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Mindfulness Lessons in a Virtual Natural Environment to Cope with Work-Related Stress

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Abstract. Work-related stress (WRS) is a major cause of people's health problems, it is also an expensive issue for organizations. The effectiveness of performing mindfulness practices in counteracting WRS has been established in the literature. In addition, the main theories related to restorative environments state that contact with nature as well helps mitigate the effects of stress. Despite this evidence, practicing mindfulness in natural environments is difficult to current modern living standards. This paper describes the development and implementation of a digital training platform, named MINDLIVEN, which consists of a virtual natural environment in which mindfulness-based practices can be carried out. In addition, the platform helps organizations become more aware of risks related to WRS and supports them in planning and delivering interventions. A pilot test was conducted and the results on usability and effectiveness are described

Keywords: work-related stress, mindfulness, virtual natural environments, digital training platform

1 Reduce Work-Related Stress Through a Mindfulness in Nature Virtual Practice

1.1 Stress in Work Environments

Work-Related Stress (WRS) is a state of elevated activation of the autonomic nervous system, with affective, cognitive, and behavioral manifestations, in response to challenging situations that people face at work, such as overload, high demands, or expectations [1]. According to Eurostat data [2], WRS is the leading cause of health-related problems in workplaces, second only to musculoskeletal injuries. WRS also represents a great cost to organizations in terms of decreased productivity, employee intentions to leave work, and burnout [3]. Burman and Goswami [1] indicate a number of effects related to WRS, dividing them into cognitive consequences (e.g., mental illness, lack of concentration and judgment capacity), behavioral consequences (e.g.,

sleeping disorders, poor eating habits, addictive consumption of drugs or alcohol, and neglecting responsibilities), emotional consequences (e.g., irritation, anxiety, isolation, depression), and physical consequences (e.g., high blood pressure, nausea, cardiovascular problems, back and neck pain).

According to the literature [4, 5], in work environments, stressors may relate to the relational sphere (e.g., conflicts with managers, subordinates, or colleagues, highly competitive organizational climate), the type of task required (e.g., working shifts, task changes, responsibilities, coping with new technologies) or the physical environment (e.g., noise, temperature, and fatigue).

1.2 The Role of Mindfulness and Nature in Coping with Stress

To recover from stress, individuals need support to regenerate consumed resources and create new ones [6]. Both mindfulness and nature, are believed useful aids to this end. Mindfulness is defined as "a process of openly attending, with awareness, to one's present moment experience" [7]. It is a meditative practice characterized by awareness of the individual's present-moment state (e.g., sounds, body sensations, thoughts, emotions) and an open attitude toward one's experience [7]. The most used mindfulness practice in organizations is Mindfulness-Based Stress Reduction [8] and various studies have shown its effectiveness in stress reduction [9, 10, 11]. In addition, other positive effects have been found, such as improvement in job performance, creativity, problem-solving, and cognitive flexibility [12]. According to Glomb and colleagues [12], mindfulness produces these effects through the activation of three fundamental mechanisms: 1) decoupling (e.g., creating distance) the self from the events, thoughts, and emotions that are perceived as current threats, 2) decreasing automatic mental processes in which past experiences and cognitive schema constrain thinking and 3) increasing awareness and regulation of physiological systems.

Physical settings can also play an important role in coping with stress. A growing amount of research indicates that natural environments (e.g., green space) have a multiplicity of beneficial effects on people's health, including an increase in positive emotions and a decrease in tension, anger, and depression, a reduction in cognitive fatigue, [13, 14, 15], and a reduction in stress reactions [16, 17]. There are two main theories that can explain the beneficial effects of exposure to natural environments: the Stress Recovery Theory (SRT) [18] and the Attention Restoration Theory (ART) [19]. SRT is focused on the immediate and unconscious emotional response elicited by a natural environment and suggests that contact with nature can promote mild to moderate feelings of interest, calm, and pleasantness and, consequently, allow recovery from a stress condition. ART focuses on cognitive responses and suggests that contact with nature allows people to restore resources consumed in tasks that require voluntarily directed attention and, consequently, to recover from cognitive fatigue.

1.3 Mindfulness Classes in a Virtual Natural Environment

The field of nature-based mindfulness is at the beginning: meditation literature and environmental psychology are to date poorly connected [20]. Anyway, interesting converging points can be found in the literature. For example, when people practice mindfulness or are exposed to nature they disengage from habitual and reactive thoughts and emotions, this mechanism, called detachment in mindfulness and being

away in theories on restorativeness, is a successful stress management strategy [21]. Moreover, both meditation and contact with nature lead to an experience of "presence" characterized by a particular quality of attention (curiosity and soft fascination, respectively) [22]. There are clear differences as well. For example, mindfulness is a voluntary practice aimed at stress reduction, related to top-down processes, while restorativeness theories state that nature itself possesses elements that can "capture" involuntary attention through a bottom-up process. Anyway, Lymeus et al. [20] propose that top-down and bottom-up processes can converge, so that meditation training and exposure to nature could complement and enhance each other in contrasting WRS.

Regarding the possibility of practicing mindfulness in natural environments, the modern lifestyle often makes prolonged and direct contact with nature difficult [23]. Regarding this, Virtual Reality Technology (VR) allows individuals to be exposed to natural elements virtually. A Virtual Environment (VE) is a 3D digital space created through computing technology [24], it is comprised of visual stimuli projected on a screen and, generally, acoustic stimuli produced by an electronic device (e.g., a headset, or speakers). VE with its characteristics of immersion (i.e., the system provides the subject with a surrounding and convincing environment) [25], presence (i.e., the sense of actually being in the scenario) [25], and realism (i.e., the convergence between the expectations of the user and the actual experience in the VE) [26], allows individuals to be extracted from the physical world and placed in a "synthetic" world [24]. Muhanna [27] states that, in order to create a compelling experience for users, VE must involve different spheres of the individual, such as cognitive dimension (e.g., mental engagement, task meaningfulness, and continuity), affective dimension, sensory/active dimension and relational dimension (e.g., the possibility to interact with other users of the system).

Regarding the need to counteract stress at work, interventions through digital training platforms that make use of VR are spreading rapidly in organizations [28]. In fact, this type of training provides a number of advantages such as reduced costs for companies, wide flexibility (i.e., people can do the training anywhere and anytime), the possibility of reaching a large number of people, the chance to involve even those who cannot or do not want to engage in an in-person training [29]. There is a body of literature showing the effectiveness of training delivered through digital platforms, ranging from vocational training [30], to psychological therapy [29] and WRS counteracting, with effects even in the long term [31, 32].

2 A Digital Training Platform to Address Work-Related Stress: MINDLIVEN

The Mindfulness-in-Nature Based Training through Virtual Environments (MINDLIVEN) is an Erasmus + project involving 7 institutions from 5 different countries (Greece, Italy, Poland, Portugal, and Spain) and aims to provide an innovative solution to addressing WRS. The steps to realize the platform were as follows: 1. Based on previous research, an analysis of stress-related needs in workplaces was conducted, and the main mindfulness in-nature-based practices (MiNBP) were studied; 2. A digital training platform in which to run MiNBP was created; 3. A pilot test to assess the

effectiveness of the tool was conducted; 4. A policy report including clear recommendations for the further development and application of the MINDLIVEN concepts and tools was prepared.

The MINDLIVEN online learning platform is a web-based application that provides users with access to educational content and communication tools. It's built using web technologies that can be accessed through a web browser on any device with an internet connection, using responsive design techniques to ensure that the interface adapts to the user's device. The platform also includes a range of embedded tools and resources. The platform was developed using agile methodologies, which involve iterative development and frequent feedback from users. This approach allowed the development team to continuously refine the platform's design and features to meet the users' needs. The platform's content is stored on a cloud-based server, which allows users to access it from anywhere and ensures that their progress is saved across devices. The platform also includes communication tools that enable users to connect with each other and collaborate on learning activities.

The learning contents and lessons are provided in the form of engaging animated videos with voice-overs. These videos are thoughtfully designed to incorporate mindfulness practices and micro-practices, featuring guided meditations to enhance the learning experience. To cater to diverse preferences, these practices can be conveniently followed independently on various devices like computers (Windows, MacOS, LINUX) or mobile phones as there is an app developed specifically for Android and iOS platforms.

What sets MIDNLIVEN apart from typical mindfulness practices is the inclusion of a visual channel. In addition to the audio guidance, the MINDLIVEN practices also present a captivating visual component. Users can engage with static nature images or videos that accompany the guided meditations, further enhancing their mindfulness journey.

MIDNLIVEN will expand the immersive experience by integrating 360-degree videos. This development will enable users to fully immerse themselves in the practice, creating a heightened sense of presence and engagement. With the help of Virtual Reality goggles, practitioners will be able to explore a more vivid and encompassing mindfulness experience.

MINDLIVEN training platform is structured by three different modules. Before starting, participants are invited to read information about the project and to take a self-assessment questionnaire that measures the following: participants' WRS level, the type of relationship with nature, the levels of perceived restorativeness of the workplace, and strategies used to regulate emotions. After the survey, people receive a profile that defines their results in terms of poor, sufficient, or good stress management, levels of contact with nature, levels of restorativeness in the workplace, and quality of emotion management.

Module 1. The first module contains an introduction to the main conceptual definitions of stress and its causes, mindfulness, and nature, in order to allow the users to be familiarised with these key concepts. Information is conveyed through four short video lessons that are followed by brief quizzes with the goal to measure participants' knowledge acquisition.

Module 2. The second module offers practical activities to users, including sessions of mindfulness and instruments to assess the users' needs. The content of the mindfulness program is structured in nine video lessons. Each video lesson starts with a

"mindfulness micro-practice": a brief meditation activity that allows participants to gather attention and prepare them to focus on the activity they are going to develop. An example of micro-practice is "One minute to arrive" which invites the user to take a quiet moment to fully arrive before starting the next activity. Another goal of such micro-practices is to familiarise people with such meditation activities and foster their practices during their workday. After that, the videos briefly present important concepts related to the goal of the lesson. For instance, lesson 3 explains how to avoid and manage the distractions that can interrupt mindfulness practices. After that, a longer mindfulness practice is proposed. Anytime a mindfulness practice is developed, users

are invited to connect with a natural element of their environment (e.g., a plant, a landscape, a photo, or a poster with natural objects). Moreover, during the practices, images and sounds of natural elements are shown in order to allow people to enhance the benefit of mindfulness through nature. This second module ends with the self-assessment tool presented at the beginning. This second survey aims to evaluate the improvements participants make after completing the training program.

Module 3. The third module is dedicated to the figure of the Facilitator and explains his role. The Facilitator is a person that leads the employees and the organization in the learning process. People from the Human Resources Department are the ones that best might develop this role. However, employers, managers, and owners, after completing the training offered by the platform, might also play this role. The platform offers tools to evaluate the Facilitator's previous skills and knowledge about stress, risk assessment, mindfulness, etc., and includes specific contents that help to increase such knowledge and self-assessment tests to evaluate the level of knowledge acquired.

3 Some Preliminary Results: The results from Pilot Testing

The pilot testing phase involved participants in using the pre-final version of the MINDLIVEN training platform in the national languages, and results concern the changes in the scores in the assessment tools from the first assessment, proposed at the beginning, before starting to use the platform, and the second assessment, after using the platform.

Participants. 140 individuals connected at least once to the platform, 69% female, 36% less than 35 years old, 44% from 35 to 50 years old, and 20% more than 50. 54 (39%) used the platform only once, 61 (44%) used the platform twice, and the others used the platform more than twice.

Psychological measures. The toolkit of assessment tools measures the level of individuals using self-report measures on the following dimensions:

1. *Organisational context*, in terms of *Job Demands* and *Job Resources*, was assessed using the Health and Safety Executive (HSE) Stress Indicator Tool [33], measuring the individual perceptions in six areas of work design: Demand, Control, Support, Relationship, Role, and Change. Demand and Relationship are two dimensions assessing Job Demand, while the other dimensions concern Job Resources. This instrument consisted of a 35-item questionnaire, and responses were given on a 7-point Likert scale. A high level of the overall HSE indicates a good level of Job Resources (max 7).
2. *Physical work environment* and its restorative characteristics were evaluated through two different measurement instruments: the Nature Contact

Questionnaire (NCQ) [34], and the Restorativeness at Work (REST@WORK) scale [35].

- a. NCQ evaluated three physical environments at work with 16 items, and responses were given in terms of the number of elements or in the percentage of time in which the individual perceived a given situation during the previous week: 1. outdoor nature contact (e.g., during the break), 2. indoor nature contact (e.g., live plants or flower arrangements in the primary workspace), 3. indirect nature contact (e.g., paintings or drawings that represent realistic natural scenes). Higher scores (max 6) indicate a high level of nature contact.
 - b. REST@WORK scale used 9 items to assess, on a 10-point Likert scale, the perceived restorativeness of the indoor work environment in a typical week, considering three dimensions: being-away, fascination, and coherence. High level scores on this scale indicate that the indoor work environment is perceived as very restorative (max 11).
3. *Emotion regulation strategies* (EMRS) were assessed with 10 items using a 7-point Likert scale [36]. The scale assesses two strategies: *reappraisal* and *suppression*: individuals who suppress their emotions experience less positive emotions, worse relationships, and reduced quality of life whereas those who tend to reappraise show an opposite pattern.
 4. Finally, the level of *mindfulness experience* during and at the end of the training was measured with the Toronto Mindfulness Scale (TMS) [37], consisting of 13 items evaluated on a 5-point Likert scale. High scores indicate a good mindfulness experience, and this measure was not assessed at the beginning, when participants did not attend any lessons yet, but only after the training practices.

Measures from 1 to 3 were assessed at the beginning, before participants started Module 2, as a baseline, and then again after the training. Mindfulness experience was assessed only after the training because it explicitly refers to the experience during the training.

These results describe the changes in T1 vs T2 scores in the perception of the organizational and the physical context, and in the emotion regulation strategies (reappraisal and suppression), considering only the participants for which this two assessment time-point were available, without more than 50% of missing values, that is 74 participants (68% female). Table 1 and Table 2 show means scores (standard deviation in brackets), the paired sample t-test outcomes, and effect size (Cohen's *d*) for the scales with a significant improvement.

Table 1. Mean values (SD in brackets) on the psychological measures of the Emotion Regulation Strategies (ERS) and perception of the physical context, at T1 (before starting using the Mindliven Training platform), and at T2 (after attending at least 3 lessons).

psychological measure	score range	low level	medium level	high level	Mean score T1	Mean score T2	n	Cohen's d
ERS - Reappraisal	1-7	1-3	3-5	5-7	4.9 (0.8)	5.4 (1.2)	<.001	-0.42
ERS - Suppression	1-3	1-3	3-5	5-7	3.7 (1.1)	3.7 (1.3)	0.895	
Nature Contact - outdoor	0-6	1-3	3-5	5-7	2.2 (1)	2.5 (1)	0.016	-0.30
Nature Contact - indoor	1-6	1-3	3-5	5-7	2.8 (0.7)	3.1 (0.8)	<.001	-0.65
Nature Contact - indirect	1-6	1-3	3-5	5-7	1.6 (0.5)	1.9 (0.7)	0.004	-0.35
Restorativeness - Being Away	1-11	1-4.3	4.3-7.7	7.7-11	5.2 (2.2)	6.8 (2.8)	<.001	-0.69
Restorativeness - Fascination	1-11	1-4.3	4.3-7.7	7.7-11	2.5 (1.8)	3 (1.8)	0.084	
Restorativeness - Coherence	1-11	1-4.3	4.3-7.7	7.7-11	5.6 (1.4)	6.3 (1.5)	<.001	-0.42
Restorativeness (overall)	1-11	1-4.3	4.3-7.7	7.7-11	4.4 (1.5)	5.3 (1.6)	<.001	-0.56

The first important result concerns the emotion regulation strategies, with a significant improvement in the reappraisal strategy, moving from medium to high level. This means that the training had an important role in improving the strategy more connected with the experience of positive emotions, good relations, and good quality of life. No changes in the Suppression strategy were found.

Regarding the physical environment, both the Nature Contact Questionnaire and the Restorativeness at Work scale revealed an improvement (except for Rest – Fascination). This may be due to the fact that the participants, or the management, thanks to their participation in the training, have begun to modify the physical environment by increasing the natural and regenerative elements.

Also, the organizational context shows an improvement after the training, as shown in Table 2, mainly in the Job Resources (control, managerial and peers' support, role clarity, and involvement in organizational changes), whereas no improvement was found in Job Demands (no changes in perception of the relationship, and a small significant increase in demands).

Finally, concerning the level of the mindfulness experience, participants showed a medium-level score: 3.5 (max7), SD: 0,6. It will be interesting to see in the future whether any improvement in this ability, going through the mindfulness practices proposed by the learning platform.

Table 2. Mean values (SD in brackets) on the psychological perception of the organizational context, at T1 (before starting using the Mindliven Training platform), and at T2 (after attending at least 3 lessons).

psychological measure	score range	low level	medium level	high level	Mean score T1	Mean score T2	p	Cohen's d
Demands (Job Demands)	1-7	1-3	3-5	5-7	2.7 (0.5)	2.9 (0.6)	0.004	-0.35
Relationships (Job Demands)	1-7	1-3	3-5	5-7	1.6 (0.4)	1.5 (0.7)	0.34	
Control (Job Resources)	1-7	1-3	3-5	5-7	3.5 (0.7)	3.9 (0.5)	<.001	-0.66
Managerial Support (Job Resources)	1-7	1-3	3-5	5-7	3.6 (0.6)	4.2 (0.5)	<.001	-0.91
Peers' Support (Job Resources)	1-7	1-3	3-5	5-7	3.7 (0.6)	4.2 (0.6)	<.001	-0.79
Role clarity (Job Resources)	1-7	1-3	3-5	5-7	3.9 (0.5)	4.3 (0.5)	<.001	-0.69
Change (Job Resources)	1-7	1-3	3-5	5-7	3.4 (0.6)	3.9 (0.6)	<.001	-0.80
Job Demands (overall)	1-7	1-3	3-5	5-7	2.1 (0.3)	2.2 (0.5)	0.199	
Job Resources (overall)	1-7	1-3	3-5	5-7	3.6 (0.5)	4.1 (0.4)	<.001	-0.94

3 Conclusions

This contribution seeks to illustrate the implementation of a VR platform aimed at teaching workers how to counteract WRS through mindfulness practices in a natural virtual environment. Through virtual scenarios, trainees are exposed to the benefits of nature such as increased positive emotions and reduced cognitive fatigue. Meanwhile, users can learn how to manage mindfulness practices, in order to use these practices in their everyday life as a coping strategy to face WRS. Given these promising results of the pilot test, we can conclude that the use of the MINDLIVEN training platform leads to an improvement in the situation of individuals at work, improving both some individual characteristics, such as the ability to regulate emotions, and some characteristics of the context, both organizational and physicist.

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