BLENDED LEARNING AS A TOOL FOR DEVELOPING STUDENTS' STRESS RESISTANCE IN CRISIS SITUATIONS

BLENDED LEARNING COMO FERRAMENTA PARA DESENVOLVER A RESISTÊNCIA AO STRESS DOS ALUNOS EM SITUAÇÕES DE CRISE

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Abstract: *Blended learning distributes the load on students and promotes a convenient format for perceiving information. The aim of the study is to determine the effectiveness of blended learning for developing students' stress resistance in crisis situations. The goal was achieved using modelling methods, observation, expert assessment, calculations of the correlation coefficient, Cronbach's alpha. It was planned to use the digital platforms — Canvas and Classtime — to implement blended learning. This allowed students in Group 1 to focus on distance learning, and students in Group 2 to focus on classroom learning. This approach to learning allowed students in Group 1 to better develop theoretical skills (94%), and students in Group 2 to better develop practical skills (95%). The results showed that students in Group 1 were most able to reduce the level of anxiety (17%), which was associated with the flexibility of the educational process and the use of digital technologies. Students in Group 2 were most able to develop the level of learning motivation (98%), which was associated with the use of digital technologies in the educational process and the support of social ties. The practical significance of the article is the identified effective blended learning strategies for developing students' stress resistance. The research prospects are related to identifying the advantages of blended and distance learning for developing stress resistance and motivation of 1st and 4th year humanities students.*

Keywords: *interactive technologies. professional competence. Anxiety. learning motivation. blended learning*

Resumo: *Blended learning distribui a carga sobre os alunos e promove um formato conveniente para perceber a informação. O objetivo do estudo é determinar a eficácia do blended learning no desenvolvimento da resistência ao estresse dos alunos em situações de crise. O objetivo foi alcançado usando métodos de modelagem, observação, avaliação de especialistas, cálculos do coeficiente de correlação, alfa de Cronbach. Planeou-se utilizar as plataformas digitais - Canvas e Classtime - para implementar o blended learning. Isso permitiu que os alunos do Grupo 1 se concentrassem no ensino à distância, e que os alunos do Grupo 2 se concentrassem na aprendizagem em sala de aula. Esta abordagem ao aprendizado permitiu que os alunos do Grupo 1 desenvolvessem melhor as habilidades teóricas (94%), e que os alunos do Grupo 2 desenvolvessem melhores habilidades práticas (95%). Os resultados mostraram que os alunos do Grupo 1 foram os mais capazes de reduzir o nível de ansiedade (17%), o qual foi associado à flexibilidade do processo educacional e ao uso das tecnologias digitais. Os alunos do Grupo 2 foram mais capazes de desenvolver o nível de motivação para a aprendizagem (98%), que foi associado ao uso das tecnologias digitais no processo educativo e ao apoio aos laços sociais. O significado prático do artigo é a identificação de estratégias efetivas de aprendizagem combinada para desenvolver a resistência ao estresse dos alunos. As perspectivas de pesquisa estão relacionadas à identificação das vantagens do ensino misto e a distância para o desenvolvimento da resistência ao estresse e motivação dos alunos do 1o e 4o anos de humanidades.*

Palavras-chave: *tecnologias interativas. competência profissional. Ansiedade. motivação para aprender. aprendizagem combinada*

Introduction

Continuity of learning in crisis situations can be ensured through blended learning. In this way, students can receive full access to educational materials, acquire knowledge in accordance with the academic programme (Su et al., 2024). The search for mechanisms for implementing blended learning is an effective tool for reducing students' stress resistance, which forms relevant research questions.

Blended learning involves a combination of traditional and distance learning approaches, as well as independent learning. Blended learning primarily affects the use of a flexible approach to the implementation of learning, which contributes to the high-quality assimilation of materials (Yukhymenko et al., 2024). Blended learning ensures the use of individual pace by students to perceive information, which increases their independence, and enhances motivation. Blended learning also develops digital competence, thereby contributing to the expansion of educational opportunities (Kyei-Akuoko et al., 2025). Self-study, which is one of the elements of blended learning, ensures conscious perception of academic programme materials to expand professional knowledge. Blended learning contributes to the modernization of the educational process, as it is aimed at increasing professional competence based on the search for new approaches to learning. Various forms of acquiring information can be used during blended learning (Chovriy et al., 2024a Chovriy et al., 2024b). For example, theoretical classes can be held remotely, practical classes in the classroom; basic training is held remotely, classroom lessons are only for consolidating the main tasks. Blended learning also provides the opportunity for students to form their own study schedule, focusing on the impact of the crisis situation (Buch and Stjerne, 2024).

Blended learning is particularly effective in times of crisis, as it does not involve students in classroom activities only and provides uninterrupted access to learning (Mahande et al., 2025). This helps to stabilize students' mental state by creating comfortable learning environments, allowing students to be in safer places and to perceive materials in accordance with the developed programme (Ameloot et al., 2024). The development of students' stress resistance provides an increasing motivation for learning, better assimilation of information, and its objective use (Al-Mekhlafi et al., 2025). Stress resistance decreases based on the use of a flexible approach, preservation of social ties, development of independence, and the availability of feedback (Kok et al., 2025).

The studied theoretical material gives grounds to determine the advantages of blended learning, but the lack of specific strategies for its implementation creates research gaps. The novelty of the study is the adaptation of effective blended learning strategies to improve students' academic performance and minimize stress factors on students. The hypothesis of the study is that

the orientation towards blended learning contributes to an increase in the level of students' stress resistance during the impact of crisis situations, which is associated with the students' adaptation to distance classes and classroom lessons.

The aim of the research is to study the effectiveness of blended learning as a tool for developing students' stress resistance in crisis situations. The aim was achieved through the fulfilment of the following research objectives:

- Build strategies for implementing blended learning in crisis situations;

- Assess the effectiveness of students' skills before and after blended learning and determine the change in students' stress resistance under the influence of blended learning;

- Identify elements of the educational process that had the greatest impact on the development of students' stress resistance.

The analysis of methods for organizing blended learning was carried out by studying various academic articles. The process involved determining the advantages of blended learning and the possibility of its adaptation for students of different fields. Brenya (2024) noted that blended learning is aimed at increasing the value of the educational process by involving digital resources to transform traditional educational strategies. However, a negative impact on students can be observed because of the selection of inappropriate technological resources and lack of student motivation. In contrast to the previous study, Suson (2024) noted that digital technologies are not the only tool for increasing the effectiveness of learning. Blended learning can be implemented through the integration of teacher support, selection of useful educational information, ease of use of technologies. Teacher support has a positive effect on the development of student motivation to cover educational needs. Another approach is considered in the study of Jayarathna and Herath (2024), which involves the use of a structured approach to implementing blended learning. Blended learning in a blog format enables students to receive feedback from teachers. The most positive impact on acquiring information is when students consider real-world situations and solve them using professional solutions.

Fu and Qiu (2024) believe that the blended learning format has become the most widespread during the COVID-19 pandemic. It has been found that this learning approach has a greater impact on burnout for students with lower academic performance than for students with higher academic performance. Continuous assessment of students' psychological state enhances students' motivation to study. The prevalence of blended learning during the COVID-19 pandemic was also examined by Balanga and Cabuquin (2024) in their study. However, the authors believe that blended learning has its drawbacks, which cannot be used as the only learning format. This is related to distracting factors, time constraints, and the selection of quality information, which contributes to increased stress in students. Quality education can be achieved by strengthening cooperation between students and teachers.

According to Henríquez and Hilliger (2024), the integration of technology into the educational process contributes to the potential for the development of blended learning. The choice of technology should be focused on teaching methods and the possibility of their adaptation to the students' needs. It is possible to achieve high results in learning due to the active participation of students, which affects the assimilation of the necessary materials. Li et al. (2024) considered more specific possibilities of digital technologies for blended learning. This involved the use of Rain Class software to create an active learning environment in blended learning. The lack of interaction with the teacher during such learning increased the level of students' anxiety. The use of group work ensured a decrease in student anxiety. However, the level of anxiety did not have a negative impact on the level of student success, which depended on the level of perception of information by students.

The impact of stress factors on students during the learning process was considered in the following studies. AlQashouti et al. (2024) note that the students' difficulties in adapting to the learning process depend on the students' basic abilities and personality traits. Therefore, these aspects must be taken into account when organizing training. Minimizing stress is possible based on the students' active involvement. This can be implemented through building specific learning goals, developing independence, and shaping learning behaviour. Other stress factors affecting students are considered in the article by Alruwaili (2024), which assesses technological barriers and digital

literacy inequalities. These gaps can be addressed through a systematic approach and improving student support mechanisms. Reducing the stressful impact of blended learning on students is possible through feedback based on the use of ChatGPT, which is considered by Wu et al. (2024). ChatGPT can influence the progress of students' self-regulation and facilitate the processing of students' requests in real time, which affects the elimination of knowledge gaps. This approach affects the development of students' intrinsic motivation and expands the conditions for their support.

The literature review found that studies are aimed at analysing the advantages or disadvantages of blended learning, and also separately investigate the level of students' anxiety. However, the combination of the presented research approaches has not been considered in one study, which requires addressing these gaps. Therefore, it is necessary to build blended learning strategies and identify factors that influence the change in students' stress resistance.

Methodology

Research design

The first stage of the study provided for choosing a strategy for implementing blended learning. The implementation of blended learning during the study involved a combination of distance learning, classroom lessons, and self-study. Theoretical and practical lessons were provided during distance learning. *The second stage of the study* was an assessment of the effectiveness of blended learning, for different groups of students. The results were obtained based on a comparison of students' academic performance before and after the study. *The third stage of the study* included determining students' stress tolerance depending on the existing level of anxiety, cognitive performance, learning motivation, and emotional overload. The elements that most contributed to the development of students' stress resistance were also identified.

Sampling

The sample of students was formed among students of 2-3 years studying at Uzhhorod National University. The study involved a total of 178 students from different departments (pedagogy, political science, cybernetics and applied mathematics, probability theory and mathematical analysis, physical therapy). The main emphasis when selecting students was on the year of study, not the level of skills. This was due to the possibility of attracting students for whom it is possible to compare previous academic results with those obtained during blended learning. The sample was made among students who preferred the traditional approach to learning. The distribution of students into two groups was even, which excluded the advantages in the level of knowledge of some students over others. Group 1 included 89 students for whom the emphasis in blended learning was made on distance learning; Group 2 – 89 students for whom the emphasis in blended learning was made on classroom lessons. Independent work of students involved studying theoretical material with its subsequent consolidation in practice. A blended learning approach was used by two groups of students. However, for students in Group 1, the ratio of distance learning to classroom learning was 50% to 35%; for Group 2, 35% to 50%, respectively. Independent learning included 15% of all learning among students in both groups. The duration of the study was 4 months, which involved 5 lessons per week. The students participated in the research programme upon their voluntary written consent.

Methods

- the modelling method was used as the main mechanism for building of blended learning strategies. The method compares the ways of combining classroom and distance learning in the educational process and determines the most favourable strategies in the distribution of classes and the choice of digital technologies;

- the expert assessment was used to determine the level of student efficiency before and after the study. The process involved the assessment of tasks completed by students in the classroom and remotely. This involved recording the initial and final results to assess the obtained dynamics. The level of student efficiency was determined for each academic subject to obtain averaged results;

- the observation method was used to assess the level of students' stress resistance. The process included the assessment of changes not only during the performance of standard educational tasks, but also creative ones. This allowed to assess the level of students' psychological and social adaptation to the use of blended learning;

- the calculation of the correlation coefficient contributed to the statistical assessment of the obtained level of academic knowledge acquired by students, which affected the effectiveness of the educational process. The correlation coefficient takes into account the linear relationship between indicators. The indicators are interconnected if the calculations are equal to 0.9 - 1 (Alruwaili, 2024).

$$k_s = \frac{\sum_{i=1}^{n}(p_i - p_{cep})^{1/2}}{m-1}, \quad (1)$$

m – number of indicators;

p_i – normalized value;

p_{cep} – arithmetic mean value.

- the calculation of Cronbach's alpha contributed to the identification of the most influential elements of the educational process on the development of students' stress resistance. Cronbach's alpha contributed to the identification of the statistical reliability of indicators based on the average covariance to isolate the average total variance. The results will be correct when the value approaches 0.9 and will differ at values less than 0.5 (Brenya 2024).

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum_{i=1}^{N}\sigma_{\chi_i}^2}{\sigma_T^2}\right). \quad (2)$$

N – number of estimated indicators;

$\sigma_{\chi_i}^2$ – indicator variance;

σ_T^2 – total indicator variance.

Instruments

Google Forms were one of the main instruments for obtaining information from students regarding the impact of the most significant element on the development of stress resistance. This enabled students to assign points to each element (flexibility of the educational process, support of social connections, use of digital tools, development of independence, availability of feedback) from 1 to 5. This approach contributed to determining the advantages of some elements over others. The data from students were collected within 10 hours. The tool for processing statistical data was the Stata programme, which contributed not only to the calculations, but also to the graphical implementation of the obtained data.

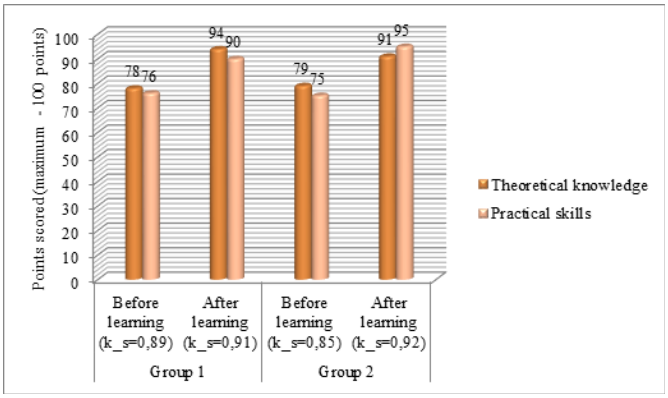
The Canvas platform was used to conduct theoretical classes during distance learning. The platform facilitated the use of ready-made materials and integrated information for the implementation of the academic programme. The platform can be used for different subjects, which facilitated the creation of training courses and grouping materials by topic. The Canvas platform facilitated distance learning using built-in chats, which influenced the interaction between students and teachers. The Classtime platform was also used during distance learning for the assessment of students' knowledge in real time. The process involved the creation of tests and other tasks that could be checked automatically.

Results and discussion

After blended learning, students identified an approach that was more effective. The comparison was conducted among students who had predominantly distance learning (Group

1) and students who had predominantly classroom learning (group #2). The results included a comparison of students' performance before and after the study (Figure 1).

Figure 1. Student performance level depending on the learning strategy used



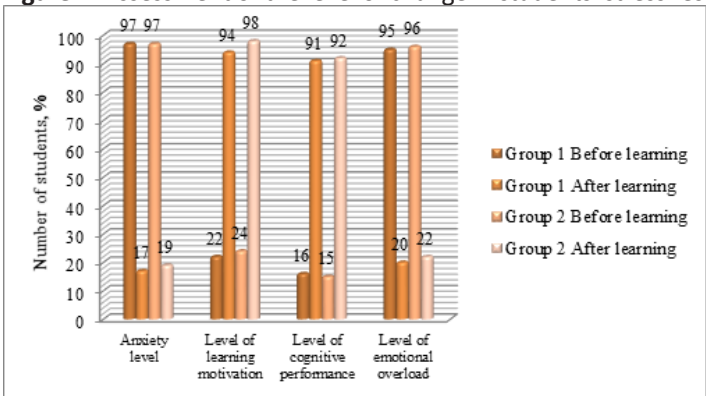
Source: developed by the author

A comparison of the effectiveness of blended learning showed the advantages of acquiring theoretical and practical skills depending on the chosen approach. The results showed that a higher level of theoretical skills was obtained by students who had distance learning. This was due to a high level of concentration on theoretical materials, which allowed for an extensive study of a separate issue. The acquisition of theoretical skills was implemented under the influence of technical accessibility and the choice of effective methodological approaches. For students, this approach had the advantages of the absence of time restrictions for processing educational materials.

A higher level of practical skills were developed among students of Group 2, who had classroom lessons. This was due to the possibility of ensuring continuous interaction between teachers and students, solving group tasks. Conducting practical lessons in the classroom provided students with access to educational tools and devices, which contributed to the development of algorithmic thinking. Working in groups during classroom lessons contributed to the development of communication skills and the exchange of experience. The obtained results showed that an even distribution of distance and classroom classes allows for more effective results.

The study determined how students' stress tolerance levels changed during blended learning. The results included an assessment of changes in anxiety, learning motivation, cognitive performance, and emotional overload. The results are presented in Figure 2.

Figure 2. Assessment of the level of change in students' stress resistance



Source: developed by the author

Assessment of the level of students' stress resistance showed that students were able to improve it during blended learning. This was due to the correct distribution of the educational process, the use of instrumental, digital resources, and social support. The level of anxiety decreased the most in students of group No. 1. The level of anxiety was reduced because of the reduction of

social pressure on students and the possibility of full access to classes, which helped to minimize students' uncertainty. The combination of distance and classroom tasks made it possible to adjust the educational load and the opportunity to study materials while reducing the impact of the crisis situation.

The students of Group 2 developed their learning motivation the most, as unresolved educational issues could be solved remotely during classroom lessons. The use of digital technologies allowed students not to be limited to traditional approaches to the perception of information to achieve high results. The combination of different formats of classes enabled students to concentrate on important material that contributes to the development of professional skills.

The level of cognitive performance was higher in the students of Group 2, which contributed to the perception and rethinking of educational information for its practical use. Cognitive performance was developed under the influence of the high-quality use of digital materials, the selection of appropriate information, and the organization of the educational process. This affected the development of working and long-term memory, the development of concentration, which contributed to the variation of educational materials and their use for the implementation of professional activities.

In the students of Group 1, the level of emotional overload was reduced more than in students of Group 2, which contributed to satisfaction with the educational process. The obtained results were associated with the consistent and logical presentation of educational material and the combination of active learning methods (group work). This allowed for an even distribution of the educational load through interval repetition, timely feedback on the level of acquired skills, and increased educational performance.

Among the students, it was determined which elements had the greatest impact on the development of stress resistance. The selected criteria were flexibility of the educational process, support of social connections, use of digital tools, development of independence, availability of feedback (Table 1).

Table 1. Assessment of elements that contributed to the development of students' stress resistance

Determined elements	Group 1				Group 2			
	Number of students, %				Number of students, %			
Flexibility of the learning process	95	42,1	5,3	0,93	92	41,2	5,5	0,89
Supporting social connections	83	39,5	5,9	0,86	94	41,9	5,3	0,91
Using digital tools	94	41,8	5,4	0,92	95	42,3	5,2	0,92
Developing independence	82	39,4	6,1	0,85	91	39,9	5,6	0,85
Availability of feedback	90	41,1	5,7	0,91	83	39,5	5,9	0,87

Source: developed by the author

It was found that the students' stress resistance was developed based on the influence of a set of educational criteria. Students in Group 1 noted that the flexibility of the educational process had the most positive impact, which is associated with the possibility of combining distance, classroom, and independent learning. The flexibility of learning was also associated with the possibility of constant access to educational materials, which contributed to their deeper study. Support for social ties for students in Group 2 was more effective, as the advantage of classroom learning contributed to interaction with teachers, group work. The students gained professional

knowledge and could use it when working with educational projects. Digital technologies allowed for the correct organization of the educational process, contributed to constant access to materials, thereby expanding professional competence.

The development of independence among students in Group 2 had a greater impact on the development of stress resistance, which is associated with the ability to consciously perceive the educational process and adapt to the emergence of crisis situations. Based on self-study, students could use constructive thinking to solve the tasks, which reduced emotional burnout. The feedback for students in Group 1 had a greater advantage, as it ensured the creation of a full-fledged learning process based on an understanding of the level of gained knowledge.

Blended learning can be implemented based on a combination of online and modular distance learning using the STEM model. The topic can be mastered by repeated learning of information, using Internet resources for self-study. But such learning has a negative meaning in the presence of distracting factors due to the lack of constant interaction with the teacher (Jasmin and Ongcoy, 2024). The use of adaptive hybrid learning systems contributes to the development of dynamic learning, affects the growth of student progress. This is determined by the use of different learning theories, solving real problems in educational settings (Pan et al., 2024). The use of digital technologies allows for more dynamic and thorough blended learning. The use of the Edpuzzle application contributes to the perception of information based on interactive video lessons, which affects the development of student independence and creativity. This is possible based on the visual perception of materials, choosing an independent learning pace (Chust-Pérez et al., 2024). The HTML5 platform can be used in blended learning, which increases its effectiveness. Students believe that better perception of information is possible on the basis of creating attractive content and selecting the most important information. Structuring the material contributes to its visual perception and the possibility of using it in professional activities (Noutcha and Kieffer, 2024). The analysed studies reflect the significant importance of modern digital technologies in the implementation of blended learning. However, specific strategies for implementing blended learning based on the distribution of distance, classroom, and independent learning were not considered. These gaps were eliminated in our study, which provided the comparison of the effectiveness of blended learning for students who had predominantly classroom learning and students who had predominantly distance learning.

The most effective blended learning strategy is the students' self-regulated ability to learn, which is developed under the influence of independent learning. The academic stress reduces the effectiveness of blended learning, deteriorating learning behaviour. These negative factors can be avoided under the influence of digital transformation of the educational process (Chen et al., 2024). The quality of blended learning depends on the students' motivation for synchronous and asynchronous learning. Students should develop independence in learning, which promotes the creation of a constructive learning approach (Adigun et al., 2025). The effectiveness of blended learning depends on the students' academic motivation. Its development is possible on the basis of the perception of educational materials, the elimination of the effects of stress factors. Digital technologies facilitate the perception of educational materials, as well as perform practical tasks for learning materials (Han, 2024). The analysed studies paid attention to the development of student motivation, which increases the effectiveness of blended learning. In our study, increasing the effectiveness of the educational process is associated with the choice of specific strategies for blended learning that contribute to the development of students' stress resistance to achieve higher results.

Digital tools influence the creation of sustainable psychological support for students based on constant access to educational materials and social interaction (Yang et al., 2025). Managing students' stress is interconnected with increasing their academic performance. Stress factors can be eliminated through emotionally-oriented learning, which is associated with receiving feedback (Morento et al., 2024). Blended learning promotes deeper learning through digital approaches. Collaboration with teachers, a transparent assessment system, and the distribution of learning time affect the transformation of learning and the reduction of stress factors for students. The model of deeper learning should be built on student learning in small groups, which ensures the acquisition of knowledge through direct learning and a personalized approach (Sliwka et al.,

2024). The mentioned studies examine the features of reducing stress factors due to the use of digital technologies. Our article identified the complex influence of factors on the development of students' stress resistance and identified criteria that were associated with reducing the negative psychological impact on students (for example, anxiety level).

The analysis of the studies showed that the published articles are related to the development of students' stress resistance during blended learning, which involves the use of digital tools and an orientation towards the development of motivation. In our article, attention was paid to the implementation of blended learning using different approaches (with a preference for distance learning or classroom lessons). This made it possible to determine the overall effectiveness of learning, determine the level of stress resistance and the factors of the educational process that had the most positive impact. The obtained results correspond to the hypothesis of the study, which made it possible to identify the positive impact of blended learning on the development of students' stress resistance. The results of the study can be used in educational institutions when choosing forms of learning and developing strategies to reduce stress factors on students during academic studies.

Limitations

The limitations of the article are related to the exclusive analysis of blended learning for reducing the impact of stress factors on students. This was due to the choice of effective approaches to the implementation of blended learning based on the adjustment of distance and classroom lessons. However, the impact of traditional learning was not considered, which is associated with the impact of external crisis factors. Therefore, it was impossible to organize a full-fledged traditional learning, which could affect the final results. Despite this, comparison of the students' results before and after training gave grounds to evaluate the traditional and blended approaches.

Recommendations

Blended learning is an effective approach to ensuring continuous learning in crisis situations for school administrators and teachers. The choice of learning strategies should be based on the academic programme, which provides an emphasis on the development of theoretical or practical skills. However, achieving the greatest effectiveness among students is possible due to an even distribution of classroom and distance learning.

Conclusion

Blended learning is a high-quality mechanism for students to achieve high results based on continuous learning. It eliminates emotional overload, interaction of all participants in the educational process, and a flexible approach to the perception of materials. The obtained results meet the set goal and confirm the advantages of blended learning for the development of students' stress resistance. For blended learning, classes were divided into classroom, distance learning, and independent learning. For students in Group 1, distance learning prevailed during training, which allowed them to achieve higher theoretical knowledge. For students in Group 2, classroom learning prevailed in the educational process, which contributed to better development of practical skills. During training, students used the digital platforms Canvas and Classtime, which contributed to the continuity of learning.

The study showed that blended learning had a positive impact on improving the level of students' stress resistance. For students in Group №1, the positive impact was primarily associated with decreased anxiety, for Group 2 — with an improvement in learning motivation. The obtained results are associated with the use of a qualitative approach to organizing learning, reducing social pressure on students. Respondents in Group 1 noted that the most favourable impact on

the development of stress resistance was the flexibility of the educational process, for students in Group 2 — the support of social ties. The use of digital tools that provided constant access to materials was also important for both groups of students.

The practical significance of the article is the confirmed advantages of blended learning for the development of students' stress resistance. The prospects of the study will be related to determining the quality of blended learning for students of the 1st and 4th year of the humanities based on the creation of hybrid learning strategies.

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