

N. TAJIMURATOV¹, I. KOLEVA²

¹M. Auezov South Kazakhstan University (Shymkent, Kazakhstan)

²St. Kliment Ohridski Sofia University (Sofia, Bulgaria)

*Address of correspondence: Nurlan Tajimuratov, PhD student, M. Auezov South Kazakhstan University, Shymkent, Republic of Kazakhstan,
E-mail address: nurlan_kz.90@mail.ru/Tel.:+7 702 681 6959

MODEL OF DEVELOPING STUDENTS' STRESS RESILIENCE IN THE DIGITAL EDUCATIONAL ENVIRONMENT OF A UNIVERSITY

Abstract

The research develops and theoretically substantiates a model for developing stress resilience in students within a university's digital educational environment. The structure of the model is represented by four interconnected and interdependent components: the target component (determining the strategic direction of the process), the content component (revealing cognitive, emotional-regulatory, and behavioral blocks of stress resilience development), the technological component (represented by a system of adaptive-preventive technologies), and the performance-evaluation component (including criteria and levels for assessing stress resilience). Special attention is given to innovative adaptive-preventive technologies as the instrumental basis for developing stress resilience, including: monitoring of psycho-emotional states, interactive trainings and virtual simulators, intelligent systems for filtering information flow, and workshops on digital hygiene. The study identifies and scientifically substantiates pedagogical conditions for developing students' stress resilience in a university's digital educational environment: creating a psychologically safe digital educational environment; integrating health-preserving technologies into the digital educational process; providing psychological and pedagogical support for students; and developing adaptive capabilities of learners in the digital educational space. The proposed model ensures systematicity, continuity, and effectiveness in the process of developing stress resilience, contributing to the development of students' competencies for effective functioning in a digital educational environment while maintaining psychological well-being.

Keywords: stress tolerance of students, the digital educational environment of the university, the model of development of stress tolerance of students.

Introduction. In today's world, the higher education system is experiencing an unprecedented transformation in scale and intensity, caused by the aggressive digitalization of all aspects of the educational process (Telukdarie, 2019). This revolutionary transition to a fully-fledged digital educational environment (Al-Abdullatif, 2020), catalyzed by global pandemic and geopolitical challenges of recent years (Mahmood, 2021), has not simply modified, but radically reconstructed traditional forms and methods of learning. Universities have effectively transformed into digital ecosystems (Ellis, 2004; Hew, 2009), where physical and virtual educational spaces are inextricably intertwined, creating a fundamentally new reality of the educational process. According to international research,

currently more than 85% of higher education institutions have implemented digital platforms and technologies as a mandatory component of the educational process, and more than 60% of academic courses are delivered in hybrid or fully distance format (International Association of Universities, 2023). Traditional lectures have transformed into interactive webinars, seminars have shifted to the format of virtual discussion platforms, and paper textbooks have been replaced by digital educational resources with augmented reality elements (Ponachugin, 2019; Marín, 2020). However, behind the facade of innovation and progressiveness of digital transformation lies a critically important anthropological aspect: in parallel with the obvious technological advantages of digitalization, a complex, multi-level set

of psycho-emotional problems is forming, which modern students face. It is this dramatic dissonance between technological progress and psychological well-being that makes the study of stress resilience development in new digital conditions not just relevant, but strategically necessary for preserving human potential in higher education (MacGeorge, 2005).

The digital educational environment of higher education institutions generates a fundamentally new, historically unprecedented context of psychological pressures: total information oversaturation, cognitive overload from the need to simultaneously manage multiple digital platforms and interfaces, dramatic reduction in authentic social interaction, complete blurring of once clear boundaries between study, work and personal time (Kumpikaitė-Valiūnienė, 2021; Eravwoke, 2021). Modern research in neurophysiology records a 37% increase in cortisol levels (stress hormone) among students when working with several digital platforms simultaneously compared to traditional forms of education. Psychologists note the phenomenon of “digital fragmentation of attention,” where the average time of maintaining focus on a single learning task has decreased from 42 minutes in 2000 to 8-12 minutes in 2023 (Kolinichenko, 2022). Cybersecurity specialists record an increase in “digital anxiety” among 73% of students related to concerns about the confidentiality of personal data when using educational platforms. Modern students are forced to exist in a mode of continuous multi-level adaptation – not only to traditional academic requirements but also to kaleidoscopically changing technological tools of education (Kramskoy, 2021). The average student is forced to master 6-8 new digital tools annually, while the half-life of the relevance of obtained digital skills is only 1.5-2 years, forming a qualitatively new type of educational stress characterized by chronicity, high intensity, and multimodal impact, which requires fundamentally different, yet unexplored mechanisms of psychological defense and adaptation (Bashkireva, 2020). The relevance of the topic is enhanced by the characteristics of the digital generation of students who, despite

technological literacy, demonstrate increased vulnerability to stress factors. Research shows an increase in anxiety disorders, decreased concentration, and emotional burnout among university students in conditions of distance and blended learning. The development of stress resilience becomes not just a desirable quality but a necessary component of the educational competencies of the modern student.

The result of this research will be a model for developing students’ stress resilience, which can serve as a theoretical and methodological basis for improving psychological support systems for students, modernizing curricula taking into account stress resilience factors, as well as developing digital tools for self-diagnosis and self-regulation of students’ psycho-emotional state. In the context of continuing digitalization of education, creating an effective model for developing stress resilience becomes a strategic task for universities. Research question: “What are the structural and functional components of the model for developing students’ stress resilience in the digital educational environment of a modern university?”

Materials and Methods. In scientific research, a model represents an abstract, simplified representation of a real object, process, or phenomenon, reflecting its most essential properties and interrelationships. The model performs a crucial heuristic function, allowing researchers to gain new knowledge about the studied phenomenon by analyzing its simplified analog (Frigg, 2006). In the context of pedagogical research, a model serves as a tool for understanding pedagogical reality, providing the possibility to predict educational process outcomes and determine optimal ways to achieve set goals. Constructing a model for developing students’ stress resistance in a university’s digital educational environment allows for a systematic representation of this process, highlighting its key components, establishing functional relationships between them, and determining conditions for effective implementation.

In the structure of the designed model, the target component occupies a fundamental position, performing a system-forming

function and determining the vector of the entire process of developing students' stress resistance in the digital educational environment. The architectonics of the content component reflects the multidimensionality of the stress resistance phenomenon, identified through theoretical analysis, and is presented as a triad of interconnected blocks: cognitive, emotional-regulatory, and behavioral. The technological component is constructed based on a comprehensive study of effective mechanisms for developing stress resistance in digital conditions and represents a set of adaptive technologies that ensure the formation of psychological resistance to digital stressors. The result-evaluation component is integrated into the model to ensure the measurability of achieved results and organize systematic monitoring of the dynamics of stress resistance development in the digital educational environment.

Results and Discussion. The architecture of the proposed model is characterized by both vertical (hierarchical) and horizontal functional connections between its constituent elements, which ensures their synergistic interaction and the integrity of the entire structure. The theoretical and methodological foundation for designing the model was the integration of systemic, personality-oriented, and activity-based approaches, which allowed for the development of a holistic and dynamic model for developing students' stress resistance in the digital educational environment of a university, the graphical representation of which is presented in Figure 1.

The target component of the model is focused on developing students' stress resistance as an integrative quality of personality that allows them to function effectively in a digital educational environment. This is implemented through a holistic pedagogical process at the university, involving the integration of stress resistance development strategies into the general system of professional training for modern specialists. Such integration ensures the formation of not only narrow professional competencies but also students' adaptive capabilities to the digital educational environment.

The methodological basis of the target component is a complex of complementary approaches. The personality-oriented approach ensures consideration of individual characteristics of students in the process of stress resistance formation, allowing for the adaptation of pedagogical influences to the unique characteristics of each learner. The activity-based approach is implemented through the active involvement of students in practical activities to overcome stressful situations arising in the digital environment. The competency-based approach is aimed at developing specific skills and abilities for stress-resistant behavior necessary for successful academic and professional activities. The systemic approach ensures the integrity and interconnection of all elements in the process of developing students' stress resistance.

The content component of the model, logically derived from the target component, represents the structured content of the educational process and includes three interconnected blocks encompassing all spheres of the student's personality.

The cognitive block is aimed at forming a system of knowledge about the nature of stress, the specifics of digital stressors, mechanisms of mental self-regulation, and principles of digital hygiene. This block creates a theoretical foundation for developing stress resistance, providing students with the necessary information to understand processes occurring during digital stress and possibilities for managing them. Students' awareness of the specifics of digital stressors (information overload, multitasking, technical failures, constant availability) allows them to better prepare for potential stressful situations and develop adequate response strategies.

The emotional-regulatory block is focused on developing emotional stability, forming skills of emotional self-regulation, and psychological flexibility in the digital environment, ensuring students' ability to manage their emotional reactions to digital environment stressors, maintain internal balance when facing difficulties, and quickly recover after stressful situations. The psychological flexibility

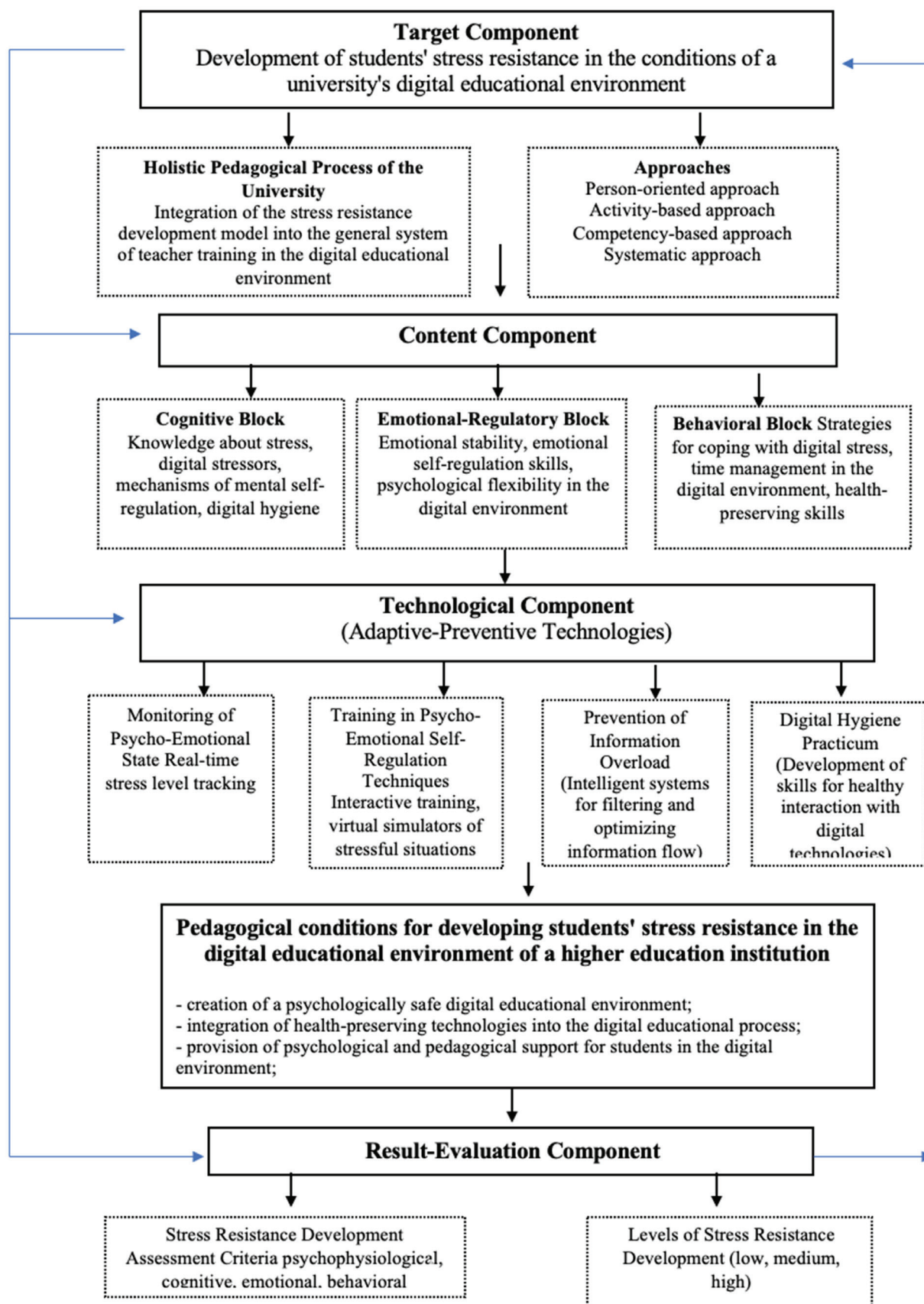


Figure 1: Model for Developing Students' Stress Resilience in the University Digital Educational Environment

developed within this block allows students to adapt to the constantly changing conditions of the digital educational environment without compromising their psychological well-being.

The behavioral block of the content component focuses on students' mastery of effective strategies for coping with digital stress, developing time management skills in the digital environment, and cultivating health-preserving habits. This ensures the development of practical abilities and skills that allow students to effectively operate in stressful situations, rationally organize their activities in the digital environment, and maintain physical and mental health during intensive use of digital technologies. Special attention in this block is given to the balance between digital activity and rest, which is an important factor in preventing digital stress.

The technological component of the model for developing students' stress resistance in the university's digital educational environment represents a complex of adaptive-preventive technologies aimed at the practical implementation of the target and content components.

This component includes four interconnected technological blocks, each oriented toward solving specific tasks in the process of developing stress resistance.

The first block – monitoring of psycho-emotional state and tracking stress levels in real-time – involves using modern diagnostic methods and digital tools for continuous observation of students' psycho-emotional states. Such monitoring allows for timely identification of stress symptoms, determination of individual reactions to various digital stressors, and tracking the dynamics of students' emotional states during the learning process. Real-time stress level tracking can be carried out using both traditional psychodiagnostic methods and digital technologies (specialized applications, wearable devices for tracking biometric indicators, etc.). The monitoring results serve as the basis for individualizing preventive and corrective measures.

The second block – teaching psycho-emotional self-regulation techniques through interactive training and virtual simulators of

stressful situations – is aimed at developing practical skills for managing one's emotional state under conditions of digital stress. Within interactive training sessions, students master various relaxation techniques, breathing exercises, cognitive restructuring methods, attention-switching techniques, and other means of self-regulation. Virtual simulators of stressful situations allow students to practice skills for overcoming typical stressors in the digital educational environment (technical failures, information overload, multitasking, etc.) in a safe environment. Such practical preparation contributes to the formation of automated skills for effectively responding to stressful situations in real life.

The third block – prevention of information overload through intelligent systems for filtering and optimizing information flow – is focused on creating an optimal information environment that reduces the risk of information stress. Within this block, students learn to work with various information management tools: programs for filtering and structuring information flows, systems for organizing educational materials, and tools for creating a personalized information environment.

The fourth block – a practical course on digital hygiene aimed at developing skills for healthy interaction with digital technologies. Within this block, students master the principles of ergonomic organization of digital workspace, work-rest schedules when working with digital devices, and prevention of visual and physical strain. The practical course includes training in skills for establishing a balance between online and offline activities, managing digital presence, and protection from the negative effects of social networks and other potentially stressogenic digital environments. Special attention is paid to forming a conscious attitude toward the use of digital technologies and developing digital detox skills – the systematic disconnection from digital devices to restore psycho-emotional balance.

All four blocks of the technological component are closely interconnected and provide a comprehensive approach to developing students' stress resistance. Monitoring the

psycho-emotional state helps identify problem areas, training in self-regulation techniques develops stress management skills, prevention of information overload reduces the intensity of stressful impacts, and the digital hygiene practicum ensures sustainable interaction with the digital environment.

The technological component of the model is implemented in the context of specially created pedagogical conditions that ensure effective development of students' stress resistance in the university's digital educational environment. The first pedagogical condition is the creation of a psychologically safe digital educational environment, which involves forming a learning space that minimizes psycho-emotional risks and creates a comfortable microclimate for educational activities. A psychologically safe digital educational environment is characterized by technical stability of the platforms used, an intuitive interface, and availability of prompt technical support, which significantly reduces the level of stress associated with technical failures and difficulties in using digital tools. An important aspect of this condition is the formation of a positive communicative atmosphere, including the development and implementation of ethical norms for digital interaction, prevention of negative phenomena in virtual communication, and establishment of constructive feedback between all subjects of the educational process. Information transparency, expressed in clear structuring of educational materials, unambiguity of requirements for completing assignments, and timely information about changes, also serves as a significant component of a psychologically safe digital environment, helping to reduce uncertainty as one of the key stress-inducing factors.

The second pedagogical condition is the integration of health-preserving technologies into the digital educational process, focused on minimizing the negative impact of digitalization on students' physical and mental health. This condition is implemented through the optimization of academic workload, which implies rational distribution of digital assignments, adherence to hygienic standards

for the duration of work with digital devices, and regulation of the volume of information for assimilation in accordance with the cognitive capabilities of students. The ergonomic organization of digital learning, including the integration of systematic physical activities into the educational process, the implementation of automated reminders about the need for breaks, and methodological recommendations for organizing workspace, contributes to the prevention of physical and psychological overload. A significant component of this condition is the rational alternation of synchronous and asynchronous learning formats, providing an optimal balance between different types of educational activities and preventing cognitive exhaustion of students.

The third significant pedagogical condition is the provision of psychological and pedagogical support for students in the digital environment, which represents a system of targeted support for learners in the process of adapting to the digital educational space. This condition is implemented through the organization of tutorial support, which involves assigning mentors to students who provide assistance in mastering digital learning tools, solving emerging technical difficulties, and adapting to the specifics of the digital educational process. Psychological support, including the availability of psychological services, conducting individual and group consultations on stress management, and organizing webinars on psycho-emotional self-regulation, is an integral element of student support. The formation of mutual assistance communities, implemented through the creation of virtual support groups and forums for exchanging experiences in overcoming the difficulties of digital learning, contributes to the development of social resources for stress resistance.

The fourth pedagogical condition is the development of students' adaptive capabilities in the digital educational space, focused on forming competencies that ensure flexible adaptation to the constantly evolving digital environment. Within this condition, systematic development of students' digital literacy is carried out, including training in the effective

use of digital tools, updating digital skills in accordance with technological innovations, and forming a culture of information security. Special attention is paid to developing time management skills in the digital environment, which involves teaching methods of planning and organizing educational activities in digital education conditions, forming abilities to prioritize tasks and manage information flows. The development of cognitive flexibility, implemented through training in skills of effective switching between tasks, adaptation to new digital tools, and positive reappraisal of problematic situations, contributes to the formation of psychological resources for resisting stress. A significant aspect of developing adaptive capabilities is the formation of a proactive position among students, involving the development of an attitude toward actively overcoming difficulties in the digital environment, teaching skills for independently finding solutions to emerging problems, and stimulating initiative and creative approaches to using digital technologies.

The identified pedagogical conditions form a holistic system characterized by internal unity and complementarity of components. A psychologically safe educational environment creates the foundation for effective implementation of health-preserving technologies, psychological and pedagogical support contributes to the development of students' adaptive capabilities, and the development of adaptive capabilities, in turn, increases the level of psychological safety in the educational environment.

The result-evaluation component of the model for developing students' stress resistance in the university's digital educational environment represents a systemic element that provides diagnostics, measurement, and evaluation of the effectiveness of implementing all preceding components of the model. This component performs the function of feedback, allowing for timely adjustment of the stress resistance development process and optimization of pedagogical influences in accordance with the obtained results.

In the structure of the result-evaluation component, two main elements are distin-

guished: criteria for assessing the development of stress resistance and levels of stress resistance development. The criteria apparatus for evaluating stress resistance development has a multifunctional structure and includes psychophysiological, cognitive, emotional, and behavioral criteria, providing a comprehensive approach to measuring this integrative quality of personality.

Psychophysiological criteria are aimed at assessing the vegetative manifestations of stress resistance and include measuring such indicators as stability of vegetative functions when exposed to digital stressors, recovery rate of physiological parameters after stress exposure, stability of psychomotor reactions when working in the digital environment, and absence of pronounced psychosomatic reactions to digital stress. This group of criteria allows for an objective assessment of the physiological components of stress resistance, using both hardware diagnostic methods and validated self-assessment questionnaires of physiological reactions.

Cognitive criteria are focused on evaluating the characteristics of thought processes and cognitive strategies for overcoming stress in the digital educational environment. This group includes such indicators as maintaining concentration in conditions of information overload, flexibility of thinking when solving problematic situations in the digital environment, constructive interpretation of stressful events, formation of cognitive coping schemes for digital stress, and mindfulness in the use of digital technologies. Assessment of cognitive criteria is carried out through analysis of strategies for solving problematic situations, testing cognitive functions, and studying the features of attributive style and belief systems of students.

Emotional criteria are aimed at diagnosing the emotional sphere and include assessment of such parameters as emotional stability when exposed to digital stressors, ability to regulate the intensity of emotional reactions, differentiation of emotional experiences, predominance of a positive emotional background when working in the digital environment, and emotional

resilience to the uncertainty characteristic of the digital space.

Diagnosis of emotional criteria is implemented through psychodiagnostic methods aimed at investigating the emotional sphere, as well as through methods of analyzing emotional states in the process of modeling stressful situations in the digital educational environment.

Behavioral criteria are focused on evaluating external manifestations of stress resistance and include such indicators as effectiveness in applying coping strategies for digital stress, adaptability of behavior in changing digital environment conditions, maintenance of working capacity when exposed to digital stressors, constructiveness of communication in stressful situations of digital interaction, and consistency in implementing health-preserving practices when working with digital technologies. Assessment of behavioral criteria is carried out through observation, analysis of activity products, methods of self-assessment of behavioral reactions, and expert evaluation.

Based on a comprehensive assessment across all groups of criteria, levels of development of students' stress resistance in the digital educational environment are determined: low, medium, and high. The low level is characterized by pronounced psychophysiological reactions to digital stressors, dominance of maladaptive cognitive schemas, instability of emotional state, and prevalence of non-constructive behavioral strategies in stressful situations of the digital educational environment. The medium level manifests in moderate psychophysiological reactions to digital stress, partial formation of adaptive cognitive schemas, relative stability of emotional state, and predominant use of constructive coping strategies with the presence of some ineffective behavioral patterns. The high level of stress resistance is characterized by minimal psychophysiological manifestations when exposed to digital stressors, dominance of adaptive cognitive schemas, pronounced emotional stability, and systematic application of effective behavioral strategies for coping with stressful situations in the digital educational environment.

The result-evaluation component of the model involves using a complex of diagnostic methods, including both standardized psychodiagnostic tools (questionnaires, tests, scales) and qualitative assessment methods (observation, interviews). An important aspect of implementing this component is the monitoring nature of diagnostics, which involves conducting initial, intermediate, and final assessments of the stress resistance level, allowing for tracking the dynamics of this quality's development and making adjustments to the pedagogical process.

The result-evaluation component is organically integrated into the overall structure of the model and exists in a dialectical relationship with the preceding components. Diagnostic data obtained within this component serve as the basis for adjusting target guidelines, content, technological tools, and pedagogical conditions for implementing the model, ensuring its adaptability and flexibility in accordance with individual characteristics and educational needs of students.

Thus, the result-evaluation component performs the function of providing feedback and objective measurement of the effectiveness of the model for developing students' stress resistance in the university's digital educational environment, which allows for optimizing the pedagogical process and achieving maximum results in forming this professionally significant quality of future specialists.

Conclusion. The problem of developing students' stress resistance becomes particularly relevant in the context of the rapid digitalization of higher education. Today's students face daily information overloads, the need for quick adaptation to new technologies, and the transformation of traditional forms of communication, which significantly increases the level of psycho-emotional tension and requires special pedagogical support. In the course of the research, a model for developing students' stress resistance in the university's digital educational environment was designed. This model reflects the relationship between the goals, content, technologies, and evaluation of the pedagogical process results, ensuring its integrity and direction. Adaptive-preventive technologies acquire special significance in the developed

model, contributing not only to reducing the negative consequences of digitalization but also to forming sustainable self-regulation strategies among students. The substantiated pedagogical conditions create the necessary foundation for the effective implementation of the model in educational practice. The practical significance of the research lies in the possibility of its use for improving educational programs aimed at developing students' adaptive competencies.

The model can be integrated into the higher education system, complementing traditional methods of specialist training, taking into account the challenges of the digital era. Prospects for further research are related to testing the model in various educational contexts, developing methodological recommendations for teachers, and studying the dynamics of students' stress resistance development at different stages of education.

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