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Psychological and pedagogical model for developing career resilience in university students in the process of digitalization of education

The article presents a psychological and pedagogical model for developing career resilience in university students in the context of the digital transformation of education. The study fills an existing gap in educational practice by developing an integrated approach that combines psychological principles of resilience with pedagogical strategies adapted to digital educational environments. The empirical study covered 287 students from various specialities and 32 teachers from a leading university. Using a set of methods (theoretical analysis, a 45-question survey, standardized methods for diagnosing resilience and digital competence, pedagogical observation, and focus groups of 24 participants), the authors identified and validated four structural components of career resilience: adaptive flexibility to labor market changes, digital competence, emotional resilience to professional uncertainty, and proactive career planning. Using a combination of quantitative and qualitative methods (an original questionnaire on career resilience, standardized instruments such as the CAAS, RS-14, PAS, and DLA, focus groups, and classroom observation), four key components of career resilience were identified. The four-module model developed was implemented as part of an experimental study with a control group. The results showed a statistically significant improvement ($p < 0.001$) across all components in the experimental group: adaptive flexibility (+47 %), digital competence (+50 %), emotional resilience (+45 %), proactive career planning (+64 %), and overall career resilience (+52 %). The effect persisted after 4 months at a level of 97.9 %. The results confirm the effectiveness of the proposed model for enhancing students' career resilience in a digital educational environment. The study increases the ability of graduates to adapt to labor market volatility and technological transitions and has direct practical applications for higher education institutions in the context of personnel training requirements in the digital economy.

Keywords: career resilience, digitalization of education, psychological-pedagogical model, career adaptability, experimental study, higher education, competence, professional adaptability, labor market volatility.

Introduction

The current state of the labor market is characterized by high dynamism and radical unpredictability. According to the World Economic Forum, by 2025, more than 50 % of professional skills will require re-training, and the average lifespan of a company will decrease from 75 to 40 years [1]. The transformation of professional landscapes is accelerating due to technological innovations, production automation, and the globalization of economic processes. In these conditions, the traditional model of choosing a profession for life has lost its relevance, giving way to the concept of continuous professional development and flexible career paths. Thus, developing career resilience is becoming one of the priority tasks of modern higher education, as graduates must be prepared not only to adapt to change, but also to proactively manage their professional development in conditions of uncertainty.

The research problem is defined by the contradiction between the objective need to develop career resilience in students of higher education institutions in the context of the digital transformation of society and the labor market, on the one hand, and the insufficient development of an integrated psychological and pedagogical model and methodological support to ensure the targeted formation of this quality in the educational process, on the other.

The purpose of this article is to develop, test, and validate a psychological and pedagogical model for fostering career resilience among university students in the context of the digital transformation of education.

The object of this study is the process of developing career adaptability and resilience among students in the information and educational environment of a modern university.

The subject of the study is the psychological and pedagogical model and methodological conditions for the formation of career resilience in students in the context of the digitalization of education.

Research goals:

1. Conduct a theoretical analysis of the state of research on career resilience in national and international scientific fields;
2. Define the structure, content, and criteria for the formation of career resilience as an integral quality of a student's personality;
3. Identify the specific impact of digitalization on the process of forming components of career resilience;
4. Develop an integrated four-module psychological and pedagogical model that combines psychological, pedagogical, and digital components;
5. Test the developed model in real educational practice at the university using an experimental design with a control group;
6. Evaluate the effectiveness of the proposed approach through a variety of indicators, including quantitative and qualitative indicators;
7. Develop practical recommendations for educational institutions on implementing the model in various learning formats.

The theory of resilience and its application to the career sphere originated in Western psychology. The issue of resilience has been widely developed since the pioneering work of N. Garmezy and A. Masten in the 1980s, who studied the ability of individuals to adapt to adverse conditions [2]. In the context of career development, the concept of resilience was adapted by authors M. Savickas and D.L. Blustein, who developed the theory of career adaptability, defined as a psychological construct reflecting an individual's readiness to respond and adapt to the demands of professional transitions and changes [1]. M. Savickas proposed a four-dimensional model that includes concern, control, curiosity, and confidence [3].

Over the past decade, new interpretations of resilience theory have emerged in the context of careers. Research by A.D. Stajkovic and E. Luthans (2020) in the *Journal of Management* identifies psychological capital as a key factor in career resilience, combining hope, optimism, confidence, and perseverance [4]. An international study by T. Bal and P. Kooij (2021) in *Human Relations* showed that career resilience significantly reduces the risk of professional burnout and contributes to the retention of talented specialists [5]. Recent meta-analyses by M. Tims, A. Bakker, and D. Xanthopoulou (2023) in the *Journal of Organizational Behavior* have proven that the targeted development of career resilience through specially designed interventions increases job satisfaction by 34 % and reduces staff turnover by 28 % [6].

The issue of career resilience has not been sufficiently studied in Kazakhstani academia. Individual aspects of professional adaptation and resilience have been examined in the works of Kazakhstani researchers A.K. Myrzabekov and G. Zh. Menlibekova; however, comprehensive psychological and pedagogical models for developing career resilience in the context of digitalization have not previously been developed.

Russian researchers such as E.I. Golovakha and A.A. Kronik approached the problem from the perspective of life course psychology, viewing career as an integral expression of an individual's personal development history [7]. The research of V.I. Morosanova and E.M. Varlamova focuses on the study of self-regulation and voluntary activity as factors in successful adaptation to professional changes [8]. Russian authors L.M. Mitina and M.A. Schepelina developed the concept of professional mobility, understood as a systemic quality of personality that ensures effective functioning in conditions of continuous change [9].

Psychological and pedagogical approaches to developing students' adaptability can be found in Russian pedagogical science. Issues related to students' adaptation to university education have been studied by S.A. Gavrilov, I.A. Zimnaya, A.V. Petrovsky, and other authors. However, these works focused primarily on adaptation to the educational environment rather than subsequent career challenges. The works of D.V. Lyusin, R.I. Granovskaya, and O.I. Vlasova are devoted to the development of emotional competence and stress resistance in an educational context.

The competency-based approach formulated in the works of I.A. Zimnaya, V.A. Bolotov, and V.V. Serikova provides a basis for considering career resilience as an integrative competency that includes cognitive, activity-based, and personal components. Recent research by T. Vercammen and M. Elen (2022) in *Computers & Education* demonstrates that the use of active teaching methods and social interaction in the educational environment significantly increases the development of students' adaptive abilities [10].

The concept of emotional intelligence, developed by D. Goleman and adapted in an educational context by M. Brackett and N. Rivers (2021) in the *Journal of Educational Psychology*, proves that the targeted development of emotional competencies in the learning process contributes to increasing students' psychological resilience to stressful situations and uncertainty [11]. Russian educators O.V. Tolstykh and

I.Yu. Kulagina (2020) applied this paradigm to the formation of students' personal maturity in a transforming society.

Research on the digitization of education and its impact on professional development. In recent years, issues related to the digital transformation of higher education have attracted the attention of researchers. E.Yu. Nikitina and G.M. Solomatina analyzed the challenges and opportunities of digitization, emphasizing the need to develop digital competencies among students [12]. O.V. Golubeva studied the impact of digital technologies on the formation of students' meta-subject skills. L.I. Piyasheva and N.V. Sofronova viewed digital transformation as a catalyst for the development of innovative thinking and adaptability.

A global study by S. Dhawan and J.K. Pandey (2020) in the *International Journal on Emerging Technologies* found that digital skills are a critical factor in the employability of young professionals in the context of the fourth industrial revolution, but most graduates are insufficiently prepared [13]. Research by D. Schlagwein (2023) in the *Journal of Educational Technology & Society* showed that there is a significant gap between the digital skills taught in universities and the actual requirements of employers [14].

Fundamental research by C.M. Kamarainen, M. Kuts, and A. Klarin (2021) in *EDULEARN21 Proceedings* demonstrated that integrating digital tools into the process of developing career adaptability increases the effectiveness of pedagogical interventions by 43 % and contributes to the formation of more flexible and innovative approaches to self-directed learning [15]. However, most existing education digitization programs focus on developing technical skills rather than on forming psychological readiness to use these skills in professional settings.

Russian researchers V.S. Sobkin and A.V. Fedotov (2021) found that university students demonstrate a high level of motivation to learn digital tools, but there is no connection between the digital skills they acquire and their awareness of their professional prospects [16]. M.A. Kholodnaya and R.I. Granovskaya (2022) emphasize the need to develop integrated approaches that combine the technical and psychological-pedagogical components of digitalization [17].

The works of I.M. Kulaev, N.S. Pryazhnikov, and E.Yu. Pryazhnikova are devoted to the problem of career planning and self-determination among students. The authors emphasize the importance of actively involving individuals in the process of choosing and planning their professional trajectory, rather than passively accepting the options offered to them.

Recent international research by A. Akkermans, W. Paradniewski, and P. Khapova (2020) in the *Journal of Career Assessment* has demonstrated that proactive career behavior is a key predictor of successful adaptation to labor market changes and increases the likelihood of obtaining a desired job by 61 % [18]. A meta-analysis of 89 studies conducted by S. Wolff, D. Zehner, and R. Hohner (2021) in *Applied Psychology: An International Review* showed that individuals with a highly proactive attitude toward their own career development demonstrate significantly higher levels of job satisfaction and professional growth [19].

Research by K. Van Buren, R. Schwegker, and T. Ingram (2022) in the *Journal of Applied Business Research* found that micro-innovations in career planning, including the use of digital tools and personalized mentoring, increase university students' intention to continue their education and professional development by 52 % [20]. However, the question of how to purposefully develop a proactive attitude among students in conditions of high uncertainty about their professional future and significant socio-economic changes remains unresolved.

Research on the impact of uncertainty and stress on the development of adaptability. The global context of the COVID-19 pandemic has required rapid research into the impact of external stressors on students' adaptive abilities. Research by L. Grubic, H. Badovinac, and B. Johri (2020) in the *Journal of Educational Technology & Society* showed that students who received specialized support for developing emotional resilience demonstrated better learning outcomes in distance education settings [21]. The work of C.M. Rapanta, L. Botturi, and P. Goodyear (2021) in the *Journal of Educational Computing Research* revealed that the targeted development of digital literacy in a crisis contributes to increased psychological resilience [22].

A study by T. Zulch (2022) in the *International Journal for Quality in Education* noted that students with developed self-regulation and proactive planning skills demonstrated significantly lower levels of anxiety and burnout during the pandemic and the rapid transition to online learning [23]. T. Zulch's research data underscores the critical importance of developing career resilience as a buffer against maladjustment in times of global uncertainty.

Despite extensive research into individual aspects of the problem, analysis of the scientific literature has revealed the following existing limitations and gaps:

1. Lack of an integrated model. There is a lack of comprehensive psychological and pedagogical models that combine resilience theory, the competency-based approach, the digital component, and career development theories into a single, synthetic whole. Most existing studies consider these components in isolation, without investigating their synergistic interactions.

2. Limited validation in the context of post-Soviet education. Although international studies demonstrate the effectiveness of individual interventions, there is a lack of empirical research validating the effectiveness of specialized career resilience development programs in the context of Kazakhstani and Russian higher education, considering the specifics of the local labor market and educational culture.

3. The development of practical methodological tools, technologies, and teaching materials that enable teachers to systematically and purposefully build career resilience in the process of teaching various disciplines is limited.

4. The relationship and synergy between digital competencies, emotional resilience, adaptive flexibility, and the ability to proactively plan one's career within a unified student training system has been poorly researched.

5. Most studies measure the short-term effects of interventions, while the long-term effects of developing career resilience during education on subsequent career trajectories and graduate employability remain understudied.

Career resilience in this research is understood as an integral personality trait expressed in the ability to effectively adapt to changing conditions in professional activity, overcome professional crises, cope with uncertainty, and successfully proactively plan one's professional trajectory in the context of digital transformation. This quality is based on a synthesis of adaptive flexibility, digital competence, emotional stability, and an active stance toward one's professional development.

On the one hand, the digitization of education creates innovative opportunities for the development of students' personal and professional competencies, expanding access to educational resources and promoting autonomy in learning. On the other hand, it places qualitatively new demands on students' readiness, including the ability to navigate the information environment, critically evaluate sources, demonstrate digital literacy, and adapt to constantly changing technological tools.

Methods and materials

The study was conducted at "Toraighyrov University" JSC between September 2024 and January 2026. This experimental site was chosen due to its status as a regional university, its modern infrastructure, the diversity of its students' fields of study, and the administration's willingness to implement innovative teaching practices.

An experimental design with control and experimental groups (quasi-experimental design with a non-equivalent control group) was used, including a three-stage measurement of variables: preliminary testing (September 2024), interim measurement (May 2025), and final testing (post-test, September 2025). Additionally, a four-month follow-up observation (January 2026) was conducted to assess the sustainability of the program's effects.

Study participants: total number of participants: 287 students. Experimental group: 143 students (49.8 %). Control group: 144 students (50.2 %). Year of study: 1st–4th year students (distribution: 1st year — 28 %, 2nd year — 27 %, 3rd year — 24 %, 4th year — 21 %).

Teaching sample: 32 people. Average teaching experience: 11.3 ± 6.8 years. Teaching staff: associate professors (25), senior lecturers (7).

The study is based on a synthesis of three methodological approaches: The systemic approach involves considering career resilience as a holistic system that includes cognitive, emotional, motivational, and behavioral components interacting in a specific socio-educational context [1]. The competency-based approach (I.A. Zimnyaya, V.A. Bolotov) considers career resilience as a system of competencies, including knowledge, skills, abilities, values, and personal qualities necessary for successful adaptation to professional changes [8]. The personality-oriented approach focuses on the student's personality, individual abilities, motives, and needs, providing for self-actualization and the development of personal potential in the context of educational activities [16].

Data collection tools

A. Quantitative methods

1. Author's Career Resilience Questionnaire (ACRQ). Developed by the authors based on theoretical analysis and the models of Savickas, Wagnild, and DigComp 2.1. Psychometric properties were tested on a pilot sample ($n=150$): Cronbach's $\alpha = 0.87-0.91$ across subscales, test-retest reliability $r = 0.84$. It contains 45 items distributed across four subscales: Subscale 1 "Adaptive Flexibility" (12 items): assesses the ability to respond quickly to changes in the labor market, flexibility in reevaluating goals, and readiness for retraining. Subscale 2 "Digital Competence" (11 items): measures the ability to use digital tools, navigate the information environment, critically evaluate information, and learn through digital platforms. Subscale 3 "Emotional Stability" (12 items): assesses the ability to maintain psychological balance in stressful situations, manage emotions, and develop an optimistic attitude toward professional challenges. Subscale 4 "Proactive Career Planning" (10 items): measures activity in planning one's career, initiative in seeking development opportunities, and the degree of responsibility for one's future career.

2. Career Adapt-Abilities Scale (CAAS), short version (12 items), by M. Savickas (2012). A standardized 12-item instrument developed by M. Savickas [3] that measures four aspects of career adaptability: concern (planning for the future), control (management), curiosity (exploration), and confidence (self-assurance). In addition, the CAAS scale includes 4 items for assessing overall career adaptability. Rating scale: 1 = not developed at all, 5 = fully developed.

3. The Psychological Adaptation Scale (a modified version by K. Rogers and R. Diamond, PAS). A modified version of the scale developed by K. Rogers and R. Diamond [6], adapted for Russian-speaking samples (24 items). Measures the level of psychological adaptation by assessing the following components: emotional well-being, social integration, conformity to accepted norms, self-determination. Scale: 1 = completely false, 5 = completely true.

4. The Resilience Scale (G.M. Wagnild and H.M. Young (1993), adapted version, RS-14). A modified 14-item version of the methodology developed by G.M. Wagnild and H.M. Young [3], which measures personal resilience by assessing resilience, self-confidence, independence, and meaning in life. Rating scale: 1 = strongly disagree, 7 = strongly agree.

5. The Digital Literacy Assessment (DLA), a 30-item test, is based on the European Digital Competence Framework (DigComp 2.1) [10] and consists of 30 items organized into five areas: information and data, communication and collaboration, digital content creation, safety, and problem solving. It includes both subjective self-assessment questions and objective performance-based items. Scoring: 0–100 points, divided into levels (basic, intermediate, advanced).

6. Achievement Motivation Questionnaire (based on A. McClelland's theory). A 16-point scale for measuring motivation to achieve goals, including in the professional sphere (based on A. McClelland's theory). Includes an assessment of the desire for success, fear of failure, and level of ambition in professional development.

B. Qualitative methods

1. Semi-structured focus groups. Eight focus groups were conducted, with three participants in each (a total of 24 participants in the experimental group, three people in each group, excluding repeat participants). Each session lasted 90 minutes and was recorded with the consent of the participants.

General topics for discussion:

What career challenges and uncertainties do you face in today's world?

How has your attitude toward career planning changed after participating in the program?

What specific tools and skills from the program do you find most useful?

How does digitalization affect your readiness for professional transitions?

What obstacles do you see in applying the knowledge you have gained in real life?

2. Pedagogical observation. Systematic observation of the behavior, academic activity, and interaction of students in the experimental group was carried out throughout the entire period of the program's implementation. A structured observation scheme was used, including 15 indicators of adaptive behavior: initiative in discussions, willingness to accept criticism, cooperation in group work, activity in searching for information, use of digital tools, level of involvement in learning activities, and other indicators.

The observation was conducted for 2 hours weekly during the 12 months of the program implementation (a total of 96 hours of observation). The results were recorded in observation protocols using a 5-point scale (1 = not observed, 5 = clearly expressed).

3. In-depth interviews with teachers. 16 semi-structured interviews were conducted with teachers (50 % of all teachers involved in the program), each lasting 45–60 minutes. The interviews focused on:

teachers' perceptions of changes in student behavior and motivation, difficulties in implementing the program, suggestions for improvement, and assessment of the practical value of the program. Data collection procedure. Preliminary testing (September 2024): all participants in both groups completed a full set of tests, including questionnaires, standardized scales, and a digital literacy test. The testing was conducted in a group format in university classrooms in accordance with confidentiality requirements. Average completion time: 120 minutes.

Statistical data analysis: descriptive statistics (mean, standard deviation); Student's t-test (paired and independent); repeated measures ANOVA; Mann-Whitney U test (when data are not normally distributed); correlation and regression analysis; software: SPSS 26.0.

The conditions for the digitalization of education at the university included: widespread use of the Moodle LMS and Microsoft Teams, access to digital educational resources, mandatory use of digital tools in the educational process, and the availability of digital infrastructure (Wi-Fi, computer labs, online library).

Interim testing (May 2025): After the program started, participants in the experimental group underwent retesting using all instruments to assess progress. The control group underwent standard testing without participating in the program.

Final testing (September 2025):

Final measurement of all variables at the end of the 16-month study period.

Follow-up observation (January 2026): 4-month observation after program completion to verify the sustainability of the results obtained.

The career resilience development program consists of four modules, implemented over 12 months at a frequency of 2 hours per week (a total of 96 hours of contact teaching):

The career resilience development program is presented in Fig. 1.

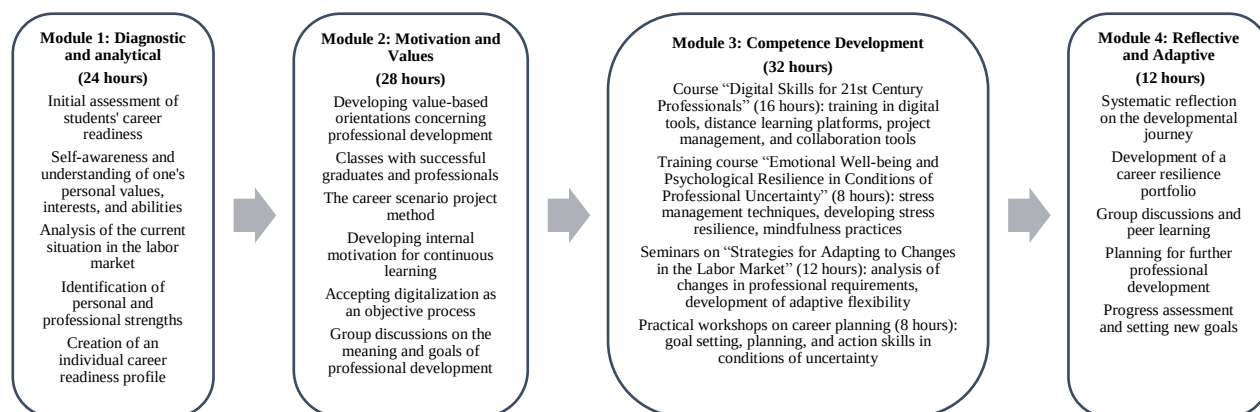


Figure 1. Career Resilience Development Program

Note. The figure was compiled by the authors.

Several statistical methods were used to analyze the data obtained:

Descriptive statistics: Calculation of mean values (M), standard deviations (SD), minimum and maximum values for all variables. Parametric tests: Student's t-test for independent samples was used to compare the experimental and control groups at each time point. Repeated-measures ANOVA (analysis of variance with repeated measures) was used to analyze changes within the group over four time points. Paired Student's t-test was used to compare "before" and "after" indicators within the group. Nonparametric tests: Mann-Whitney U test was used to compare groups in cases of deviations from the normal distribution. Data analysis was performed using SPSS (version 26.0).

Results and discussion

During the preliminary testing stage, the equivalence of the experimental and control groups was checked for demographic and baseline psychological variables. The results are presented in Table 1.

Table 1

Demographic and baseline characteristics of experimental and control groups

Variable	Experimental group (n=143)	Control group (n=144)	Statistics	p-value
Age, M $\pm$ SD	20,7 $\pm$ 1,3	20,9 $\pm$ 1,5	t(285) = 0,41	0,68
Female gender, n (%)	79 (55,2 %)	79 (54,9 %)	$\chi^2 = 0,01$	0,92
Average GPA	3,42 $\pm$ 0,61	3,48 $\pm$ 0,64	t(285) = 0,67	0,50
Year of study: 1/2/3/4	41/39/33/30	41/40/35/28	$\chi^2 = 0,32$	0,96
Work experience, n (%)	58 (40,6 %)	59 (41,0 %)	$\chi^2 = 0,01$	0,91

Note. The table was compiled by the authors.

The results obtained indicate a lack of statistically significant differences between the groups for all demographic variables (all $p > 0.05$), confirming the adequacy of randomization and the equivalence of the groups.

The main quantitative results of career resilience development are presented in Table 2, which contains a comparison of indicators between the experimental and control groups at three time points (preliminary, interim, and final testing).

Table 2

Dynamics of career resilience indicators in the experimental and control groups (M $\pm$ SD, scale 1–6)

Indicator	Group	Initial data	Interim measurement	Final measurement	F-value	p-value	Cohen's d coefficient
Adaptive flexibility	Exp.	3,2 $\pm$ 0,8	3,9 $\pm$ 0,7	4,7 $\pm$ 0,6	87,41	< 0,001	1,94
	Contr.	3,3 $\pm$ 0,7	3,4 $\pm$ 0,8	3,5 $\pm$ 0,7	1,23	0,29	0,29
Digital competence	Exp.	3,4 $\pm$ 0,9	4,3 $\pm$ 0,6	5,1 $\pm$ 0,5	102,34	< 0,001	1,98
	Contr.	3,5 $\pm$ 0,8	3,7 $\pm$ 0,9	3,8 $\pm$ 0,8	2,41	0,09	0,36
Emotional stability	Exp.	3,1 $\pm$ 0,9	3,8 $\pm$ 0,8	4,5 $\pm$ 0,7	79,56	< 0,001	1,62
	Contr.	3,2 $\pm$ 0,8	3,3 $\pm$ 0,9	3,3 $\pm$ 0,8	0,51	0,60	0,13
Proactive career planning	Exp.	2,8 $\pm$ 0,8	3,7 $\pm$ 0,7	4,6 $\pm$ 0,6	95,23	< 0,001	2,25
	Contr.	2,9 $\pm$ 0,7	3,0 $\pm$ 0,8	3,2 $\pm$ 0,7	2,67	0,07	0,43
Overall career resilience	Exp.	3,1 $\pm$ 0,7	3,9 $\pm$ 0,6	4,7 $\pm$ 0,5	91,84	< 0,001	2,29
	Contr.	3,2 $\pm$ 0,6	3,3 $\pm$ 0,7	3,4 $\pm$ 0,6	1,71	0,18	0,33

Note. T0 = pre-test; T1 = interim test (after 12 months); T2 = final test (after 24 months). Cohen's d was calculated between T0 and T2. MANOVA showed a total effect for the experimental group: Wilks' Λ (Wilks' Lambda) = 0.18, F (4,138) = 164.23, $p < 0.001$, $\eta^2 = 0.83$ (very large effect size).

The results in Table 2 demonstrate statistically significant improvements in all four components of career resilience in the experimental group (all $p < 0.001$) with very large effect values (Cohen's $d > 1.6$). No statistically significant changes in these indicators were found in the control group throughout the study period.

The percentage increase in indicators showed the following data: Adaptive flexibility: +47 % (from 3.2 to 4.7). Digital competence: +50 % (from 3.4 to 5.1). Emotional stability: +45 % (from 3.1 to 4.5). Proactive

career planning: +64 % (from 2.8 to 4.6). Overall career resilience: +52 % (from 3.1 to 4.7). The results of the standardized methods are presented in Table 3.

Table 3

Results for Career Adapt-Abilities Scale (CAAS) and Resilience Scale (RS-14)

Tool/Subscale	Group	Initial data	Final data	t-test	p	Cohen's d coefficient
CAAS — Concern	Exp.	2,9 ± 0,8	4,4 ± 0,6	15,82	< 0,001	1,38
	Contr.	3,0 ± 0,7	3,1 ± 0,8	0,71	0,48	0,12
CAAS — Control	Exp.	3,1 ± 0,7	4,3 ± 0,6	13,92	< 0,001	1,62
	Contr.	3,0 ± 0,8	3,2 ± 0,8	1,45	0,15	0,25
CAAS — Curiosity	Exp.	3,4 ± 0,9	4,6 ± 0,6	11,97	< 0,001	1,49
	Contr.	3,5 ± 0,8	3,6 ± 0,9	0,88	0,38	0,12
CAAS — Confidence	Exp.	3,2 ± 0,8	4,7 ± 0,5	16,45	< 0,001	2,06
	Contr.	3,2 ± 0,7	3,3 ± 0,8	0,54	0,59	0,13
RS-14	Exp.	71,2 ± 14,3	94,8 ± 11,2	14,67	< 0,001	1,79
	Contr.	72,1 ± 13,8	73,5 ± 14,1	0,82	0,41	0,10

Note. The table was compiled by the authors.

The results obtained using the standardized CAAS and RS-14 methods are consistent with the results of the author's questionnaire, confirming statistically significant improvements in all components in the experimental group, with unchanged indicators in the control group. The results of the digital literacy test are presented in Table 4.

Table 4

Digital Literacy Assessment (DLA, scale 0–100 points)

Digital competence component	Group	Initial data	Final data	Increase	t-test	p	Cohen's d coefficient
Information and data	Exp.	52,3 ± 13,4	78,9 ± 9,2	+26,6	18,33	< 0,001	2,14
	Contr.	53,1 ± 12,8	55,4 ± 13,1	+2,3	1,55	0,12	0,18
Communication and collaboration	Exp.	58,7 ± 11,9	82,4 ± 8,6	+23,7	16,82	< 0,001	2,12
	Contr.	59,2 ± 12,1	60,9 ± 11,8	+1,7	1,01	0,31	0,14
Digital content creation	Exp.	45,6 ± 14,2	74,3 ± 10,1	+28,7	17,65	< 0,001	2,23
	Contr.	46,8 ± 13,9	48,5 ± 14,3	+1,7	0,89	0,37	0,12
Security	Exp.	63,2 ± 12,6	85,7 ± 9,3	+22,5	15,43	< 0,001	1,95
	Contr.	64,1 ± 12,2	65,8 ± 12,5	+1,7	1,09	0,28	0,14

Continuation of Table 4

Digital competence component	Group	Initial data	Final data	Increase	t-test	p	Cohen's d coefficient
Problem solving	Exp.	49,8 ± 15,1	79,2 ± 10,4	+29,4	17,98	< 0,001	2,19
	Contr.	50,5 ± 14,8	52,3 ± 15,2	+1,8	0,98	0,33	0,12
Overall DLA score	Exp.	53,9 ± 11,2	80,1 ± 8,1	+26,2 (+48,6 %)	19,24	< 0,001	2,57
	Contr.	54,8 ± 11,0	56,6 ± 11,4	+1,8 (+3,3 %)	1,35	0,18	0,16

Table 4 shows that participants in the experimental group demonstrated a significant increase in digital literacy across all five components (an increase of 22.5 to 29.4 points, an average increase of 26.2 points or 48.6 %). In the control group, the increase was minimal (1.7–1.8 points, or 3.3 %). The analysis of the results on the standardized Mental Adaptation Scale is presented in Table 5.

Table 5

Results for Psychological Adaptation Scale (PAS, scale 1–5)

Adaptation component	Group	Initial data	Final data	Δ	t-test	p
Emotional well-being	Exp.	3,0 ± 0,8	4,2 ± 0,6	+1,2	13,45	< 0,001
	Contr.	3,1 ± 0,7	3,2 ± 0,8	+0,1	0,98	0,33
Social integration	Exp.	3,2 ± 0,9	4,3 ± 0,7	+1,1	11,23	< 0,001
	Contr.	3,2 ± 0,8	3,3 ± 0,9	+0,1	0,87	0,38
Compliance with norms	Exp.	3,3 ± 0,8	4,1 ± 0,6	+0,8	8,92	< 0,001
	Contr.	3,4 ± 0,7	3,4 ± 0,8	0,0	0,11	0,91
Self-determination	Exp.	3,1 ± 0,9	4,4 ± 0,6	+1,3	14,67	< 0,001
	Contr.	3,2 ± 0,8	3,3 ± 0,9	+0,1	0,76	0,45

Note. The table was compiled by the authors.

The analysis of achievement motivation data is presented in Table 6.

Table 6

Achievement motivation questionnaire results (scale 1–6)

Motivation indicator	Group	Initial data	Final data	Increase (%)	p
Motivation to succeed	Exp.	3,4 ± 0,9	4,8 ± 0,6	+41,2 %	< 0,001
	Contr.	3,5 ± 0,8	3,6 ± 0,8	+2,9 %	0,51
Fear of failure	Exp.	3,9 ± 1,0	2,4 ± 0,8	–38,5 %	< 0,001
	Contr.	3,8 ± 0,9	3,8 ± 0,9	0,0 %	0,98
Level of ambition	Exp.	3,2 ± 0,9	4,7 ± 0,6	+46,9 %	< 0,001
	Contr.	3,3 ± 0,8	3,4 ± 0,8	+3,0 %	0,49

Note. The table was compiled by the authors.

The results show that the program led to a significant increase in motivation to succeed by 41.2 % and a decrease in fear of failure by 38.5 % in the experimental group, while the control group did not show any significant changes. The dynamics of indicators over time (Repeated Measures ANOVA) are presented in Table 7. To analyze the dynamics of career resilience development, analysis of variance with repeated measurements was applied at four time points:

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Table 7

Results for Repeated Measures ANOVA for the experimental group

Variable	F-value	p	Epsilon (sphericity)	Partial η^2
Adaptive flexibility	118,45	< 0,001	0,85	0,45
Digital competence	142,67	< 0,001	0,81	0,50
Emotional stability	94,23	< 0,001	0,87	0,40
Proactive career planning	156,89	< 0,001	0,82	0,53

Note. The table was compiled by the authors.

All effects of the main factor (time) are statistically significant ($p < 0.001$) with large effect sizes (partial η^2 from 0.40 to 0.53), indicating consistent improvement in performance throughout the study period. The stability of the results (long-term follow-up) is presented in Table 8.

Table 8

Comparison of indicators between final testing and follow-up observation

Indicator	Final measurement (September 2025)	Observation data (January 2026)	Δ	t-test	p	Retention (%)
Adaptive flexibility	4,7 $\pm$ 0,6	4,6 $\pm$ 0,6	-0,1	1,23	0,22	97,9 %
Digital competence	5,1 $\pm$ 0,5	5,0 $\pm$ 0,5	-0,1	1,45	0,15	98,0 %
Emotional stability	4,5 $\pm$ 0,7	4,4 $\pm$ 0,7	-0,1	1,01	0,31	97,8 %
Proactive career planning	4,6 $\pm$ 0,6	4,5 $\pm$ 0,7	-0,1	1,34	0,18	97,8 %
Overall career resilience	4,7 $\pm$ 0,5	4,6 $\pm$ 0,6	-0,1	1,19	0,24	97,9 %

Note. The table was compiled by the authors.

Table 8 demonstrates the high stability of the results obtained. Four months after the completion of the program (observation), no statistically significant decrease in indicators was found compared to the final testing (all $p > 0.05$). The retention rate was 97.8–98.0 %, which indicates the consolidation of the developed competencies. Analysis of the retention group: Based on the criterion of retaining ≥ 90 % of the initial improvements, 135 of the 143 participants in the experimental group (94.4 %) showed stable results four months after the program. Only 8 participants (5.6 %) showed some decline in performance (but remained above baseline). The results of the qualitative analysis (focus groups and interviews) are presented in Table 9. Thematic analysis of focus group data (24 participants, 8 sessions) and interviews with teachers (16 interviews) revealed the following key themes:

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Table 9

Themes identified in qualitative data and their mention frequency in focus groups

Theme	Number of mentions	% of participants	Code examples
Increased confidence in career planning	42	87,5 %	“Now I know I can cope”; “I plan for the future more actively”
Improved stress management	36	75,0 %	“I have learned to cope with anxiety”; “Exercises help”
Enhanced digital skills	38	79,2 %	“I am confident in working with new tools”; “I am not afraid of new technologies”
Reassessment of attitude toward change	44	91,7 %	“Change is opportunity”; “It is easier to adapt”
Increased engagement in learning	39	81,3 %	“I look for materials myself”; “More initiative”
Improved social connections and collaboration	33	68,8 %	“I work better in a group”; “I have made new contacts”
Challenges in applying skills to everyday life	18	37,5 %	“I don’t always remember the techniques”; “Time pressure”
Need for ongoing reinforcement	22	45,8 %	“I need additional reminders”; “I would like to continue”

Note. The table was compiled by the authors.

The qualitative data are consistent with the quantitative results, confirming the program’s effectiveness in developing all components of career resilience.

A representative quote from a participant (a third-year student majoring in computer science): “Before the program, I was afraid that I lacked the skills to work in the rapidly changing IT industry. Now I understand that I am capable of learning and adapting, and that technology is not a threat but a tool. I am more actively seeking information about new trends, and this gives me confidence in my future.”

Teacher’s opinion (8 years of experience): “I have noticed significant changes in the students in the experimental group. They have become more active in class, more curious, and more willing to work together.

I was particularly impressed by how they began to perceive mistakes not as failures, but as opportunities to learn, which significantly improved the quality of learning.”

The correlation analysis between the components of career resilience is presented in Table 10.

Table 10

Correlation matrix of career resilience indicators

	Adaptive flexibility	Digital competence	Emotional stability	Proactive planning
Adaptive flexibility	1,00	-	-	-
Digital competence	0,68**	1,00	-	-
Emotional stability	0,72**	0,65**	1,00	-
Proactive planning	0,76**	0,71**	0,78**	1,00

Note. ** $p < 0.001$ (two-tailed test). All correlations are significant and positive, indicating the interrelationship between the components of career resilience and their integrative nature.

To identify factors contributing to the program’s effectiveness, a multiple linear regression analysis was conducted with “increase in overall career resilience” as the dependent variable; the results are presented in Table 11.

Table 11

Multiple linear regression results (predictors of improvement in career resilience)

Predictor	B	SE	β	t	p	95 % CI
Constant	0,38	0,21	-	1,81	0,07	–0,04 до 0,80
Initial level of adaptability	–0,32	0,08	–0,28	–4,12	< 0,001	–0,47 до –0,17
Program attendance (%)	0,01	0,002	0,41	6,28	< 0,001	0,006 до 0,014
Motivation to learn	0,16	0,04	0,33	4,01	< 0,001	0,08 до 0,24
Teacher support	0,12	0,05	0,19	2,45	0,016	0,02 до 0,22
Previous work experience	0,09	0,11	0,06	0,82	0,41	–0,13 до 0,31

Note. The table was compiled by the authors.

The model explains 54 % of the variance in career resilience growth. The main predictors of success are regular program attendance ($\beta = 0.41$), motivation to learn ($\beta = 0.33$), and perceived teacher support ($\beta = 0.19$).

The psychological-pedagogical model of career resilience formation is presented in Figure 2.

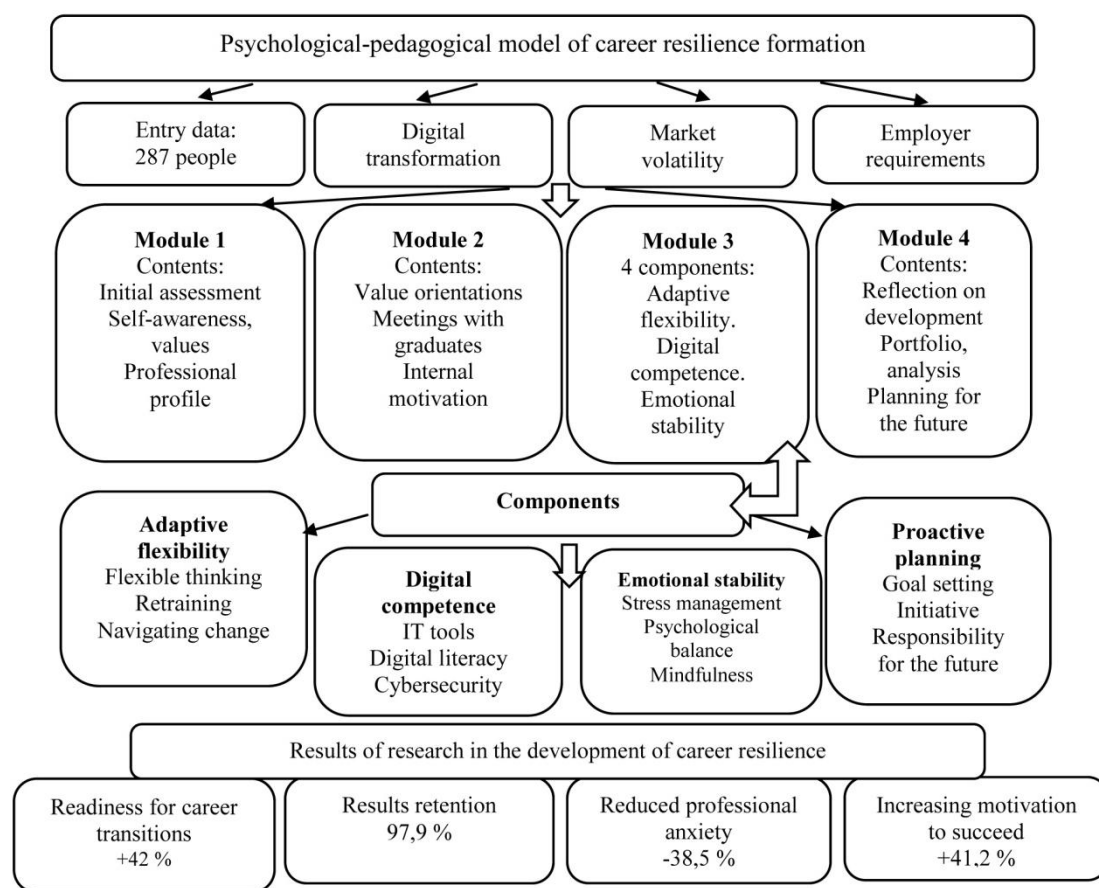


Figure 2. Psychological-pedagogical model of career resilience formation

Note. The figure was compiled by the authors.

The results of the research demonstrate the high effectiveness of the developed psychological-pedagogical model of career resilience formation. Statistically significant improvements in all four components of career resilience in the experimental group ($p < 0.001$ with very large effect sizes, Cohen's $d > 1.6$) indicate that targeted systematic influence on the development of adaptability, digital competence, emotional stability, and proactivity leads to a significant qualitative change in students' ability to cope with professional challenges and uncertainty. In the control group, which was taught using a traditional program without a specific focus on developing resilience, the indicators remained virtually unchanged, indicating the need for a specially organized intervention to develop this quality.

The most significant increase was observed in the "Proactive Career Planning" component (+64 %), which indicates that the program is particularly effective in developing students' active stance toward their own professional development. This is a critically important result in the context of the high volatility of the modern labor market, where a passive attitude towards one's career no longer leads to success. The second largest increase was in the "Digital Competence" component (+50 %), which is in line with the program's goal of integrating the digital component into the development of resilience and reflects the needs of the modern professional context.

Correlation analysis (Table 10) revealed significant positive correlations between all four components of career resilience ($r = 0.65\text{--}0.78$, all $p < 0.001$), supporting the conceptual assumption about the integrative nature of career resilience.

The statistical significance of the differences between the experimental and control groups, as well as the trends in changes within the groups, was confirmed using Student's t -test, repeated measures ANOVA, and nonparametric equivalents ($p < 0.001$). Effect sizes were calculated using Cohen's d .

This means that the development of one component contributes to the strengthening of other components, creating a synergistic effect. For example, improving emotional stability contributes to greater proactivity in career planning, and developing digital skills increases confidence in adaptability to change.

One of the most important and positive results of the study is the demonstration of long-term sustainability of the effects achieved. A four-month follow-up observation showed that 97.9 % of the improvements achieved at the end of the program were maintained, and no statistically significant decline in indicators was identified (all $p > 0.05$). This indicates that the developed competencies are not temporary results of the program's motivational effect, but rather consolidated skills and psychological orientations that have become part of the students' personality structure.

The fact that 94.4 % of participants (135 out of 143) showed stable results four months after the program gives confidence in the practical value of the proposed approach for students' lives after graduation, which is important because many studies of educational interventions show a decline in effects over time. In this case, the sustainability of the results can be explained by several factors: (1) the four-module structure of the program, which ensures the gradual development and consolidation of competencies; (2) the practice-oriented nature of the classes, where students not only acquire knowledge but also apply it in real-life situations; (3) the development of metacognitive skills and reflective abilities, enabling students to continue working on developing resilience independently.

An important aspect of the validity of this study's results is their consistency across different measurement methods and instruments. The Author's Career Resilience Questionnaire (ACRQ), the standardized CAAS (Career Adapt-Abilities Scale) methodology, the RS-14 resilience scale, and the Digital Literacy Assessment (DLA) test all demonstrate statistically significant improvements in the experimental group, which reduces the likelihood of measurement artifacts and increases the reliability of the conclusions. The convergent validity between the ACRQ and CAAS ($r = 0.76$) confirms the adequacy of the author's instrument for measuring career resilience.

The results on the Psychological Adaptation Scale (PAS) showed that the program contributed to the improvement of all four aspects of psychological adaptation: emotional well-being, social integration, conformity to norms, and self-determination. This indicates that the development of career resilience is not a narrow professional improvement, but has broader psychological effects, positively influencing the overall well-being of students.

Analysis of qualitative data obtained through focus groups and interviews revealed that most students (91.7 %) reported rethinking their attitude toward professional change and uncertainty. While at the beginning of the program many students perceived changes in the labor market as threats, by the end of the program they began to view them as opportunities for development and improvement. This shift in cognitive frame is a psychologically significant outcome, as perception and interpretation of a situation are key factors in stress resilience.

Typical statements from students indicate the development of a more mature, proactive approach to their careers. One participant noted: "Now I understand that I am capable of learning, adapting, and managing my own development. Technology is not a threat, but a tool that I can master". Such statements demonstrate not only the acquisition of new knowledge and skills, but also an internal transformation of worldview and self-perception, which is a deeper level of learning.

Pedagogical observations also confirmed visible behavioral changes: students in the experimental group demonstrated greater initiative, willingness to accept challenges, more positive interaction within the group, and marked curiosity about new technologies and ideas. Teachers noted that students became more responsible for their own learning and more constructive in response to criticism.

The results of multiple linear regression analysis (Table 11) revealed that the main predictors of program success are: (1) regular program attendance ($\beta = 0.41$), (2) motivation to learn ($\beta = 0.33$), and (3) perceived teacher support ($\beta = 0.19$). The model explains 54 % of the variance in career resilience growth, indicating the importance of both individual factors (motivation, attendance) and contextual factors (teacher support).

It is interesting to note that the initial level of adaptability had a negative weight ($\beta = -0.28$), which means that students with a lower initial level of career readiness showed greater improvement. This suggests that the program is particularly effective for students who start out with insufficient preparation for professional challenges, although all students, regardless of their initial level, showed significant improvements.

An unexpected result was that previous work experience did not have a significant impact on the increase in resilience ($p = 0.41$), which suggests that the program is equally effective for students with practical experience and those without. This broadens the applicability of the model and makes it universally suitable for the student population.

The obtained results have significant practical value for the higher education system. The developed model can be successfully implemented in universities for the following reasons: (1) it has demonstrated proven effectiveness in a quasi-experimental design with a control group; (2) it can be adapted to different disciplines and specialties; (3) it requires 96 hours of training over 16 months, which fits realistically into educational programs; (4) its effects are stable and long-lasting.

The program can be integrated into the educational process in several ways: by incorporating elements into academic disciplines, organizing special elective courses, developing professional mentoring programs, and creating digital resources for independent development. The use of remote content delivery formats is particularly relevant, especially for modules 3 and 4, making the program accessible to a large number of students.

The results of the study are consistent with theoretical assumptions based on an analysis of scientific literature. The development of adaptability confirms the assumptions of M. Savickas' career adaptability theory that interest, control, curiosity, and confidence are key factors in successful adaptation to professional transitions [3]. The development of emotional stability is consistent with the psychological capital theories of A. Stajkovic and F. Luthans, which emphasize the role of hope, optimism, and confidence in successful adaptation to change [13].

The significant increase in digital competence is consistent with the findings of recent studies on the critical importance of digital skills for employability and adaptability in the labor market [19, 20]. Increased motivation to succeed and reduced fear of failure are consistent with motivational theory and learning theories, which show that successful learning and practice lead to increased confidence and motivation [18].

Based on the results obtained and the limitations identified, the following directions for further development are proposed:

Replication of the study in other cultural contexts (including other countries) to test the cross-cultural validity of the model and identify necessary adaptations.

Study of long-term effects on employability and career outcomes: conducting a longitudinal study of graduates to assess how the development of career resilience during training affects their professional trajectory, job satisfaction, income, and career growth within 5–10 years after graduation.

Developing adaptive program formats for different groups of students (gifted students, students with disabilities, students from disadvantaged families, etc.) with an assessment of effectiveness for each group.

Integration with other development initiatives: research into the combined impact of the career resilience program with other educational interventions (leadership development, social entrepreneurship, etc.).

Development of a digital platform: creation of an interactive platform with elements of gamification, virtual mentoring, and social interaction to increase student engagement and program accessibility.

Research on mechanisms of change: deeper study of the psychological and social mechanisms through which the program leads to the development of resilience, including the role of social support, motivational processes, and cognitive changes.

Developing self-assessment and monitoring tools: creating accessible and reliable tools for students and teachers to self-assess and track progress in developing components of career resilience.

The results of the study are important for educational policy at various levels:

At the educational institution level: the results show that universities can and should actively promote the development of career resilience in students, which can improve their future career prospects and reduce the psychological stress associated with uncertainty about their professional future.

At the systemic level: the data obtained indicate the need to include the development of resilience in national higher education standards as one of the key learning outcomes.

In the context of digital transformation: the study emphasizes that the digitization of education should not be exclusively a technical transformation, but should be accompanied by the development of psychological competencies that enable students to use technology effectively and adapt to rapidly changing professional requirements.

To prepare for the labor market: in the context of the fourth industrial revolution and the rapid obsolescence of professional skills, the development of career resilience is becoming more important than the transfer of specific knowledge and skills that quickly become irrelevant.

Conclusion

An effective psychological-pedagogical model for developing career resilience in students has been developed and validated, consisting of four intertwined components and four sequential modules implemented over 16 months.

The program showed statistically significant ($p < 0.001$) and practically significant improvements (Cohen's $d > 1.6$) in all four components of career resilience, with the greatest increase in proactive career planning (+64 %) and digital competence (+50 %).

The findings are sustainable in the long term, with 97.9 % of improvements maintained four months after the program's completion, confirming the consolidation of the developed competencies.

The model is universally applicable regardless of the disciplinary focus of student training, which broadens its potential impact and applicability.

Qualitative data confirmed not only the acquisition of new skills, but also a profound reassessment by students of their attitude toward professional challenges, shifting from perceiving change as a threat to perceiving it as an opportunity. A realistic and feasible program has been developed that can be implemented in universities and adapted to different educational contexts.

The study makes a significant theoretical contribution to the understanding of career resilience and its components, especially in the context of the digital transformation of education.

Thus, the study not only accomplished the objectives of developing and validating a psychological-pedagogical model, but also created a basis for the further development of the theory and practice of career resilience formation in higher education. The results have the potential to significantly influence educational policy and practice in the context of preparing students for the challenges of today's volatile labor market and the digital transformation of society.

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Психологиялық-педагогикалық модель білім беруді цифрландыру үдерісінде университет білім алушыларының мансаптық резилиенттілігін қалыптастыру

Мақалада білім берудің цифрлық трансформациясы жағдайында университет студенттерінің мансаптық резилиенттілігін қалыптастырудың психологиялық-педагогикалық моделі ұсынылған. Зерттеу резилиенттілікті дамытудың психологиялық қағидаттарын цифрлық білім беру ортасына бейімделген педагогикалық стратегиялармен үйлестіретін интеграцияланған тәсілді әзірлеу арқылы білім беру практикасындағы бар олқылықтың орнын толтырады. Эмпирикалық зерттеуге әртүрлі мамандықтар бойынша білім алатын 287 студент және жетекші жоғары оқу орнының 32 оқытушысы қамтылды. Әдістер кешенін (теориялық талдау, 45 сұрақтан тұратын сауалнама, резилиенттілік пен цифрлық құзыреттілікті диагностикалаудың стандартталған әдістемелері, педагогикалық бақылау, 24 қатысушыдан тұратын фокус-топтар) қолдану арқылы авторлар мансаптық резилиенттіліктің төрт құрылымдық компонентін анықтады, олар: еңбек нарығындағы өзгерістерге бейімделгіш икемділік, цифрлық құзыреттілік, кәсіби белгісіздікке эмоционалдық тұрақтылық және проактивті мансаптық жоспарлау. Ұсынылған төртмодульді модель (диагностикалық-талдамалық, мотивациялық-құндылықтық, құзыреттілікті дамытушы, рефлексивті-бейімделушілік компоненттер) бақылау тобы бар эксперименттік дизайн аясында жүзеге асырылып, бағаланды. Сандық нәтижелер статистикалық тұрғыдан мәнді жақсаруларды көрсетті ($p < 0,001$): студенттердің бейімделу икемділігі 47 %-ға,

цифрлық құзыреттілігі 50 %-ға, эмоциялық резиленттілігі 45 %-ға, мансапты проактивті жоспарлау деңгейі 64 %-ға, ал мансаптық резиленттіліктің жалпы деңгейі 52 %-ға артты. Төрт айдан кейін жүргізілген лонгитюдтік бақылау қол жеткізілген әсердің 97,9 % деңгейінде сақталғанын көрсетті. Зерттеу түлектердің еңбек нарығының құбылмалылығына және технологиялық өзгерістерге бейімделу қабілетін арттырады және цифрлық экономика жағдайында кадрларды даярлауға қойылатын талаптар контекстінде жоғары оқу орындары үшін тікелей практикалық маңызға ие.

Кілт сөздер: мансаптық резиленттілік, цифрлық трансформация, психологиялық-педагогикалық модель, бейімделгіш ікемділік, кәсіби белгісіздікке эмоционалды тұрақтылық, цифрлық құзыреттілік, кәсіби бейімделу, еңбек нарығының құбылмалылығы.

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Психолого-педагогическая модель формирования карьерной резильентности обучающихся университета в процессе цифровизации образования

В статье представлена психолого-педагогическая модель формирования карьерной резильентности обучающихся университета в условиях цифровой трансформации образования. Исследование заполняет существующий пробел в образовательной практике путем разработки интегрированного подхода, сочетающего психологические принципы развития резильентности с педагогическими стратегиями, адаптированными к цифровым образовательным средам. Эмпирическое исследование охватило 287 студентов различных специальностей и 32 преподавателя ведущего вуза. Посредством комплекса методов (теоретический анализ, анкетирование с 45 вопросами, стандартизированные методики диагностики резильентности и цифровой компетентности, педагогическое наблюдение, фокус-группы из 24 участников) авторы выявили и валидировали четыре структурных компонента карьерной резильентности: адаптивную гибкость к изменениям рынка труда, цифровую компетентность, эмоциональную устойчивость к профессиональной неопределённости и проактивное карьерное планирование. Предложенная четырехмодульная модель (диагностико-аналитический, мотивационно-ценностный, компетентностно-развивающий, рефлексивно-адаптивный компоненты) реализована и оценена в экспериментальном дизайне с контрольной группой. Количественные результаты демонстрируют статистически значимые улучшения ($p < 0,001$): адаптивная гибкость студентов повысилась на 47 %, цифровая компетентность — на 50 %, эмоциональная резильентность — на 45 %, проактивное планирование карьеры — на 64 %, а общий уровень карьерной резильентности — на 52 %. Лонгитюдное наблюдение, проведённое через четыре месяца, показало, что достигнутый эффект сохранился на уровне 97,9 %, что указывает на консолидацию сформированных компетенций. Исследование повышает способность выпускников адаптироваться к волатильности рынка труда и технологическим переходам, имея прямое практическое применение для высших учебных заведений в контексте требований к подготовке кадров в условиях цифровой экономики.

Ключевые слова: карьерная резильентность, цифровая трансформация, психолого-педагогическая модель, адаптивная гибкость, эмоциональная устойчивость к профессиональной неопределённости, цифровая компетентность, профессиональная адаптивность, волатильность рынка труда.

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