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DESIGNING AI-BASED PERSONALIZED LEARNING PATHS TO SUPPORT STUDENT MENTAL WELLBEING

Abstract. The article provides a theoretical substantiation and develops methodological approaches to designing Personalized Educational Trajectories (PET) using Artificial Intelligence (AI) as a systemic tool for supporting mental health and minimizing the negative impacts of digitalization in the educational process. In the course of the study, a theoretical analysis and systematization of contemporary scientific publications regarding the impact of distance learning on the psychological state of students were conducted. The research involves a synthesis of instructional design principles and cognitive ergonomics, alongside the architectural modeling of adaptive educational systems to address modern challenges.

Particular attention is paid to studying the mechanisms of technostress and cognitive overload under conditions of excessive digital engagement, as well as the specific requirements for remote support of the learning process. A key factor

in the decline of students' mental well-being is identified: the linearity of traditional digital resources, which fails to account for fatigue dynamics and individual perceptual characteristics. The integration of AI into the design of the educational environment enables a "predictive support" mechanism. This includes the automated adjustment of material complexity and delivery pace based on an analysis of emotional markers, performance, and engagement patterns. The study emphasizes the crucial role of microlearning and emotional design as tools for reducing student anxiety. It is established that adaptive interfaces facilitate a state of "flow," which is critical for maintaining motivation and preventing burnout during prolonged crises. The design of AI-based personalized educational trajectories emerges as a humanistic response to the challenges of modern education. It allows for the transformation of digital technologies from a source of stress into a tool for therapeutic impact. The practical implementation of the proposed models requires the creation of "empathic" interfaces and the development of ethical data collection protocols, serving as the foundation for a safe and resilient educational environment of the future.

Keywords: artificial intelligence, personalized learning path, digital design, mental health, academic stress, technostress.

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ДИЗАЙН ПЕРСОНАЛІЗОВАНИХ ОСВІТНІХ ТРАЄКТОРІЙ НА ОСНОВІ ШТУЧНОГО ІНТЕЛЕКТУ ЯК ЗАСІБ ПІДТРИМКИ МЕНТАЛЬНОГО ЗДОРОВ'Я ЗДОБУВАЧІВ ОСВІТИ

Анотація. В статті здійснюється теоретичне обґрунтування та розробка методичних підходів до проєктування персоналізованих освітніх

траєкторій (ПОТ) із застосуванням технологій штучного інтелекту (ШІ) як системного інструменту підтримки ментального здоров'я та мінімізації негативних наслідків цифровізації в освітньому процесі. У ході дослідження було здійснено теоретичний аналіз та систематизацію сучасних наукових публікацій щодо впливу дистанційного навчання на психологічний стан здобувачів освіти. Був проведений синтез принципів інструкційного дизайну та когнітивної ергономіки, а також моделювання архітектури адаптивних освітніх систем для вирішення викликів сьогодення.

Особлива увага приділяється вивченню механізмів виникнення техностресу та когнітивного перевантаження в умовах надмірного цифрового залучення, а також особливих умов дистанційної підтримки навчального процесу. Виділено ключовий чинник погіршення ментального стану здобувачів освіти, яким є лінійність традиційних цифрових ресурсів, що не враховує динаміку втоми та індивідуальні особливості сприйняття. Впровадження ШІ у дизайн освітнього середовища дозволяє реалізувати механізм «предиктивної підтримки», що включає автоматичне коригування складності матеріалу та темпу його подачі на основі аналізу емоційних маркерів, продуктивності та особливостей долученості. Підкреслюється важлива роль в сучасних умовах мікронавчання та емоційного дизайну як засоби зниження тривожності здобувачів освіти. Встановлено, що адаптивні інтерфейси сприяють входженню здобувача освіти у стан «потоку», що є критично важливим для збереження мотивації та профілактики вигорання в умовах тривалих криз.

Ключові слова: штучний інтелект, персоналізована освітня траєкторія, цифровий дизайн, ментальне здоров'я, академічний стрес, технострес.

Statement of the problem. The contemporary transformational model of higher education, increasingly oriented toward online learning, has posed a series of challenges for learners' psychological well-being. The impacts of social isolation, excessive cognitive load, and "technostress" among participants in the educational process have become inherent companions of the digitalization journey. Traditional linear learning models can no longer ensure the development of adaptive mastery of educational material, individual information-perception rates, or the learner's emotional stability. In this context, the modern design of AI-based Personalized Educational Trajectories (PETs) is viewed not merely as a didactic innovation but as a necessary mechanism for supporting students' mental health, particularly under martial law and heightened emotional distress.

Modern civilization is undergoing a transition to Society 5.0, in which conventional digital technologies cease to be mere data-processing tools and

become an organic component of human living space. In higher education, this transition is marked by the implementation of the "Education 4.0" concept. This involves not only remote access to knowledge but also the creation of adaptive environments that can co-learn with the user. However, a significant problem arises: the velocity of this transformation outpaces the methodological readiness of educational institutions to provide quality psychological support.

Consequently, we observe a paradox: despite unprecedented access to information, levels of academic anxiety and feelings of alienation among students have reached historical highs.

For Ukraine, the issue of learners' mental health has acquired particular urgency. The convergence of the COVID-19 pandemic's aftermath with the challenges of full-scale war has created a uniquely complex environment where learning occurs against a backdrop of constant security threats, power outages, and social depression—all within a remote format. Under such conditions, traditional educational platforms with rigid structures and fixed deadlines become additional sources of stress. Research indicates that students in technical and creative fields, whose training requires high concentration and engagement with abstract models, are most vulnerable to "cognitive freezing"—a state in which stress blocks the ability to internalize new material, acquire experience, and effectively implement original design solutions.

A key challenge of digitalization is "technostress"—a psychological state caused by the need for constant adaptation to new software interfaces, excessive information noise, and the blurring of boundaries between academic and personal time. In engineering and creative education, where both technical literacy and emotional intelligence are vital, ignoring technostress results in a decline in the quality of professional training. A learner experiencing digital burnout is unable to engage in creative exploration or critical thinking. This necessitates a paradigm shift in educational system design: from a focus on "content delivery" to one on "cognitive comfort".

Personalization of learning is traditionally viewed as a means of improving academic performance. However, in the context of mental health, personalization acquires a new meaning—it becomes a unique mechanism for psychological defense. Currently, Artificial Intelligence (AI) offers broad opportunities to create PETs that account for both cognitive abilities and the learner's current resource state. The design of such trajectories must be based on the principles of empathy: the system becomes dynamic and adaptive, "sensing" moments of decreased productivity and offering appropriate breaks, micro-learning sessions, or alternative data visualization methods. The primary objective is to transform the digital platform from an "examiner" into a "facilitator" that supports the learner within their Zone of Proximal Development without causing exhaustion.

With the advent of Large Language Models (LLMs) and generative algorithms, AI enables the realization of previously impossible learning architectures. This includes dynamic interface designs that evolve based on user reactions within the system. In the educational process, this translates into the immediate generation of personalized prompts, visualizations of complex physical processes, or the transformation of abstract formulas into interactive models tailored to each student's individual perception style. It is crucial to emphasize that AI is not viewed as a replacement for the instructor, but rather as a complementary intellectual layer of design that ensures the continuity and safety of the educational experience.

Justifying new approaches to designing educational environments that combine high technological standards with the requirements of mental hygiene is an urgent necessity. The need to balance learning efficiency with the preservation of mental resources guides the choice of this article's topic. The aim of the study is to provide a theoretical justification for the concept of AI-based empathetic PET design as a strategic tool for ensuring learners' psychological well-being in the digital age.

Review of recent research and publications. The problem of educational digitalization and its impact on students' mental health has become a focal point for the global scientific community. Analysis of the source base identifies several key conceptual directions that form the foundation for developing AI-based Personalized Educational Trajectories (PETs). These include: digital well-being and distance-learning challenges; technostress and cognitive load; AI as a mental health support tool; intervention design and immersive technologies; and the social and media contexts of digitalization.

Firstly, digital well-being and the challenges of distance learning. Fundamental to this study are works analyzing the overall state of digital welfare. Neagu and Vieriu (2025) examine "digital engagement" among technical university students and find that it is a critical factor that can either facilitate professional competency development or lead to psychological exhaustion [9]. The transition from face-to-face to online learning is thoroughly examined by Butnaru et al. (2021), who identify the risks of social isolation and their destructive impact on emotional resilience [4]. Similar conclusions are drawn by Ramane et al. (2021), who highlight a direct link between online learning formats and deterioration in students' overall health metrics [11].

Secondly, the landscape of technostress and cognitive load. One of the most significant barriers to effective digitalization is technostress. Upadhyaya and Vrinda (2021) analyze its impact on academic productivity, indicating that excessive technological load depletes the cognitive resources needed to master complex engineering material [15]. Sharma and Gupta (2023) deepen this analysis

by applying a multidimensional transactional theory of stress to study students' cognitive appraisal of digital tools [14]. They demonstrate that coping strategies depend directly on the ergonomics and adaptability of the educational platform's design. Norabuena-Figueroa et al. (2025) supplement these data, emphasizing that digital teaching practices should aim to minimize academic stress by simplifying visual interfaces [10].

Thirdly, Artificial Intelligence as a mental health support tool. Current research views AI not merely as a tool for automated grading but as an intelligent assistant. Zhai et al. (2025) detail the concept of "technology-driven support," in which AI algorithms are used for emotional monitoring and to provide predictive assistance to at-risk learners [18]. However, Delello et al. (2025) warn that AI implementation poses new challenges for educators, specifically the need for new competencies to maintain mental well-being in the "classroom of the future" [6]. Wang (2023) summarizes the psychological impact of distance formats, highlighting the need to create "human-centered" AI to prevent feelings of depersonalization [17].

Fourthly, intervention design and immersive technologies. Severes et al. (2025) discuss the practical design of digital interventions and propose a collaborative approach to developing mental health support systems [12]. The effectiveness of specific solutions, such as the "SortOut" mobile application, was studied by Alhasani and Orji (2022), who used persuasive design methods to address stress states [1]. A meta-analysis by Ferrari et al. (2022) confirms that systematically designed digital interventions can significantly improve learner well-being [7].

In this context, immersive technologies deserve special attention. Cuiñas et al. (2025) demonstrate the potential of Virtual Reality (VR) for desensitization and the reduction of exam stress [5]. Simultaneously, Babalola and Onasanya (2024) compare the effectiveness of online and offline classrooms, noting the need for specific content design for virtual spaces [2].

Fifthly, the social and media context of digitalization. The influence of the broader digital environment cannot be ignored. Braghieri et al. (2022) provide data on the correlation between social media use and declining mental health, which must be considered when integrating social elements into educational platforms [3]. Sharma and Nigam (2025) add that digital literacy is a key protective factor against academic pressure [13]. Maluleke (2022) and Uyun (2025) conclude that the path from social isolation to active engagement in online education lies through the creation of a safe, emotionally comfortable, and personalized digital environment [8, 16].

The aim of the article is to provide a theoretical justification and conceptual model for the design of AI-based personalized educational trajectories

as a holistic system aimed at optimizing cognitive load, ensuring mental well-being, and fostering creative thinking among learners in conditions of intensive digitalization.

Presentation of the main research material. The traditional paradigm of educational platform design based on simple "content delivery" is no longer viable. Linear content distribution has become ineffective in the context of digital transformation, as it fails to address the growing risks of social isolation and emotional exhaustion among learners [4, 11]. An alternative approach - the conceptual model of empathetic design - offers a solution to these challenges by reimagining the role of AI as an active mediator that harmonizes learning complexity with the student's psychological state. At the visual-ergonomic level, the system automatically optimizes the interface to prevent sensory overload; at the content-temporal level, it dynamically varies task complexity, correlating with the need for simplified visual environments to reduce academic stress [10]. This approach transforms the digital platform from a control tool into a predictive support system, utilizing empathetic AI agents to ensure "human-centered" interaction and mitigate feelings of depersonalization.

Cognitive load management within this model is based on the principles of predictive scaffolding. Since excessive technological load depletes the cognitive resources needed to master complex material, AI is used to analyze learning analytics to identify moments of frustration or "cognitive freezing." When a learner's pace slows down, the system integrates adaptive prompts or switches to a micro-learning mode, maintaining active engagement. This is critical for the creative development of future design specialists, as the mastery of competencies depends directly on the selected technostress coping strategies and the ergonomics of the educational platform.

The objectification of the Personalized Educational Trajectory (PET) utilizes non-invasive monitoring of emotional markers, including keystroke dynamics, eye-tracking, and NLP-based sentiment analysis of messages. The collected data allow the system to respond promptly to signs of fatigue or depressive moods, forming the basis for technology-driven mental health support. Immersive technologies and VR environments serve as additional modern tools, utilized for desensitization to overcome exam stress and reduce cortisol levels. The integration of such solutions—similar to mobile stress management systems with persuasive design elements—significantly improves student well-being during the learning process, particularly under martial law and heightened emotional distress.

It is essential to note that implementing the empathetic design model requires a hybrid approach, where AI does not replace the instructor but provides an analytical toolkit for targeted intervention and determining the "optimal

moment" for interaction. Collaborative approaches to digital intervention development ensure higher levels of student engagement and trust. Simultaneously, the transition to the "classroom of the future" requires new digital literacy competencies from educators, acting as a key protective factor against academic pressure and promoting mental well-being in a globalized media environment. Overall, AI-based PETs emerge as a holistic humanitarian technology capable of mitigating the risks of "digital alienation" and fostering the formation of a psychologically healthy professional personality.

Current developments in digital assistants focus on relieving human routine, yet some models can actively assist learners. A vital component of the proposed model is the "cognitive hygiene digital assistant," which operates using adaptive early-warning algorithms. Unlike standard LMS notifications, this system uses data mining to detect "academic procrastination" as a symptom of stressful freezing. In engineering education, where learning often involves complex CAD systems or modeling environments, AI design allows for the integration of "contextual prompts"—micro-interventions that reduce frustration when technical errors occur. This fosters high professional self-esteem and prevents the development of a sense of technological inferiority.

The development of self-regulation skills through AI feedback is particularly important today. The system does not merely adapt content; it provides learners with visualized reports on their cognitive activity, so-called "productivity mirrors," which facilitate a higher adaptive level of self-assessment based on external system data. This enables students to recognize their own exhaustion patterns and consciously choose rest strategies. This correlates with the concept of "digital literacy as a protective factor," as learners master tools for managing their mental state in the digital space - a critical soft skill for the modern specialist.

Experimental PET design also incorporates "dynamic inclusivity" for high-risk groups, including individuals with disabilities, veterans, and those with Post-Traumatic Stress Disorder (PTSD). In such cases, the environment design includes automatic filtering of potentially triggering audiovisual stimuli and replacing rigid deadlines with adaptive "time corridors" based on the user's current resilience state. Thus, the technology evolves into a unique tool for social readaptation, ensuring equal opportunities for quality education without the threat of re-traumatization.

From an administrative perspective, AI enables the generation of "predictive academic risk maps" for entire cohorts. Instructors receive aggregated, anonymized data on overall stress levels in the classroom, enabling timely adjustments to assessment schedules or module complexity. This synergy between AI's analytical capabilities and the teacher's empathetic intervention

mitigates the risks of collective burnout and fosters a supportive academic culture where mental health is recognized as a priority value alongside professional success.

Conclusion. The study demonstrates a conceptual transition from techno-centric design to an empathetic architecture of personalized educational trajectories, where digitalization is framed as a tool to enhance the learner's cognitive and emotional resilience. Theoretical analysis and modeling results confirm that the fundamental starting point for designing adaptive systems should be the learner's "resource profile," which integrates current anxiety levels, cognitive fatigue rates, and dominant information-processing styles. This approach mitigates the contradiction between rigorous academic requirements and limited emotional resources under prolonged stress, transforming rigid linear course structures into flexible environments focused on the predictive elimination of technostress and the prevention of academic burnout.

Implementing AI within the learning architecture enables the role of a dynamic facilitator, capable of maintaining cognitive comfort through the predictive management of the instructional load. By automatically adjusting content modality, deploying micro-learning strategies, and regulating task complexity in real-time, the AI system sustains the learner's psychological flow, which is vital for preventing depressive states in digital spaces. The use of generative algorithms to create personalized prompts and interactive models transforms the educational process from an external controlling factor into an adaptive support layer that harmonizes intellectual challenges with the individual's current psychophysiological state.

Adopting empathetic design principles—such as visual ecology and the emotional valence of the interface—fundamentally shifts the human-computer interaction (HCI) paradigm toward mental hygiene. Key emphasis is placed on creating immersive "islands of psychological safety" and on using analytical mental-state heat maps, which redefine the instructor's role as a learning experience designer capable of targeted mentoring. Overall, AI-based personalized trajectories emerge as a holistic humanitarian technology that not only improves professional training for future design specialists but also fosters their emotional resilience amidst global digitalization and social uncertainty.

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