfaction among office-based and hybrid-mode workers?

3. Study 1

3.1. Method

3.1.1. Context and Procedure. Study 1 is aimed at understanding participants' experiences of (in)effective ICT usage at work and identify the resources that are perceived as the most pertinent in dealing with technological tasks. To do so, we relied on the CIT, originally developed by Flanagan [14]. Despite its original positivist basis, it also has inductive and interpretative properties and is considered a flexible tool for investigating occupational and organizational phenomena [13, 71]. In the current study, a CI was defined as a memorable recent event where the individual had experienced an (un)successful attempt to use ICTs in their work. We were particularly interested in the resources that the participants considered important across these CIs.

Using CIT, the data can be collected in a variety of ways, such as through direct observations, semistructured interviewing, or written open-ended questions [71]. We used an online open-ended questionnaire for data collection. This approach was chosen in order to sample a larger number of knowledge workers from various industries, ensuring a wide range of CIs. Prior to data collection, the study received approval from the institutional research ethics board (protocol no. 13/(1.13 E) 250000-KT-158), and informed consent was obtained from all participants.

3.1.2. Participants. The participants were recruited via researchers' personal networks and social media and with the help of graduate student research assistants, who received course credit for completing this task. In total, 99 employed individuals completed the questionnaire. Four participants' responses were removed, as they belonged to occupational categories other than knowledge work. Therefore, the final sample consisted of 95 individuals, reporting 104 CIs. The mean age of the sample was 31.83 years (SD = 9.27), 25 participants were male (26%), 68 were

female (72%), and 2 indicated other response option (2%). Regarding their education level, 83 (87%) participants held a higher education degree and represented a variety of sectors, including financial services and insurance, healthcare, retailing and sales, marketing, public service, education, and IT. Most participants indicated using ICT at work on a daily basis.

3.1.3. Measures. The participants were instructed to remember either a positive or negative ICT usage situation at work that was important to them and describe it by answering a set of open-ended questions. Depending on the outcome (successful versus unsuccessful), these situations could be perceived as challenging yet still positive or hindering and negative. Therefore, data collection was structured so that participants themselves determined whether the CIs were positive or negative. The questions were developed following methodological CIT guidelines (e.g., [13]). Given that the questionnaire was filled out online, the participants were asked to respond about one CI of choice. If they wished, participants could report more incidents by repeating the same procedure. As part of the questionnaire, we asked about the supporting and hindering factors (i.e., resources) that the participant deemed important in their described situation. Specifically, when the participant chose to report a positive incident, we asked what individual and organizational resources helped them to achieve a positive outcome in that situation. In the case of a negative CI, we asked what kind of resources the participants were lacking or would have needed in order to avoid the negative outcomes. In the current study, we will exclusively focus on the latter two questions that concern resources relevant for (un)successful ICT usage at work. The analyses of the nature of the CIs are part of another research project and are beyond the scope of this paper.

3.1.4. Data Analysis. In CIT, the data analysis is aimed at creating categories related to the investigated phenomenon that describe the data in a meaningful and systematic way [14, 71]. The first step of data analyses included the organization of raw input, that is, compiling a list of factors (resources) that were indicated by the participants as important for their (in)effective usage of ICT at work. The second author manually reviewed the entries, searching for identical entries that were grouped together. We used a bidimensional frame of reference (positive versus negative CIs and individual versus organizational level), allocating these entries into four separate lists: (a) individual supportive factors, (b) organizational supportive factors, (c) individual hindering factors, and (d) organizational hindering factors.

In the second step, two experts (first and second authors) performed content analysis on these entries. Although our study is partly informed by theory and prior empirical work on technostress inhibitors, we aimed to benefit from an inductive approach that is considered a strength of CIT [13]. For this reason, we did not use a predefined categorization scheme but developed it in a bottom-up manner. To do so, content analysis was conducted in several iterations. First, one of the experts read the four entry lists twice and pregrouped the entries in each list by similarity. The theoretical meaningfulness and specificity of the emergent categories were then reviewed with the second expert, who was familiar with the literature on the topic and had also read the contents of the entry lists. After discussing potential modifications, both experts performed the classification task again, independently allocating the entries into the agreed-upon categories. At this stage, the experts held regular meetings to discuss the discrepancies and decide about unclassified entries. At the final stage, two other members of the research team who did not take part in the classification reviewed the results to ensure that the data were meaningfully represented in the distinguished categories.

3.2. Results. Out of 104 reported CIs, 59 were positive, and 45 were negative. The question about individual supportive or hindering factors yielded 126 entries (73 unique entries) for positive CIs and 70 entries (55 unique entries) for negative CIs. The question about supportive or hindering organizational factors yielded 84 entries (65 of them unique) for positive CIs and 62 entries (53 of them unique) for negative CIs. The final classification of factors (resources) in a bidimensional space is provided in Table 1.

Six personal resource categories were common for positive and negative CIs, and, respectively, there were seven and four specific categories for differently valenced events. The most salient personal resource category in the case of positive CIs was *ICT literacy* (22 entries). Although to a lesser extent, it emerged in negative CIs as well (12 entries). This category included ability and skills to use ICT tools, (lack of) experience, and similar aspects. Another category, common in positive and negative CIs, was *Attention to detail, meticulousness* (13 entries). Personal qualities mentioned here either helped to achieve success or deal with an IT problem or their lack led to disturbances at work.

The largest valence-specific personal category that emerged from positive CIs was *Eagerness, knowledge seeking* (16 entries). Participants attributed their success to personal resources such as curiosity and desire to learn new things. *Flexibility and interest in using ICT* was also a prominent category (15 entries), encompassing openness to using ICT, interest in automating work processes, and seeking effectiveness. *Perceived ICT ability and confidence* had 9 entries, including resources such as tech-savviness, receptiveness, and ability to learn. Specific for negative CIs was a category of *IT-related planning and preventive measures* (14 entries). Participants mentioned that they lacked planning skills, testing or double-checking while using ICT at work.

Regarding organizational resources, content analyses revealed six categories that were common for positive and negative CIs. In addition, two valence-specific categories emerged for each type of CI. The most salient category across positive and negative CIs was *Adequate IT infrastructure* (28 and 14 entries, respectively). Examples of resources in this category were quality equipment, suitable software, and adequate internet connection. The category of *Effective organization of work processes* was mentioned 12 times in negative CIs and 7 times in positive CIs. Typical resources in this category were well-timed system updates, check-

TABLE 1: Classification of resources in a bidimensional space.

Resources	Critical incidents	
	Positive CI	**Negative CI**
Personal (*common* for positive and negative CI)	**ICT literacy (experience, knowledge and skills)** (22) **Attention to detail, meticulousness** (13) **Persistence and patience** (8) **Social skills** (7) **Generic (non-IT) expertise and skills** (7) **Proactive orientation** (6)	**ICT literacy (experience, knowledge and skills)** (12) **Attention to detail, meticulousness** (4) **Persistence and patience** (4) **Social skills** (6) **Generic (non-IT) expertise and skills** (1) **Proactive orientation** (6)
Personal (*specific* for positive and negative CI)	Eagerness, knowledge seeking (16) Flexibility and interest in using ICT (15) Organizational skills (9) Perceived ICT ability and confidence using it (9) Analytical thinking (5) Creative thinking (6) Miscellaneous (3)	IT-related planning and preventive measures (14) None/nonpersonal factors (12) Self-regulation skills (8) Miscellaneous (3)
Organizational (*common* for positive and negative CI)	**Adequate IT infrastructure** (28) **ICT knowledge sharing (informal) and instrumental help from colleagues** (22) **Supportive atmosphere** (11) **ICT literacy facilitation and training** (7) **Effective organization of work processes** (both IT and non-IT related) (7) **IT expert support, helpdesk, etc.** (4)	**Adequate IT infrastructure** (14) **ICT knowledge sharing (informal) and instrumental help from colleagues** (6) **Supportive atmosphere** (4) **ICT literacy facilitation and training** (7) **Effective organization of work processes** (both IT and non-IT related) (12) **IT expert support, helpdesk, etc.** (12)
Organizational (*specific* for positive and negative CI)	Other organizational resources (7) Miscellaneous (10)	Communication about IT disturbances (5) Miscellaneous (1)

Note: Numbers in brackets indicate the number of mentions of resources in the category. The categories in bold are common for positive and negative CI. Categories written in nonbold format are specific for positive or negative CI.
Abbreviation: CI, critical incident.

ups, and timely communication. The lack of these resources led to unexpected issues, whereas administering systematic testing prevented work disturbances. *ICT literacy facilitation and training* was mentioned 7 times in each type of CI and included resources such as developing digital literacy in the company, methodological specifications, and (lack of) training. Interestingly, valence-specific organizational resources only pertained to *Communication about IT disturbances* (in negative CIs) and some miscellaneous aspects, showing a quite similar outlook for the most important resources, independent of the valence of the CI.

3.3. Discussion. Content analyses provide several insights into how participants dealt with technological challenges at work. Interestingly, with regard to personal resources, the literature often highlights control beliefs related to ICT usage, such as perceived ICT control [39] and ICT self-efficacy [66]. In our findings, ICT-related control aspects did not emerge as a universally salient category. Instead, actual ICT literacy was identified among the most important personal resources across different CIs. Skills, knowledge, and mastery experience in a particular domain are considered major sources of self-efficacy in that domain [72]. Therefore, the development of technological expertise may serve several purposes in contemporary workplaces—both increasing confidence and actually helping to tackle technological demands, as shown in our participants' accounts. It is, however, notable that resources that helped people deal with technological aspects were not exclusively ICT-related. We identified a range of generic personal strengths that enable optimal overall functioning in the organizational environment (such as social skills, proactivity, and attention to detail).

Another aspect that emerged is that aside from the universally relevant personal resources, several resources were specific to either positive or negative situations. For example, favourable attitudes towards ICT and perceived confidence in technology were only helpful in positive situations but did not contribute to the prevention of negative experiences. In contrast, accounts of negative incidents often included the element of uncontrollability (i.e., participants indicated that external factors were responsible for the incident and that none of their personal resources could have helped). While technological issues may indeed be caused by external factors, drawing on prior work on the locus of control (e.g., [73]), these results may also indicate that people use different attributions when interpreting their effective versus ineffective usage of ICT.

Our findings on organizational-level resources elaborate on prior research on technostress inhibitors (e.g., [5, 6]). In line with the technostress inhibitor literature, ICT literacy facilitation category emerged among organization-level resources. However, the participants' accounts additionally draw attention to the relevance of various forms of knowledge sharing among colleagues as well as a supportive atmosphere that were particularly applicable in situations of

effective ICT use. It may, therefore, be important to expand the concept of literacy facilitation by distinguishing between these different aspects of knowledge exchange in contemporary knowledge work settings. Moreover, differently from personal resources, most organizational resource categories were applicable to both positive and negative CIs. While participants highlighted several types of "soft" aspects, structural resources (adequate IT infrastructure) scored high across both types of CIs. High-quality IT infrastructure is indispensable for the perceived ease and usefulness of technological tools, which are essential in increasing technology acceptance among employees [74]. Therefore, it may be an important resource to consider next to similar structural resources, such as technical support provision (see [675]).

4. Study 2

4.1. Method

4.1.1. Participants and Procedure. In Study 2, employees from various backgrounds and industries filled out an online survey ($N = 355$). Data collection occurred twice, and the period between the first (T1) and second (T2) measurement points was approximately 4–6 months, with a 50.4% participation rate at T2. The mean age of the sample was 36.28 years (SD = 13.22). More details about the demographic composition of the sample are provided in Table 2. Prior to data collection, the study received approval from the institutional research ethics board (protocol no. 13/(1.13 E) 250000-KT-158), and informed consent was obtained from all participants.

4.1.2. Measures. ICT literacy support was measured at T1, using three items adopted from Ragu-Nathan et al. [6]. Items were rated on a five-point Likert-type scale ranging from 1 *totally disagree* to 5 *totally agree*. A sample item is "Our organization provides end-user training before the introduction of new technology."

ICT self-efficacy was measured at T1 and T2 using a scale constructed specifically for this study. It was developed based on theoretical recommendations for constructing self-efficacy measures [72]. The scale comprises four Likert-type items, rated from 1 *totally disagree* to 7 *totally agree*. A sample item is "Although I may need training as new information technologies emerge, I do not doubt I will do a good job."

Basic need satisfaction was measured at T1 and T2. We used the autonomy and competence subscales from the Work-Related Basic Need Satisfaction Scale [76]. All items were rated on a five-point Likert-type scale ranging from 1 *totally disagree* to 5 *totally agree*. Three items were used to measure autonomy (e.g., "I feel free to do my job the way I think it could best be done"), and four items measured competence need satisfaction (e.g., "I feel competent at my job").

Burnout was measured at T1 and T2 with the Burnout Assessment Tool (BAT; [23]). We used the recently validated ultrashort version (BAT-4; [77]). It consists of four items measuring the core symptoms of burnout: exhaustion, mental distance, cognitive impairment, and emotional impairment (e.g., "At work, I feel mentally exhausted"). All items were rated on a five-point Likert-type scale ranging from 1 *never* to 5 *always*.

TABLE 2: Sample demographic characteristics.

Sample characteristics	Frequency	Percentage
Gender		
Male	72	21.5%
Female	262	78.2%
Other	1	0.3%
Education		
Secondary	35	10.4%
Vocational	9	2.7%
Higher education (nonuniversity)	46	13.7%
Higher education (university)	245	73.1%
Working time		
Part-time	57	17.0%
Full-time	278	83.0%
Job status: Supervisor		
Yes	65	19.4%
No	270	80.6%
Work setting		
Office	191	57.0%
Hybrid	144	43.0%

The reliability coefficients (Cronbach α) for all measures are presented in Table 3.

4.1.3. Data Analyses. Descriptive statistics were calculated using SPSS-28 software. Hypothesis testing was performed in Mplus v8.4. As the data contained missing values, the analyses were carried out using the full information maximum likelihood (FIML) estimation with robust standard errors. To do so, we inspected attrition patterns prior to hypothesis testing. They showed no relationship between the main study variables at T1 and the likelihood of dropout. The only variable that was associated with higher dropout tendencies was participants' age, with more younger employees in the dropout group ($\Delta M = 5.57$, $p = 0.018$). Therefore, we used all available data to test our hypotheses and initially included age as a control variable. However, as this inclusion did not alter the results, the final analyses opted out age as a covariate.

Mediation processes cannot be fully tested with two waves of data. Therefore, a two-step procedure was applied for hypotheses testing, as recommended by Cole and Maxwell ([78]; also see [79]). As shown in Figure 1, in the first step, we examined the longitudinal relationships between the hypothesized Predictor A (resources comprising ICT literacy support and ICT self-efficacy) and Mediator B (autonomy and competence need satisfaction). In the second step, we examined the longitudinal relationships between Mediator B (autonomy and competence need satisfaction) and Outcome C (burnout). If A longitudinally affects B, and B longitudinally affects C, the association between A and C is likely mediated by B.

TABLE 3: Descriptive statistics and correlations between the study variables.

	M (SD)	1	2	3	4	5	6	7	8	9
1. ICT literacy support T1	3.65 (0.91)	(0.84)								
2. ICT self-efficacy T1	5.50 (0.96)	0.16*	(0.69)							
3. ICT self-efficacy T2	5.61 (0.87)	0.15	0.60***	(0.69)						
4. Autonomy NS T1	3.82 (0.76)	0.23***	0.17**	0.26**	(0.75)					
5. Autonomy NS T2	3.71 (0.78)	0.30**	0.29**	0.30**	0.61***	(0.75)				
6. Competence NS T1	3.83 (0.70)	0.12	0.21**	0.24*	0.42***	0.45***	(0.84)			
7. Competence NS T2	3.74 (0.74)	0.16	0.28**	0.26**	0.40***	0.57***	0.71***	(0.87)		
8. Burnout T1	2.51 (0.71)	−0.16*	−0.29***	−0.36***	−0.50***	−0.43***	−0.32***	−0.33***	(0.77)	
9. Burnout T2	2.54 (0.71)	−0.08	−0.25**	−0.32**	−0.51***	−0.54***	−0.35***	−0.39***	0.76***	(0.75)

Note: All variables were measured on a 5-point scale, except ICT self-efficacy, measured on a 7-point scale. Cronbach *αs* are provided in the brackets on the diagonal.
Abbreviation: NS, need satisfaction.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

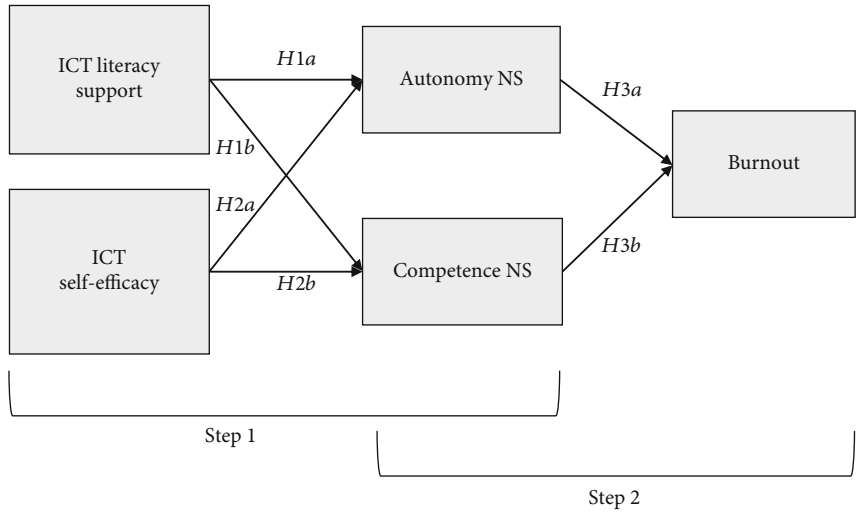

Figure 1: Conceptual research model, assessed on hybrid and office workers. *Note.* NS—need satisfaction.

In both steps, four competing models were tested: a stability model, an expected direction model, a reversed direction model, and a reciprocal model. The stability model contains autoregressive paths only. The expected direction model additionally includes cross-lagged paths (from T1 ICT resources to T2 basic need satisfaction in Step 1 and from T1 basic need satisfaction to T2 burnout in Step 2). The reversed direction model tests an alternative direction of the proposed cross-lagged paths. The reciprocal model combines the autoregressive and cross-lagged paths in both directions. To inspect whether the hypothesized cross-lagged patterns differ between hybrid and office workers, the final model was tested using the multigroup function in Mplus.

Model comparisons were based on the Satorra–Bentler scaled $\Delta\chi^2$ test (T statistic—an alternative to $\Delta\chi^2$ when FIML estimation with robust standard errors is used), a comparative fit index (CFI), Tucker–Lewis index (TLI), and the root-mean-square error of approximation (RMSEA). A good fit is indicated by CFI and TLI of at least 0.90, preferably higher than 0.95 [80], while RMSEA is expected to be 0.08 or less [81].

4.2. Results. Descriptive statistics are provided in Table 3. All correlations were in the expected direction. ICT resources were positively correlated with basic need satisfaction, and burnout was negatively correlated with both ICT resources and basic need satisfaction.

Table 4 provides information about the fit indices of alternative models. In Step 1, testing the cross-lagged relationships between ICT resources and basic need satisfaction, the expected direction model had the best fit, and it was significantly better than the stability model. The reversed direction model showed poor fit, and even though the reciprocal model fitted the data adequately, it was worse than the expected direction model. Overall, the hypothesized model showed the best fit, indicating ICT resources as likely predictors of basic need satisfaction.

TABLE 4: Fit indices for the tested models.

Model	χ^{2a}	df	Scaling correction factor	CFI	TLI	RMSEA	Model comparisons	T	Δdf
Step 1: Predictors ➔ mediators									
S1-stability	42.87	24	1.0262	0.913	0.870	0.069	—	—	—
S1-expected	11.31	10	1.0891	0.994	0.982	0.028	S1-stability-S1-expected	32.28**	14
S1-reversed	40.86	20	1.0340	0.904	0.827	0.079	S1-stability-S1-reversed	1.77	4
S1-reciprocal	9.13	6	1.1433	0.985	0.926	0.056	S1-stability-S1-reciprocal	33.99*	18
							S1-expected-S1-reciprocal	1.86	4
Step 2: Mediators ➔ outcome									
S2-stability	24.58	12	1.0255	0.954	0.907	0.079	—	—	—
S2-expected	12.61	8	1.0775	0.983	0.949	0.059	S2-stability-S2-expected	12.61*	4
S2-reversed	16.13	8	1.0300	0.970	0.910	0.078	S2-stability-S2-reversed	8.45	4
S2-reciprocal	6.51	4	1.0754	0.991	0.945	0.061	S2-stability-S2-reciprocal	18.20*	8
							S2-expected-S2-reciprocal	6.10	4

Note: T—Satorra–Bentler scaled $\Delta\chi^2$ test. Expected—expected direction model. Reversed—reversed direction model.
[a]Satorra–Bentler scaled χ^2 value.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

In Step 2, testing the relationships between basic need satisfaction and burnout, the expected direction model, but not the reversed direction model, had a better fit than the stability model. Moreover, the reciprocal model was not superior to the expected direction model (see Table 4).

Multigroup comparisons showed that the hypothesized cross-lagged effects were particularly salient among hybrid workers (see Figure 2), while only the autoregressive paths were significant for office-based workers. In both groups, the autoregressive paths were significant for all variables that were measured twice (i.e., ICT self-efficacy, basic need satisfaction, and burnout), with standardised path estimates ranging between 0.42 and 0.72.

The results supported hypotheses *H1a*, *H2a*, and *H2b* among hybrid workers. While *H1b* was not supported, the observed effect was in the expected direction ($p < 0.1$). Both ICT resources at T1 predicted autonomy need satisfaction at T2, and ICT self-efficacy also predicted competence need satisfaction at T2 when individuals were working in a hybrid setting. Moreover, in line with *H3a*, autonomy need satisfaction at T1 predicted lower burnout over time, but this effect was nonsignificant for competence need satisfaction. Therefore, *H3b* was not supported.

Although our main focus was to test mediation using a two-step approach [78], we also inspected direct links between ICT resources and burnout. According to the results, there were no significant longitudinal relationships between these variables in any of the tested models.

4.3. Discussion. Study 2 investigates the role of two types of ICT resources in basic need satisfaction and burnout among office-based and hybrid workers. Adopting a partial longitudinal mediation approach, we demonstrated that both personal (ICT self-efficacy) and organizational (ICT literacy support) resources help satisfy employees' basic psychological needs in increasingly digitalized work environments, which, in turn, may help manage occupational health risks. In doing so, our study responds to the call for investigating the impact of technologies on the world of work (e.g., [4]) and reveals underlying psychological mechanisms that could explain the benefits of the new ICT-related resources.

Notably, according to our findings, both ICT self-efficacy and ICT literacy support predicted basic need satisfaction. This indicates that changing working environments can generate new types of resources that help to attend to employees' basic needs. It is important not only that such specific resources emerge but that they also fit into the conventional understanding of resources with corresponding beneficial effects, which we demonstrated in the present study. In line with prior research, ICT resources seem to have similar potential as traditional job resources for satisfying basic needs in the workplace [82]. In turn, autonomy satisfaction was found to predict a lesser risk of burnout over time. This corresponds to prior literature suggesting that autonomy may represent one of the most important psychosocial factors in the workplace [83, 84]. The added value of our study is that it reveals specific indirect pathways that explain how such preventive effects unfold.

It is notable that ICT resources were particularly beneficial for hybrid-mode but not office-based employees. This finding fits well with the assumption that hybrid workers inevitably need to strengthen their ICT self-efficacy and ICT literacy to be able to be independent while using ICT, including extensive internet usage, virtual communication, and specific software applications, in addition to the need for ICT accessibility in general [85, 86]. Of course, most jobs also require ICT in the office, yet hybrid work increases the amount and/or frequency of ICT usage. Hence, it is not surprising that the role of ICT resources was so salient among those who constantly work with and face (possible) ICT challenges. As already noted in the introduction, the integration of technologies significantly changes the work environment and presents new demands [82], which may increase the risk of burnout. Our study shows that these

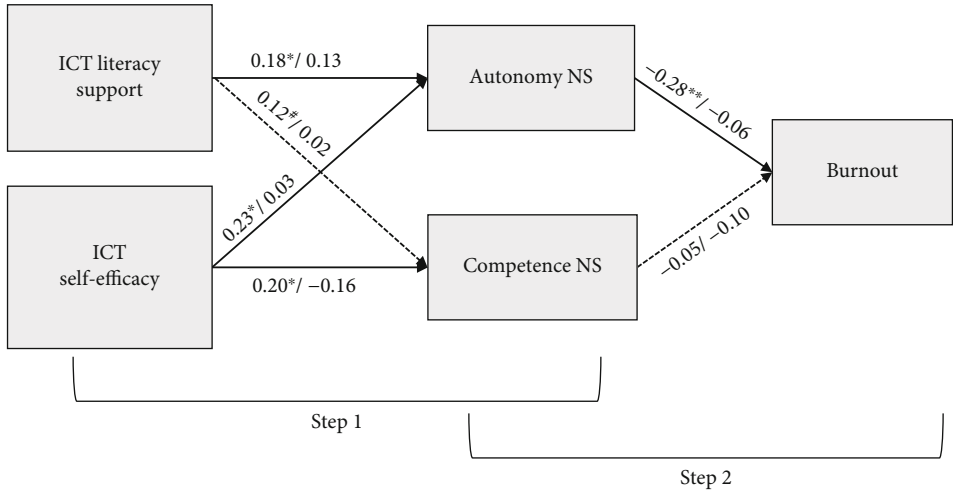

FIGURE 2: Analyses' results for hybrid and office workers (expected direction models). *Notes.* Standardized (beta) regression coefficients are provided for hybrid/office workers. NS—need satisfaction. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; $^{\#}p < 0.1$ level.

new challenges require new remedies—ICT-related resources could be one such remedy for hybrid knowledge workers, preventing adverse outcomes.

5. General Discussion

5.1. Theoretical Implications. Our findings contribute to theoretical knowledge building in several ways. First, we provide insights into the conceptualization of resources necessary for optimal functioning in the increasingly digitalized world of work. In doing so, we add to both earlier works on technostress inhibitors [6] and recent attempts to conceptualize digital aspects of the work environment (e.g., [82]). Our analyses yield empirical evidence to support the idea that contemporary work environments produce not only new ICT-related job demands but also new job resources that are so needed to counter technostress. Importantly, we show that these new ICT resources can stem both from persons and from organizations and that they act in an expected way, reducing the risks of strain and burnout. Our findings from Study 1 additionally draw attention to the fact that technological expertise may not always outweigh the importance of traditional transferable skills, such as proactivity, attention to detail, and social skills. Therefore, they should not be ignored. This is also in line with prior research, showing that mental and emotional competencies affect technology usage outcomes [87] and that traditional personal and digital resources may have synergetic effects on optimal employee functioning [36]. In sum, our qualitative findings draw attention to the fact that even though modern workplaces are permeated with digital tools that are supposed to facilitate the workflow and boost performance, this is not a given; people encounter multiple technological issues in their daily tasks, and the above-discussed organizational and personal resources are needed to address them.

In addition, we contribute to the SDT and job design literature by demonstrating how autonomy and competence need satisfaction may serve employees in reducing strain at work. In doing so, our study showed how the linkage between ICT resources and burnout unfolds. The findings particularly highlight the beneficial role of autonomy, suggesting that equipping employees with relevant ICT resources may help avoid the so-called autonomy paradox (i.e., a situation when technologies used at work not only enhance but also restrain employees' autonomy; see [39]). The synergy of personal and organizational resources becomes especially evident in our work. Both ICT literacy (as a personal resource) and ICT literacy support (as an organizational resource) emerged in our findings, showing that mutual efforts from employees and organizations could lead to a strong platform enabling well-being in modern workplaces. The idea that personal and organizational resources have an interaction effect still needs statistical evidence [36], yet our study supports the development of this line of thought.

Finally, in the context of digitalization, a better understanding of in-person and hybrid work is of key importance. The latest research formulates the question about *how* and not *if* the office and hybrid work differ (e.g., [88]). We provide evidence that mechanisms for managing burnout risks may be different for office-based and hybrid-setting employees. Our findings particularly highlight the relevance of ICT-related resources in facilitating basic need satisfaction for hybrid-setting workers, opening up the way for an investigation of the mechanisms that might explain such effects. Specifically, hybrid work settings by default involve the techno element, putting employees at a higher risk of encountering ICT-related challenges. It is long known that these challenges may create technostress (e.g., [6]). Using longitudinal data, we highlight that adequate ICT resources lessen the risk of burnout for this group of workers, which is a recognized occupational health hazard in modern workplaces [17]. Bakker and de Vries [24] argued that stable resources are paramount when jobs become stressful. Our findings support the idea that, next to personal self-efficacy, organizational ICT resources, which can be planned and stable, are indeed crucial. Specifically, with regard to ICT

literacy facilitation, our insights from qualitative analyses suggest that it may involve various forms of (in)formal knowledge exchange, which deserves further attention.

5.2. Practical Implications. According to our findings, personal and organizational resources are crucial in supporting employees' autonomy. For organizations, we recommend that they proactively provide their employees with training, courses, and learning materials before introducing new technologies and continue to support their staff using various technologies at work (e.g., [4]). Clear instructions and information facilitate learning, and accessible information whom to contact if problems occur strengthens ICT literacy support [6]. If situations allow, providing employees the opportunity to choose the desired software or technology also supports autonomy. Overall, companies should continuously support their staff in using the latest technologies, providing training in advance [69], yet also providing space and time for them to develop the needed skills to develop ICT self-efficacy and autonomy.

Employees can develop their ICT self-efficacy, which can also enhance perceptions of autonomy. When people are allowed to decide how to use technology without overly relying on others, they can feel more empowered. When technology-related problems occur, employees should first try to troubleshoot and solve technical problems using their own skills [61]. ICT self-efficacy could be developed step by step, gaining small wins when dealing with technology-related questions.

Attention should be drawn to the new personal and job resources in work design. It should be noted that technological advancements create both new types of challenges but also new types of resources [82]. These resources should be consciously used in order to support employees in the constantly changing work settings. This is especially important for hybrid setting workers, who inevitably face intensive ICT usage. When people conduct part of their work remotely, organizations should ensure that employees have access to needed ICT resources, feel prepared to work remotely, and know and are able to access help if disturbances occur. Even though it might sound simple, it should not be forgotten that ICT resources include adequate internet access, remotely available software, and work-suitable ICT hardware, such as laptops, computers and phones, and manuals and ad hoc available IT support. Organizations should also be aware that some additional needs to successfully work in a hybrid way may occur over time [46], so regular surveys and inspections on employees' well-being are needed. ICT literacy support can benefit the staff, organizations, and even the broader society, with upskilling and reskilling being highly needed in many areas.

5.3. Limitations and Future Research Guidelines. The present paper has several limitations that must be taken into account when interpreting the results. Notably, while Study 1 was based on a heterogeneous sample, the participants were quite young, which might not fully reflect ICT usage experiences of all workers. It would be important to explore ICT resource strategies among older employees in future research.

Furthermore, despite the advantage of a longitudinal design, Study 2 contains only two waves. Testing a longitudinal mediation ideally requires a three-wave design; therefore, the indirect relationships between ICT resources and burnout are approximations and should be interpreted cautiously. It must also be noted that traditional cross-lagged models do not allow for separating within- and between-person variance. Since intraindividual effects can be implied from theory, it would be useful to investigate these effects in future studies including more time points.

Another common limitation in longitudinal research is that the optimal time lag for detecting the hypothesized relationships is often not known. It is possible that some cross-lagged effects occur faster than others (for instance, burnout is a syndrome that may take time to manifest). Therefore, more studies are needed to better understand the impact of ICT on key psychological states.

The current study is primarily focused on the satisfaction of the basic needs for autonomy and competence, and it does not investigate the need for relatedness. This rationale was based on theoretical reasoning. Autonomy and competence are considered agentic needs in the literature, whereas the need for relatedness reflects interpersonal aspects (e.g., [89]). In our study, ICT literary support targets tech mastery and skill development, and ICT self-efficacy is inherently a personal agency construct. Therefore, there was a strong theoretical basis to expect that these resources would help satisfy the agentic but not interpersonal needs. However, we acknowledge that relatedness is important in various work situations, and one might argue that satisfying the basic psychological need for relatedness could serve as a predictor of lower work strain and may even help alleviate burnout. However, this implies a different psychological mechanism than the one investigated in our study. Future research should analyse this line of thought more in detail.

Last but not least, in the present study, we assumed that the psychosocial environment (including the ICT component) of the office and hybrid setting workers is different without fully evaluating it statistically. We tested technological dependency as a control variable in supplementary data analyses, but as this construct did not change the results, it was not included in the final model. Even though the assumption of different psychosocial environments in hybrid versus office-based work is based on observations in prior literature [85, 86], specific aspects (e.g., ICT demands, learning possibilities, and feedback availability) and their relevance could be statistically assessed in future research, also including the investigation of different coping strategies and employee technology-related attitudes.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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