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Interpretation of workplace well-being in higher education along the analogy of collective synchronisation

Introduction

In reflecting upon the First Epistle to Timothy (1 Timothy 4:8), one may adopt as a thesis that the attainment of long life spent in good health can only be realised if, at every level and in every sphere, the necessary actions are taken – or, where appropriate, certain forms of conduct are consciously refrained from: *"For physical training is of some value, but godliness has value for all things, holding promise for both the present life and the life to come."* This imperative also manifests itself at the micro level, for example, within the workplaces of higher education institutions, in relation to academics (as employees) and students (as persons present within the scope of the work activity). Higher education is typically a sector in which multiple generations work together and diverse bodies of knowledge coexist; its advantages can – and indeed must – be harnessed to foster workplace well-being.

Well-being is a complex construct. The World Health Organization (WHO) Well-Being Index, for instance, is based on the assessment of five factors: cheerfulness and good spirits; calmness and relaxation; activity and vitality; waking feeling fresh and rested; and the presence of interesting things in everyday life. Each of these factors indicates that a satisfactory state of health, mediated through individuals (employees), also influences workplace organisations. Physical and mental well-being may positively affect employee performance, and effective workplace health protection can only be implemented where the preconditions for health are fulfilled.

With regard to mental well-being, the present paper is linked to the "Healthy Workplaces" campaigns of the EU-OSHA (European Agency for Safety and Health at Work). The 2026–2028 campaign focuses specifically on mental health at work.

An analysis of the relationship between health (as a state) and work requires a broad and systemic perspective. In connection with academic roles, the continuous – and at times near-constant – transformation of physical infrastructure and the operational environment may generate occupational safety and health problems/challenges. Solving and overcoming these problems and challenges necessitates innovations and transformations grounded in cooperation, shared reflection, and collaborative creation. In other words, to achieve the desired outcomes, cooperation is essential – whether in employee–employee or employee–employer relations, and extending to those within the scope of the work activity. Where such cooperation is ensured, stakeholders can jointly generate ideas to solve problems and overcome challenges, and subsequently implement their concepts collectively.

It is a fact that innovations support effective occupational safety and health management; however, certain "novelties" emerge whose impacts are not yet fully understood. From an occupational safety perspective, these too will affect the employees (the academics), and thus, occupational health and safety itself becomes a domain of continuous innovation. It should be noted that workplace health protection constitutes an employer's obligation, whereas workplace health maintenance and health promotion are typically defined as responsibilities or tasks. Yet these may more accurately be regarded as problems, insofar as there may be incomplete knowledge concerning the current situation, the desired target state, or the methods required for implementation, specifically in relation to:

- the workplace itself and/or
- the employees and/or
- the environment and working conditions and/or
- those present within the scope of the work activity.

From the perspective of both effective workplace health protection and health maintenance and promotion, such (early-stage) problems should be construed as opportunities. Their identification, analysis, and resolution are formulated as objectives to achieve a higher level of organisational functioning and create workplace well-being.

In higher education workplaces, the primary target group comprises academics; however, academics' working culture and health-related behaviours undoubtedly influence those within the scope of the work activity, for example, students.

The system of workplace health protection, health maintenance, and health promotion

The concept of health was defined by the World Health Organization (WHO) in 1948 as follows: *"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."* Subsequently, the same organisation reviewed this definition (in 1984) and formulated (in 1986) the comprehensive definition still in use today: *"Health is the extent to which an individual or group is able to realise aspirations and satisfy needs, and to change or cope with the environment. Health is a resource for everyday life, not the objective of living; it is a positive concept, emphasising social and personal resources, as well as physical capacities."* (URL1) This concept has consistently appeared in everyday life in connection with work activity. Within the Member States of the EU, Council Directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work stipulates the necessity of *"the introduction of measures to encourage improvements in the safety and health of workers at work"* (thus establishing occupational safety and health implementation at the workplace as an employer obligation). The protection of individuals engaged in organised work activity is therefore encompassed by occupational safety and health legislation (Act XCIII of 1993), the domains of which comprise occupational safety, occupational health (occupational hygiene and occupational medicine), and social aspects of labour protection. It should be noted that, in part, the workplace is also a setting for

- health maintenance (the support of a health-promoting lifestyle and of the social, economic, environmental, and personal factors that encourage it), and
- health promotion (the process that enables individuals (as employees) and micro-communities (as workplaces) to exert greater control over the preservation and improvement of their health).

Workplace exposures affecting employees derive from (Ungváry–Morvai, 2010; Erősné, 2024):

- the work activity itself (which may be mechanical (physical), psychological (emotional), mental (cognitive), or physiological),
- working conditions (workplace circumstances) and
- the working environment (which may be physical, chemical, biological, ergonomic, or psychosocial in nature).

From the perspective of health maintenance and promotion, however, the decisive factor is the total 24-hour load imposed on the human organism (Ungváry–Morvai, 2010), which, beyond the aforementioned workplace exposures, also includes the following health determinant components:

- the physical environment (buildings, settlement characteristics, residential activities),
- the social environment (family, relatives, friends, the wider community) and
- the effects of lifestyle and life conduct (Ádány et al., 2023; Erősné, 2024).

Employees are simultaneously and collectively exposed to these influences, among which certain factors are not directly measurable but may only be estimated. Within academic roles in higher education, examples include certain ergonomic and psychosocial risks. Workload (exposure) results in strain. It is important to note that the magnitude and nature of strain depend not only on the workload

but also on the individual performing the work, owing to individual differences in response reactions. The optimisation of strain is therefore achievable solely on the basis of knowledge of both workplace exposure and the working individual's work capacity (functional capacity plus health status). Strain may be regarded as optimal (or approaching optimal) if and only if:

- the workload is less than (or at most equal to) and
- The strain is likewise less than (or at most equal to) the employee's work capacity.

The creative intellectual activity closely associated with academic posts is classified, from the perspective of occupational medical fitness examinations, as one of the activities involving increased psychological load (Decree 33/1998 [VI. 24.] of the Ministry of Welfare). In the presence of disturbing stimuli, and particularly in creative intellectual work performed under complex rules and instructions, it is necessary not only to reduce workload but also to enhance the adaptive capacity of the human organism. To this end, following an analysis of work processes, it is necessary to examine how the individual appears and functions within those processes. Through workload–strain analysis, the permissible limits of performance capacity and load tolerance of the working individual may be determined. On the basis of these findings, principles of work organisation may be outlined, and working conditions, workplace circumstances, and the working environment may be modified accordingly (Nagy, 2025). Feedback following the completion of occupational safety tasks identified through workplace risk assessment may reveal deficiencies, omissions, or changes affecting health protection. The remaining (early-stage) problems conceal underlying "needs".

Within the process of health maintenance and promotion that supports adequate and effective occupational safety and health practice, the responsibility of the individual, as an employee, together with their health-promoting lifestyle and health behaviour, is indisputable. This undoubtedly requires the employee attributes projected in a recent report by the World Economic Forum (WEF) (WEF, 2025). The report identifies the following top five competencies:

- analytical thinking,
- resilience, flexibility, and agility,
- leadership skills and social influence,
- creative thinking,
- motivation and self-awareness.

These share the common feature that each is essential to effective occupational safety and health practice, and that each presupposes a certain degree of mental maturity. It is therefore necessary to continuously examine how mental health can be supported at every stage of life. The focus should not be confined to crisis management but should also encompass preventive measures that reduce the risk of stress, depression, and other mental disorders. Preparing individuals to manage their own health actively (self-management) assumes particular importance.

With specific reference to higher education, it may be regarded as a premise that individuals (academics) and university communities must be enabled – in alignment with WHO and EU-OSHA guidance – to recognise the health potentials available to them and to make effective use of these (ideally engaging in health-promoting activities with their attendant positive externalities). Among health promotion strategies, support for mental health must therefore occupy a central position (as reflected in the aforementioned 2026–2028 Workplace Mental Health Campaign). In essence, this concerns a state of mental well-being in which individuals recognise their own abilities, are capable of coping with life's stresses, and are able to participate in community life (URL2; URL3).

From an occupational safety perspective, workplace health protection, health maintenance, and health promotion, together with the creation of workplace well-being, may be interpreted through an "onion

model" (encompassing concentric layers). The "core" is occupational safety and health itself (Erősné, 2024).

Method

With regard to (early-stage) problems related to workplace health protection, health maintenance, and health promotion (identification of type, solution process, mode of solution), the Bartee approach (Bartee, 1973) provides a useful framework for focused analysis. Within this framework, issues may be examined in the interrelation of complexity, uncertainty, and time dependence, thereby forming the basis for (risk-based) decision-making.

An occupational safety and health problem constitutes an existing difficulty or challenge that requires resolution in order to prevent it from becoming a potential future threat. A problem may be regarded as solved when the perceived current situation and the desired situation are considered identical (Bartee, 1973). This approach to problem-solving supports both risk analysis (assessment, management, and communication) and the process of workplace risk assessment (the ranking of existing or anticipated risks). It is upon the latter that workplace health protection measures are founded, and it likewise provides the basis for health maintenance, health promotion, and workplace well-being programmes.

The process of problem-solving and its stages of application comprise:

- identification of the problem type (closed or open),
- determination of the mode of solution (individual, group-based, organisational, societal),
- specification of the solution process (exact/analytical or creativity-driven).

The recognition of occupational safety-related (early-stage) problems and the determination of their type typically occur simultaneously. In most cases, open-type problems can be identified. Such problems are characterised by the possibility of multiple solutions; resolution is grounded in creativity (often resulting in distinctive and high-impact outcomes); the boundary and limiting conditions are flexible; concrete solutions frequently depart from strictly logical approaches; and the solution process is, in most instances, non-algorithmic.

Interpretation of workplace well-being in higher education

On the basis of its activities as an employer, a higher education institution is classified, from an occupational safety perspective, within Hazard Class II (Decree 5/1993 [XII. 26.] of the Ministry of Labour). The institutes and departments of higher education institutions – as workplaces – may typically be regarded as dynamic micro-environments. This is coupled with the inherent complexity characterising academic roles. Reference to academic posts may suggest work performed in front of the lectern (teaching); however, alongside time devoted to teaching, a substantial proportion of working time is allocated to research and scholarly activity, which in recent years has been supplemented by societal engagement and intensified administrative responsibilities. Consequently, specific hazards, exposures, and risks may emerge.

In the course of work associated with academic posts in higher education, the most characteristic problems linked to particular tasks primarily involve psychosocial, ergonomic, psychological, and cognitive burdens. Corresponding actions may be assigned to these, identifying workplace health maintenance and health promotion opportunities, while bearing in mind that disease burden diminishes academic effectiveness and the capacity and willingness to engage in innovation and transformation.

Let the subject area of health protection, health maintenance, and health promotion, together with workplace well-being in higher education, be considered. Interpreting this domain as a coupled, multi-component system, the Kuramoto model helps understand its functioning and effects. The Kuramoto model provides a mathematical framework for structuring the formal components of the system

through the analogy of the collective synchronisation of multiple interacting oscillators (Kuramoto, 1975). The model can describe and illustrate real phenomena.

Within the model, each oscillator possesses its own frequency and phase, and oscillators are weakly coupled. The purpose of the interaction is for the oscillators' phases to become synchronised over time. A model approximation is that the interaction acts solely on the phases. Each oscillator is influenced by the others through their phase differences. Parametrically, this may be represented by the following nonlinear differential equation:

$$\frac{\partial \theta_i}{\partial t} = \omega_i + \frac{K}{N} \sum_{j=1}^{N} \sin(\theta_j - \theta_i)$$

Applied to the subject under investigation, the model comprises the following components and characteristics:

- oscillator – academics possess an individual “natural frequency” (e.g., individual stress tolerance, personal health behaviour, individual workload rhythm, personal work–life (im)balance) (ω_i);
- phase – a time-varying, environmentally sensitive characteristic (e.g., current health status, level of workload; this may be analogous to mental load, stress state, energy level, or degree of regeneration) ($\theta_i(t)$) ;
- interactions derived from phase differences – group effects (analogous to collegial support, departmental working culture, shared workload peaks (e.g., marking periods, administrative surges, managerial performance expectations, work stoppages)); where interaction is strong, members of the work group become synchronised (e.g., becoming fatigued or regenerating simultaneously) ($\sin(\theta_j–\theta_i)$) ;
- coupling strength – the extent to which organisational regulation and support influence system stability (strong organisational support – harmonised workload; weak organisational support – deterioration of health) (K).

Within the model, the degree of synchronisation is indicated by the order parameter, which can be interpreted as an organisational diagnostic. It assumes values between 0 and 1 (1 – complete synchronisation: aligned, stable and balanced workload, though potentially excessively intensified; 0 – fragmentation: substantial individual differences and heterogeneous workload distribution). In operating the system, sub-objectives may include balancing workload, reducing stress peaks, understanding collective rhythms, and recognising the role of organisational synchronisation in health protection, maintenance, and promotion.

Health protection pillar

Applying the Bartee approach, both the type of occupational safety-related problem and the mode of its resolution may be identified, together with the nature of the required action. Estimable exposures and problems that fall within acceptable and tolerable categories call for scheduled measures; thus, the employer is advised to respond. In other cases, action is required, meaning that the employer must intervene. Among the possible measures is the application of subliminal (below-threshold) messages. Workplace occupational safety practices may incorporate stimuli or suggestive messages of short duration and/or high intensity that are not consciously perceived but are processed by the brain and may influence behaviour.

With regard to academics, the sources of workplace risks arising from work activities are typically psychological (emotional) and cognitive (mental), while those arising from the working environment include ergonomic and psychosocial exposures, as well as effects of working conditions. Together, these constitute the total job-related workload.

Problems posing a threat to employees' (academics') health (Act XCIII of 1993, Section 87(13)) must therefore be identified. It should be noted that a hazard becomes a risk (Act XCIII of 1993, Section 87(1/F)) if it is capable of materialising.

Problems and controls/measures from an occupational safety perspective (non-exhaustive list):

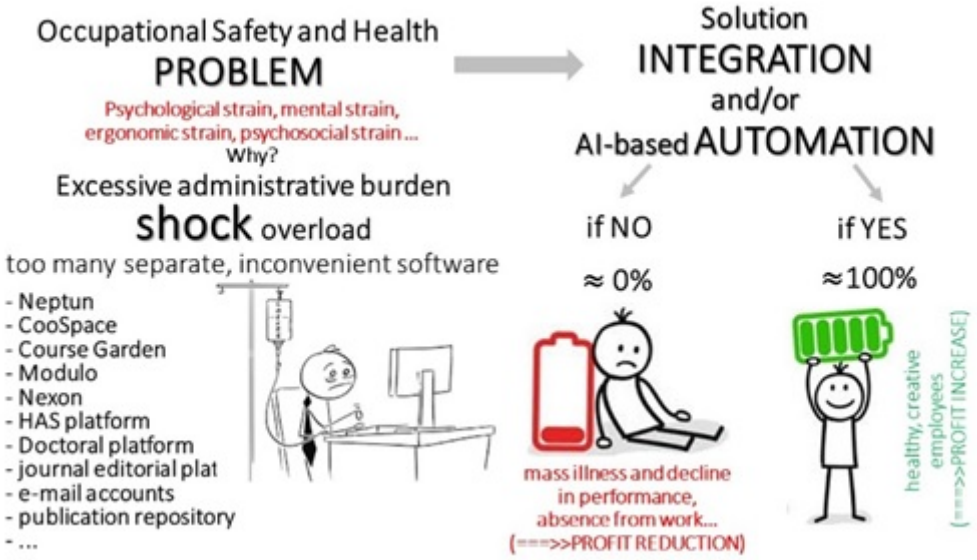
- multi-focused work within the academic sphere (potentially elevated stress levels) ∴, regular communication training, stress management training;
- flexible working hours combined with continuous availability ∴, ensuring opportunities for detachment; establishing clear boundaries between work and private life;
- regulation-centred operation ∴ application of artificial intelligence for search and harmonisation purposes;
- compressed teaching blocks; breaks used for preparation and travel between campuses ∴, a maximum of three teaching blocks (75 minutes per block); provision of genuine breaks;
- preparation of teaching materials, drawing, intensive use of Information and Communication Technology tools ∴, touchscreen and digital pen-enabled devices; adjustable workstations designed with enhanced consideration of MSZ EN ISO 9241-5:2001 and MSZ EN ISO 26800:2012;
- blurring of work–life boundaries; spread of atypical employment forms ∴, ensuring the possibility of disengagement;
- grant writing (resource generation) in a multicultural environment ∴ reduction of administrative burden, bridging time-zone differences;
- complexity of job tasks (mandatory use of numerous software systems; time pressure; tight deadlines; malfunctioning systems) (technostress) (URL4) ∴ modification of work schedules; application of the results of technical development (Act XCIII of 1993, Section 18(1));
- disciplinary advancement; continuous individual training and self-development support for regenerative capacity;
- fast work pace as a stress factor, preference for a gradual and evenly distributed workload;
- extension of laptop usage time and human "operating time" genuinely "disconnected" breaks; regular opportunities for physical, mental, and emotional recovery.

Academic posts are inherently complex. In the course of work, owing to the intensified use of digital devices and software, or changes in employment forms, newly emerging risks must be addressed alongside – or instead of – already known risks, and existing risks may also intensify. The issue of software ergonomics (Izsó–Antalovits, 2000) – understood as supporting human information processing through the design of software user interfaces (typically screen-based information exchange) – is increasingly important. The impact of (excessive) screen time on individuals' mental health likewise warrants particular attention.

At the same time, scientific and technological development offers opportunities: under favourable conditions, diseases may be prevented, (early-stage) problems may be resolved, and risks may be managed and reduced.

The effects of intensified administration, software proliferation, and their consequences, as well as the health-preserving role of artificial intelligence, are illustrated in Figure 1.

Figure 1 — From lecturer to “weary” bureaucrat



In relation to academic posts, the emergence of pathological workplace stress (distress) must also be examined (Nagy, 2025). Increased psychological burden (creative intellectual activity, responsibility, screen-based work) and the psychosocial aetiological factors of the work environment may induce substantial mental effort. Psychosocial risks are primarily related to the design, organisation, and management of work (e.g., long working hours, continuous availability, work–life imbalance, intensification of work, increased employee vulnerability, excessive ‘lean’ initiatives, the constant necessity of “self-development”, etc.), yet they are also closely linked to the changing economic and social environment. The development of distress requiring intervention, however, presupposes individual predisposing factors.

To illustrate stress, a parallel may be drawn between a specialised field of psychology – namely, the resolution of pathological workplace stress – and a specialised field of engineering, safety science. In (technical) engineering design and dimensioning, once the load-induced strain is determined, the resulting stress can be calculated, and a form and material must be selected that can withstand the applied load without damage and with (multiple) safety margins. In both senses, stress arises, which must under no circumstances exceed tolerable limits or impair functioning. Moreover, from an engineering perspective, positive stress may be just as hazardous as negative stress. This raises the question: alongside distress, may eustress also constitute a comparable occupational risk?

It may further be noted that health complaints attributable to or associated with ergonomic aetiological factors predominantly involve musculoskeletal disorders; visual fatigue is also common (although currently not regarded as a direct cause of occupational disease).

Excess (unnecessary) workload affecting academics must be reduced, and their “flexible” but continuous availability must be moderated so as to include as few fatiguing activities as possible and allow sufficient time for regeneration. Otherwise, efficiency declines (under conditions of significant informational load, this may be accompanied by disorganisation of thinking). In sport, we have learned to attune ourselves to specific forms of movement and to disengage from movement phases; warm-up and stretching form integral parts of the process. In occupational activity, however, this principle is not necessarily observed. Nor is it forward-looking for higher education academic posts to be characterised by excessive overall occupational load lasting several months, even if followed by one or two weeks of optimal demand or genuine “switching off”. It resembles repeatedly injuring the same finger: by the time it is bandaged, permanent effects may have occurred, and functionality may be impaired.

The workplace health protection measures outlined above are fundamentally based on the employer's risk assessment (i.e., the ranking of actual or anticipated risks). A workplace risk assessment should also include lifestyle-related risks. Smoking, for example, is a characteristic health behaviour; alongside traditional tobacco use, the innovation of e-cigarettes has emerged, the full effects of which are not yet comprehensively understood.

In nations with advanced work cultures, occupational safety systems consider all three levels of adverse health impact:

- load,
- endangerment,
- damage-causing effect.

The occupational health and safety management system (MSZ ISO 45001:2018) prioritises the effective functioning of the workplace organisation. It adopts a process-based approach: the avoidance of hazards (as potential causes of injury and/or health impairment) constitutes its driving principle.

The health maintenance pillar

Adequate and effective workplace operational health and safety practice must be complemented by health maintenance. Conditions for the success of health maintenance programmes include assessing baseline health status (including self-report), focusing on mental health (as the foundation of overall health and well-being), and integrating into everyday higher education culture. Maintaining academic staff health is important not only at the individual level but also constitutes an operational risk from the employer’s perspective. Among the most common workplace health risk factors – alongside stress, physical inactivity, and poor nutrition – are insufficient sleep and reduced effective presence at work (presenteeism) (URL5). Presenteeism refers to the phenomenon in which employees perform their duties while mentally or physically exhausted or ill. In higher education (among academic staff), this frequently occurs due to heightened performance expectations, limited substitutability, financial considerations, and related factors.

A distinctive occupational health and safety feature of complex roles is that mutually reinforcing burdens approach the limits of work capacity. Accordingly, in formulating specific health maintenance recommendations, guidance may be drawn from occupational fitness-for-work assessments, that is, determining what level of strain is imposed on the individual by activities performed within a given teaching role under varying work environments and conditions (e.g. office, lecture hall, seminar room, teaching laboratory), and how sustainably the individual will be able to meet these demands over the long term.

In designing work processes, consideration must be given to protecting the health of academic staff (or at least ensuring that health is not endangered). From a health maintenance perspective, it is important that work favourably influences well-being and facilitates task performance, particularly by avoiding both excessive and insufficient demands. Excessive physical or sensory demands (upper threshold) lead to fatigue, whereas insufficient demands or monotonous work (lower threshold) reduce attentiveness. Occupational hygiene examinations (Act XCIII of 1993, Section 87(5/A)) support the formulation of adequate and effective recommendations and decisions.

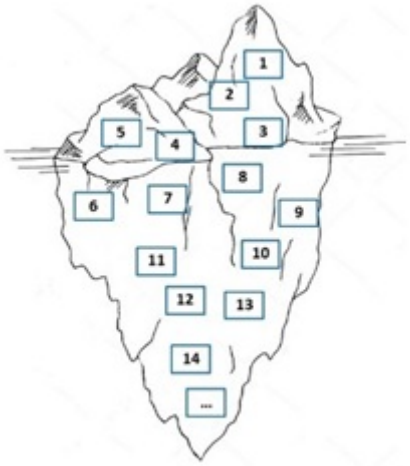
It is forward-looking that artificial intelligence may create a world in which continuous adaptation, tracking of innovations, and learning will be necessary, yet the safest work processes will protect the individual's and the employee’s health. It supports cognitive fitness (Lovretity, 2015), understood as the optimised capacity for thinking, reasoning, learning, planning, and adaptation, thereby enabling problem-solving and the management of stress and change (Lupien et al., 2007).

The health promotion pillar

In the higher education sector, early-stage resolution of early-stage problems (related to occupational health and safety) leads to the realisation of health maintenance, and health promotion likewise gains meaningful expression.

The iceberg model (Freud, 1915) illustrates (Figure 2) that in occupational health and safety contexts, it is insufficient to focus solely on what is visible or perceptible. The most "cost-effective" outcomes, development opportunities, and innovations always lie in early intervention; therefore, hidden (surface-proximal and deep-level) problems (early-stage problems) must also be identified and addressed.

Figure 2 — The iceberg model



Perceptible problems: action (1) vs omission (2), attitudes and behaviours not conducive to health (3), compromised ergonomics concealed behind public procurement processes (4), complex job tasks (5)

Hidden, near-surface problems: habits (6), lack of information (7), unwritten rules (8), individual tolerance thresholds (9), use of immature technologies (10), group dynamics (11)

Hidden, deep-level problems (early-stage problems): non-volitional unsafe behaviours (12), income-related barriers (13), single but determining events (14), etc.

Prioritisation is challenging, as certain problems occur in parallel or manifest synergistically, in which case divergent (creativity-demanding) problem-solving approaches may yield multiple breakthrough solutions.

Resolving (early-stage) problems serves multiple objectives:

- preventing escalation, thereby avoiding the emergence of hazards,
- serving health protection,
- creating opportunities for health maintenance,
- encouraging health promotion.

If health-focused developments gain ground in higher education workplaces, they will also positively influence universities' (as economic actors) innovative and transformative capacities. Among the key domains of health promotion, the following activities may be effectively implemented within higher education workplaces (linked to nutrition, alcohol consumption, physical activity, rest, sleep screening, time management planning, and reflective thinking):

- development of individual skills (e.g., life-management skills within health management),

- community actions and initiatives (operation of lecturer–student communities within higher education),
- establishment of health-supportive conditions and environments (workplace and home aesthetics).

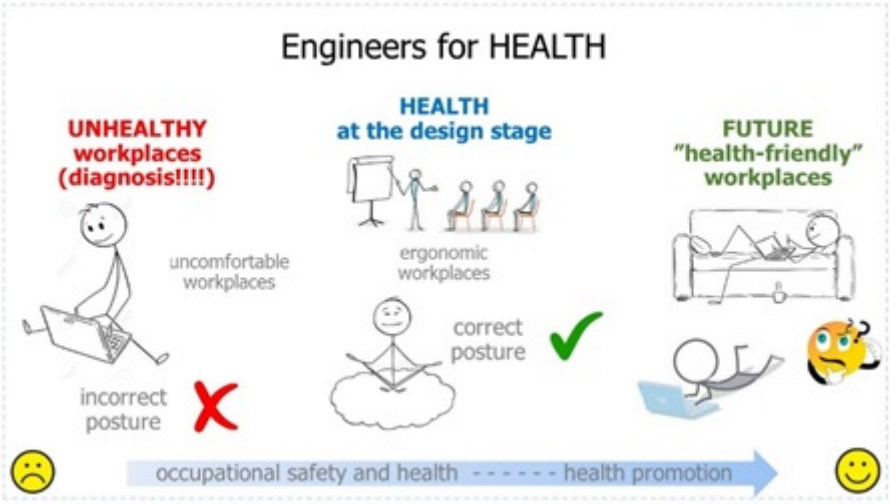
Workplace health promotion activities and programmes in higher education may thus be organised along the core principles of health promotion. These initiatives need not be confined to higher education institutions; they may also be implemented in other settings or in temporary community-based contexts (e.g., events). However, the specific nature of each health promotion activity, the instruments applied, and the expected outcomes must always be clearly defined.

By analogy with the Kuramoto model, academics (lecturers) and students may, under optimal conditions, jointly form a health-generating and health-promoting milieu. They exert reciprocal influence upon one another. This group effect constitutes a key factor in achieving optimal health and embedding patterns necessary for its maintenance. At universities comprising multiple faculties (and numerous degree programmes), interfaculty open days (e.g., a “Health Week”) may provide a framework for involving academics (as employees) and students (as persons present within the scope of work), while harnessing the inherent complexity of generational diversity. Examples include:

- screening and self-examination programmes delivered by medical doctors/medical students,
- medication safety consultations provided by pharmacists/pharmacy students,
- self-awareness groups facilitated by mental health professionals/psychology students,
- exercise sessions organised by recreation specialists/physical education teacher trainees,
- muscle balance and rehabilitation practices offered by healthcare professionals/physiotherapy students,
- Solfeggio frequency circles led by artists/music students,
- ergonomics-oriented design initiatives and diagnosis of “unhealthy workplaces” by engineers/engineering students (Figure 3),
- nature walks organised by agricultural specialists/agricultural engineering students.

These ideas and proposals do not require organisational restructuring; they can be effectively realised within the current higher education framework.

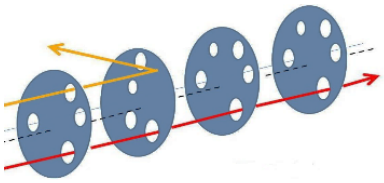
Figure 3 — Health programme poster



If the Swiss cheese model (Reason, 1998, 2000) is interpreted in relation to health promotion – where the holes represent opportunities, yet the arrangement of the slices may be such that a given health

promotion initiative is unable to pass through – this state indicates problems, environmental factors, conditions, regulations, performance requirements, etc., that hinder or render health promotion impossible. The objective is therefore to create a "cheese-slice system" in which, through the application of individual slices, safe and health-neutral work can be realised with minimal obstacles to workplace health promotion. Conditions must be established that allow these opportunities to pass through (Figure 4).

Figure 4 — Reason's Swiss cheese model



Source: (after URL6)

Notes: the lower (red) arrow indicates a successful health promotion; the upper (yellow) arrow indicates a blocked health promotion opportunity.

Results and Conclusions

In higher education, the complex nature of academic work and the variable micro-environments of individual workplaces necessitate a deeper analysis of the interrelations between work and health. The (early-stage) problems arising from different teaching tasks reveal potential shortcomings in workplace health protection, while also outlining opportunities and barriers for health maintenance and health promotion.

One precondition for the effective functioning of higher education is workplace well-being, closely linked to human infrastructure. Within higher education, it is not the ultimate root causes that must be sought; rather, centralisation should be moderated. By resolving identified (early-stage) problems through the application of local optima, workplace well-being can be achieved. The necessary human and material infrastructure, as well as opportunities for health literacy, are available to support this. An interpretation of workplace well-being analogous to the Kuramoto model illustrates that academics (lecturers) behave as synchronised oscillators, generating coordinated patterns with stable phase differences. The entities operate together, align, and evolve.

All forms of digitalisation are to be welcomed; however, they imperceptibly burden the individual as an employee, since "work" is thereby carried everywhere, along with its associated elements, making detachment impossible. Software, hardware, and other IT systems can update and recharge even during operation, unlike the human organism. Information and communication technologies, as well as various online applications, serve as examples. Conditioning mechanisms must also be considered: if a behaviour is rewarded with even slight enjoyment, repetition is likely to follow.

The modern world of work – characterised by globalisation, technological development and industrial transformation – presents new challenges, making dynamic and innovative approaches indispensable as complements to "traditional" occupational safety measures.

An innovation-oriented perspective directs attention towards applying mature and effective technologies and harnessing artificial intelligence in the service of occupational health and safety, health maintenance, and health promotion. Simulation of the Swiss cheese model helps identify where opportunities are blocked and which layers require the opening of a "hole". The goal is to establish a permeable structure by eliminating unsynchronised, poorly aligned, and non-converging slices. The conditions for achieving this are present within higher education institutions.

Environmental influence is strong; however, we continuously reshape the environment:

- technological development ⋱ transforming job tasks and workplace characteristics,
- multigenerational and multicultural workplaces ⋱ generating complex psychosocial challenges,
- Introduction of new technologies ⋱ producing unexplored health effects,
- opportunities for home working ⋱, blurring work–life boundaries,
- creation of complex roles ⋱ approaching work capacity limits through mutually reinforcing burdens.

It may be concluded that the opportunities grounded in effective workplace occupational health and safety practice must be interpreted in relation to tasks assigned to academic roles and the changing material infrastructure and operational environment. An additional asset lies in the "convergence of generations" characteristic of higher education.

Summary and Outlook

Every work process—including most tasks associated with academic posts in higher education—comprises varying proportions of physical and intellectual components. Within individual subprocesses, the determining factors are the proportions involved, the nature of the burden, and the type of strain imposed. In the case of academics (lecturers), intellectual work combined with intensive technology use clearly entails mental (neurological) and psychological (emotional) strain. Given that the fundamental principle and intention of occupational health is the prevention of occupational diseases, it is justified to explore workplace health maintenance and promotion opportunities alongside health protection tasks and measures. The Bartee approach focused on potential (early-stage) problems in academic work. Behind such problems is always an underlying need; accordingly, opportunities and tasks for health protection, maintenance, and promotion became delineable. The selection and successful implementation of programmes depend upon cooperation, joint reflection, and co-creation among employers, employees (academics), and those present within the scope of work (students). This anticipates that any programme will produce multiple effects.

Health protection, maintenance, and promotion in higher education may be identified as an interconnected, multi-component dynamic system, within which workplace well-being represents a form of dynamic equilibrium. Its characteristics include temporal variability (e.g., health status, workload), the operation of feedback mechanisms (positive and negative), and interdependence among elements. Health protection is ensured by external regulatory mechanisms, such as prescriptions and protective measures; health maintenance proposals and actions stabilise processes; and change-generating mechanisms advance health promotion. Feedback processes constitute the basis of system optimisation.

The extent to which individuals perceive their health status as their own responsibility forms part of health-related attitudes. Such attitudes may either serve or endanger health. They may also be active (doing something) or passive (abstaining from something). The health-focused behaviour of academic staff exerts both direct and indirect influence on students (e.g., through attitude formation and role modelling).

As a potential continuation of this topic, prior to (risk-based) final decisions, proposed measures should be analysed in relation to complexity, uncertainty, and time dependence. The effectiveness of interventions may be assessed, for example, using the Work Ability Index (WAI). The ultimate outcome is healthy living and workplace well-being – objectives that are also reflected among the 17 Sustainable Development Goals.

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