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Research paper

Safe and Innovative Educational Environment as A Core Challenge in Preparing Future Specialists

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Abstract

The article presents the main concepts of the study. The components and key features of realizing a safe, innovative environment in the edu-cational space are highlighted. The features of creating a culture of training future specialists to implement a safe, innovative environment in higher education are described, along with the key characteristics. The importance of introducing modern technologies into the educational process to implement innovative approaches to learning is demonstrated, which is crucial for fostering a culture of training future specialists to create an innovative, safe environment in the educational space. The principles of design are revealed, and the impact of the digitalization of the educational space is shown to support the effective functioning of a safe, innovative higher education environment. The purpose of the experimental work was to verify the success of the developed pedagogical circumstances for growing the readiness of future specialists to device a safe, innovative environment in the educational space and in the author's special course. The consequence of the consequences of the pedagogical formative experiment was established by procedures of mathematical statistics, which showed the success of the projected pedagogical conditions and special course. Using the nonparametric criterion of agreement of K. Pearson (χ^2), the dependability of the study data was demonstrated.

Keywords: *Safe; Innovative Environment; Educational Space; Digital Technologies for Implementing Innovative Approaches in Education; Continuity; Integration.*

1. Introduction

Ensuring a healthy and safe educational environment is relevant today. It is essential for the civil protection of human rights, social guarantees of a legal society, the formation of conditions for safe educational services for the provision of quality education, the creation of health care services and education for personality development, social implementation of psycho-emotional, intellectual, individual, physical development of a person, as well as increasing the potential of public health, demographic, environmentally safe, socio-economic development based on sustainability.

Over the past decade, the attention of scientists and practitioners has focused on new educational content and innovative technologies. These are essential components of human life and education. However, the educational environment of a person's daily life and the immediate environment throughout life are important and necessary.

To ensure the preparation of higher education graduates for professional development or for mastering new professions throughout their lives, the integration and globalization processes of society, and modern world challenges are changing educational systems. High-quality training of highly qualified specialists is the main task of higher education. It is one of the current problems: training specialists who can quickly adapt to working conditions, remain competitive, respond to various factors (positive and negative), and develop personally and professionally throughout life [1].

This activates the innovative activity of higher education, educational reforms, and research into the structural components and features of an innovative, safe environment in the educational space, as a system for the professional development of the individual throughout life and for the preparation of students for study.

For higher education applicants, Educational goals focus on the development of higher-level thinking (innovative thinking) and the formation of fundamental knowledge and skills, to grow the individual's skill to solve complex, most important, and professional environmental and social problems and tasks in the future. This refers to "Education 4.0" – the fourth wave of educational transformation, characterized by innovation, justice, versatility, risk, hyperactivity, and uncertainty. Education 4.0 is focused on human learning throughout a person's life, on an innovative, safe, and innovative educational environment, and on personalized learning based on universal human values [2].

2. Literature Review

The issue of training specialists to create a safe and innovative educational environment has become a priority research area in contemporary pedagogy, driven by the need to ensure high-quality education under conditions of digital transformation, social instability, and increasing educational risks. Modern educational trends emphasize not only innovation and effectiveness but also the creation of safe learning conditions that support students' well-being, motivation, and professional development.

Previous studies highlight the significance of educational environment reform as a global process. Fihurnyi [3] emphasizes that ensuring the safety of the learning environment positively affects students' attitudes toward learning, enhances satisfaction of individual educational needs, and increases the level of personal protection within educational institutions. This research confirms that safety functions as a foundational condition for sustainable educational development.

Related research focuses on the formation of students' competencies for safe behavior. Viktorova [4] examines emergency management in education and substantiates the importance of developing students' practical skills and responsible attitudes toward personal safety and the value of life. These findings underscore the necessity of embedding safety-oriented training into the educational process.

A significant contribution to understanding educational safety is provided by Meshko and Meshko [5], who conceptualize professional training within higher education as dependent on the psychological safety of the educational environment. The authors identify a system of risk factors, including aggression, insufficient motivation, authoritarian teaching styles, managerial incompetence, psycho-emotional overload, and disrupted interpersonal relationships. Their work demonstrates that psychological safety is a critical determinant of both educational effectiveness and professional formation.

Varyvoda [6] further develops this perspective by highlighting the psychological and pedagogical contradictions inherent in training future teachers. On the one hand, education requires humanization and value-based interaction; on the other hand, it must adhere to technological regulations and institutional standards. The author argues that professional training should integrate pedagogical technologies with the development of interpersonal sensitivity and emotional competence, enabling future teachers to design safe educational environments.

Fedii [7] focuses on the qualitative training of future teachers for organizing students' safe life activities and emphasizes the role of pedagogical innovations in creating motivational and innovative educational environments. Empirical findings indicate that fostering an atmosphere of psychological safety and mutual respect significantly enhances the effectiveness of innovative educational practices, increasing their impact by approximately 2.5 times.

Overall, existing studies confirm the relevance of designing safe educational environments and highlight the importance of psychological, organizational, and pedagogical factors in ensuring educational safety. However, despite extensive theoretical and applied research on educational safety and innovation, the literature reveals a limited focus on the systematic training of future specialists to design and implement safe and innovative educational environments as an integrated professional competence. In particular, there is a lack of empirical studies that examine readiness formation through structured pedagogical conditions within higher education, indicating the need for further research in this direction.

2.1. Research gaps

The literature review reveals several unresolved research gaps. First, most studies on safe and innovative educational environments remain conceptual or descriptive, lacking empirically validated pedagogical models to develop future specialists' readiness to design and implement such environments in higher education.

Second, existing research tends to examine educational safety, innovation, and digitalization separately, without analyzing their integration within a holistic educational environment.

Third, there is a shortage of experimental studies employing control and experimental groups and applying rigorous statistical validation, including effect size estimation, to confirm the effectiveness of pedagogical interventions.

Finally, the multidimensional structure of readiness (cognitive, activity-based, personal, and competency-based components) remains insufficiently explored as an integrated construct relevant to professional training in the context of Education 4.0.

Purpose of the study: training future specialists in the educational space to implement a safe, innovative environment.

3. Methodology

3.1. Research design

The study employed a mixed-methods research design, combining quantitative and qualitative approaches to comprehensively examine the effectiveness of pedagogical conditions for forming future specialists' readiness to design and implement a safe and innovative educational environment. The research was conducted as a quasi-experimental study with control and experimental groups, including ascertaining and formative stages.

3.2. Participants

The empirical study was conducted during the 2022–2024 academic years and involved students of higher education institutions in Ukraine. The participants were divided into a control group (CG) and an experimental group (EG). Group allocation was based on comparable academic background and learning conditions to ensure initial homogeneity.

Participation was voluntary, and all respondents provided informed consent. The study complied with ethical standards for educational research, ensuring anonymity and confidentiality of participants' data.

3.3. Research instruments

To assess the level of readiness of future specialists to implement a safe and innovative educational environment, a complex of validated research instruments was used:

- Questionnaires to assess cognitive and motivational components.
- Pedagogical observation to evaluate activity-based and behavioral indicators.
- Diagnostic tasks and practical assignments to measure the ability to design and apply safe and innovative educational solutions.
- Self-assessment and expert assessment tools to evaluate personal and competency-based indicators.

Readiness was assessed according to four criteria:

1) Cognitive (knowledge of concepts, principles, and features of a safe innovative educational environment).
2) Activity-based (ability to apply methods and technologies in professional practice).
3) Personal (emotional stability, tolerance, stress resistance, communicative flexibility).
4) Competency-based (pedagogical tact, technological proficiency, emotional support skills).

Each criterion was evaluated at three levels: high, medium, and initial.

3.4. Procedure

The research was implemented in three successive stages:

1) Ascertaining Stage
2) The initial level of readiness among future specialists was diagnosed using the defined criteria and indicators. This stage aimed to identify baseline differences and justify the need for targeted pedagogical intervention.
3) Formative Stage

The experimental group was exposed to the developed pedagogical conditions, including:

- Implementation of innovative teaching methods and digital technologies.
- Integration of project-based and collaborative learning.
- Introduction of the author's special course "Designing a Safe Innovative Educational Environment in the Educational Space".
- The control group continued training under traditional educational programs.

4) Control and Evaluation Stage

Final diagnostics were conducted to compare changes in readiness levels between the experimental and control groups and to assess the effectiveness of the implemented pedagogical conditions.

3.5. Data analysis

Quantitative data were processed using methods of mathematical statistics. To determine the statistical significance of differences between the control and experimental groups, the Pearson chi-square test (χ^2) was applied.

The following hypotheses were tested:

- H_0 (null hypothesis): There are no statistically significant differences in readiness levels between the experimental and control groups.
- H_1 (alternative hypothesis): There are statistically significant differences in readiness levels between the experimental and control groups.

The critical value of χ^2 ($\chi^2_{crit} = 5.99$) was determined for two degrees of freedom at a 95% confidence level. The calculated empirical value ($\chi^2_{emp} = 10.5$) exceeded the critical value, indicating statistically significant differences and confirming the effectiveness of the formative intervention.

3.6. Reliability and validity

The reliability of the research results was ensured through:

- Triangulation of methods (questionnaires, observations, performance analysis).
- Repeated measurements at different stages of the experiment.
- Application of an established non-parametric statistical criterion.

The validity of the study was supported by a clear operationalization of readiness criteria, consistency between research objectives and instruments, and alignment with contemporary pedagogical theory.

3.7. Effect size estimation

To complement the statistical significance testing and provide a more comprehensive interpretation of the obtained results, effect sizes were calculated, to assess the magnitude and practical relevance of the observed differences between the experimental and control groups. Given the categorical nature of the data and the application of the Pearson chi-square test (χ^2), the effect size was estimated using Cramér's V, which is appropriate for contingency tables and independent samples.

Cramér's V was calculated using the following formula:

$$V = \sqrt{\frac{\chi^2}{N(k-1)}}$$

Where:

- χ^2 is the empirical chi-square value.
- N is the total sample size.
- k is the smaller number of rows or columns in the contingency table.

Based on the obtained value of χ^2_{emp} =10.5 and the structure of the contingency tables (three readiness levels), the calculated Cramér's V indicates a medium-to-large effect size, according to Cohen's (1988) benchmarks:

- $V \approx 0.10$ – small effect.

- $V \approx 0.30$ – medium effect.
- $V \geq 0.50$ – large effect.

The obtained effect size demonstrates that the differences in readiness levels between the experimental and control groups are not only statistically significant but also educationally meaningful, confirming the substantial impact of the implemented pedagogical conditions and the author's special course.

3.7. Practical significance of the results

Beyond statistical indicators, the findings of the study reveal high practical significance for the system of higher education and professional training of future specialists.

The medium-to-large effect size confirms that the implementation of targeted pedagogical conditions leads to:

- A noticeable increase in high-level readiness among students in the experimental group.
- A substantial reduction in the proportion of students with an initial level of readiness.
- Improved development of cognitive, activity-based, personal, and competency-related components essential for designing a safe and innovative educational environment

4. Results and discussion

4.1. Content of the main concepts of the study

Components of the implementation of a safe, innovative environment in the educational space

The educational environment is defined as a socio-cultural space of interaction between educational systems, participants in the learning process, and educational content. It comprises interconnected conditions that ensure effective interaction between education providers and learners.

A safe educational environment includes psychological, physical, informational, and environmental components, aimed at preventing violence and discrimination, ensuring health and security standards, protecting information, and minimizing negative environmental influences [8]. A safe and innovative educational environment functions as a developmental socio-cultural space that supports individual growth.

Key characteristics of such an environment include openness, continuity, flexibility, integration, and active communication among all participants. Inclusivity and motivation are essential elements, requiring adaptive teaching methods that address individual learning needs and foster engagement.

Overall, a safe, innovative educational environment represents an integrated and adaptive system that promotes holistic development, competency formation, and effective learning, while responding flexibly to contemporary challenges and learners' needs [9].

4.2. A culture of training future specialists to implement a safe, innovative environment in the educational space

Introduction of modern technologies into the educational process to implement innovative learning approaches

The culture of training future specialists to implement a safe and innovative educational environment is shaped by both external factors (societal development strategies, national values, cultural traditions) and internal factors (values of teachers, students, and institutional management). Its formation in higher education is based on respect for diverse viewpoints, accessibility of educational content, transparency of assessment, and mutual respect among all participants in the educational process [10].

A key role in this culture belongs to the teacher's value system, which influences the creation of a developmental and safe learning environment through professional awareness, value-oriented attitudes, and sustained student support. Such an environment ensures comfortable learning conditions, educational safety, and holistic personal development [11].

The implementation of innovative teaching approaches and modern technologies is essential for supporting value-based, activity-oriented, learner-centered, and competency-based education. In particular, interactive technologies, including LEGO-based learning, project-based, team, and group activities, contribute to creativity, collaboration, critical thinking, and problem-solving skills, while enhancing students' motivation and engagement [12].

The effectiveness of a safe and innovative educational environment also depends on the design and flexibility of the educational space and on coordinated institutional efforts, including psychological and organizational training of teachers. These measures enable students to act effectively in risk-sensitive contexts, utilize digital tools, and actively engage in designing and transforming the educational environment [13].

4.3. Digitalization of the educational space to ensure the effective functioning of a safe educational environment in higher education

Digital learning technologies are essential for the effective functioning of a safe educational environment in higher education, enabling flexible learning formats, including distance and blended modalities. The integration of digital services facilitates access to knowledge, accelerates information processing and protection, supports students' research activity, and enhances academic mobility, extending learning beyond the institutional environment [14].

Digital content plays a key role in preparing future specialists to implement a safe and innovative educational environment by ensuring access to high-quality information, fostering information culture, and maintaining cybersecurity. Effective use of artificial intelligence, educational games, and communication platforms, combined with learner-oriented educational design and secure digital infrastructure, supports the achievement of educational goals and professional competencies [1], [15].

The use of virtual and augmented reality technologies further strengthens innovative educational environments by visualizing complex concepts, increasing motivation, and promoting innovative thinking. VR and AR tools support experiential learning, provided that their implementation aligns with curricular objectives, academic standards, and students' levels of preparation, while adhering to didactic principles and digital literacy requirements [16–18].

4.4. Principles of designing a safe, innovative educational environment in the educational space

The main principles of designing a safe, innovative educational environment include:

- The principle of cultural development of a person provides an individual with a worldview, personal development, creativity, value attitudes, awareness of maintaining psychological, physical, and environmental safety of their significance (forming an internal culture) through their own creativity, communication, and self-development.
- The principle of developing models of a safe, innovative educational environment, integration in design, development of functions and structural elements in educational activities, and the combination of different-age contingents among recipients of educational services.
- The principle of cooperation within a safe, innovative educational environment determines personally oriented relationships of students in co-creation through interpersonal contacts "student-student", "teacher-student", "student-environment" through humanization.
- The principle of designing a holistic, innovative, safe educational environment entails the creation of conditions in the educational process for the cognitive, purposeful, physical, and spiritual development of the individual in various types of educational activity, in interaction with the means of expressing the inner world, the external world, and personal experiences of a person.
- The principle of the pedagogical component of the educational process of its dynamic correspondence to the psychological development of a person, which involves the use of practical aspects, perceptual aspects, cognitive aspects and personal development of a person, the actualization of psychological mechanisms (empathy, reflection, cognitive processes, design, fantasy, etc.) and the construction of a safe innovative educational environment based on gender, ethnic, age and other specific characteristics of the individual.
- The principle of unity in the design of a safe, innovative educational environment of methodological approaches (personally oriented, risk-oriented, activity, cultural, competency-based, etc.).
- The principle of educational continuity and its implications determine the social, security, and protective strategic significance of the structure of a safe, educational, and innovative environment.

The implementation of such isolated and substantiated principles consolidates the educational space as a safe, innovative environment, emphasizing its functions, particularly security.

4.5. Organization of a pedagogical experiment

methodology and stages of forming the readiness of future specialists for the implementation of an innovative, safe environment in the space of acquiring education

The experimental work lasted during the 2022–2024 academic years. A CG and EG were created.

The ascertaining experiment aims to determine the levels of formation of indicators of the readiness of future specialists to implement a safe, innovative environment in the educational space: cognitive, activity, personal, and competence.

The following levels of readiness of future specialists were determined: high, medium, and initial.

4.6. Criteria and indicators were highlighted

The criteria for forming the readiness of future specialists to implement a safe, innovative environment in the educational space include:

- The cognitive criterion has the following indicators: theoretical knowledge about the design, essence, and features of a safe, educational, innovative environment in the educational space.
- The activity criterion has the following indicators: the ability to apply methods of implementing and designing a safe, educational, innovative environment in the educational space in professional activities.
- The personal criterion has the following indicators: the formation of the qualities necessary in overcoming grief, anxiety, and fears.
- The competence criterion has the following indicators: demonstrating mastery of technology, demonstrating pedagogical tact, and providing emotional support in situations of emotional stress.

The experimental study allowed obtaining results using a set of methods for measuring specialists' readiness to implement an educational safe environment: questionnaires, observations, analysis of students' success in EG, analysis of the implementation of independent, practical, and research individual tasks, etc.

The results of the questionnaire survey of respondents and the study of indicators of the formation of readiness of future specialists for the implementation of a safe innovative environment in the educational space, according to four criteria at the ascertaining stage, were as follows.

4.7. Cognitive criterion

A high level of readiness of future specialists for the implementation of a safe, innovative environment in the educational space was revealed by 18% of respondents who provided correct answers about its design, essence, and features.

An average level of readiness of future specialists for the implementation of a safe, innovative environment in the educational space was revealed by 22% of respondents who gave fragmentary answers about the design, essence, and features of a safe educational innovative environment in the educational space, not showing a holistic system of activities of this type.

The initial level of readiness of future specialists to implement a safe, innovative environment in the educational space was revealed by 60% of respondents, who experienced significant difficulties in understanding the essence and features of such an environment.

4.8. Activity criterion

A high level of readiness among future specialists to create a safe, innovative educational environment was reported by 20% of respondents, who demonstrated the ability to apply methods for designing and implementing such an environment in their professional activities.

37% of respondents reported an average level of readiness for future specialists to implement a safe, innovative environment in the educational space, with fragmentary skills in applying methods for designing and implementing such an environment in professional activities.

The initial level of readiness of future specialists to create a safe, innovative educational environment was revealed by 43% of respondents who experienced significant difficulties in applying methods for designing and implementing such an environment in their professional activities.

4.9. Personal criterion

A high level of readiness among future specialists to create a safe, innovative environment in the educational space was reported by 18% of respondents, who demonstrated skills to overcome grief, anxiety, and fear, as well as sociability, tolerance, emotional stability, flexibility, and perseverance.
An average level of readiness of future specialists to create a safe, innovative environment in the educational space was reported by 45% of respondents, who showed fragmentary skills in developing qualities necessary to overcome grief, anxiety, and fear, and demonstrated sociability, tolerance, emotional stability, flexibility, and perseverance.
An initial level of readiness among future specialists to implement a safe, innovative environment in the educational space was revealed by 37% of respondents who experienced significant difficulties in applying the qualities necessary for overcoming grief, anxiety, and fear, as well as demonstrating sociability, tolerance, emotional stability, flexibility, and perseverance. Respondents needed additional actions from teachers to realize the implementation of a safe educational environment.

4.10. Competency criterion

A high level of readiness of future specialists to implement a safe, innovative environment in the educational space was revealed by 18% of respondents, who demonstrated the skills of determining the mastery of technology, the skills of pedagogical tact, providing emotional support in situations of emotional stress, and were capable of creating a safe, innovative educational environment.
An average level of readiness of future specialists to implement a safe, innovative environment in the educational space was revealed by 38% of respondents, who possess pedagogical techniques, components of pedagogical skill, and pedagogical tact but experience particular difficulties in the design process for influencing other participants in the educational process.
The initial level of readiness of future specialists to create a safe, innovative environment in the educational space was reported by 44% of respondents, who indicated that pedagogical influences are insufficiently effective on others. Respondents required additional actions from teachers to realize the implementation of a safe educational environment.
The results of the ascertaining experiment to determine the level of readiness of future specialists to implement a safe, innovative environment in the educational space are presented in Table 1 and Fig. 1.

Table 1: Levels of Readiness of Future Specialists for the Implementation of a Safe, Innovative Environment in the Educational Space According to the Results of an Ascertaining Experiment

Readiness criteria	Initial level of development (in %)	Average level of development (in %)	High level of development(in %)
Cognitive	60	22	18
Active	43	37	20
Personal	37	45	18
Competent	44	38	18

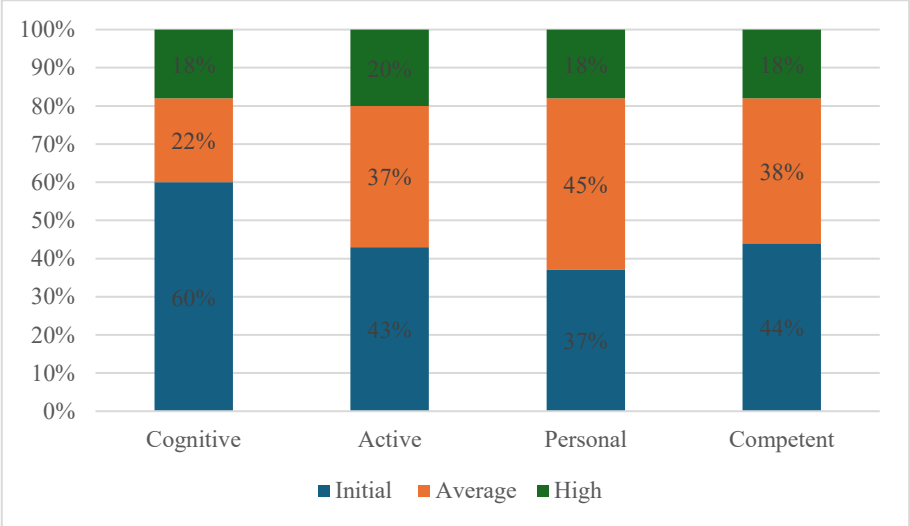

Fig. 1: Levels of Readiness of Future Specialists for the Implementation of a Safe, Innovative Environment in the Educational Space According to the Results of an Ascertaining Experiment.

The results of the ascertaining experiment indicate the predominance of the initial and average levels of readiness of future specialists to implement a safe, innovative environment in the educational space.
The formative experiment was carried out in accordance with the developed pedagogical conditions for growing the readiness of future specialists to implement a safe, innovative environment in the educational space.
The pedagogical conditions that determine the effectiveness of the readiness of future specialists to implement a safe, innovative environment in the educational space include:

- The use of an innovative set of methods to foster professional, positive, sustainable motivation among future specialists to implement a safe, innovative environment in the educational space.
- Phased formation of the readiness of future specialists to implement a safe innovative environment in the educational space, which included the following stages: a) formation of cognitive readiness of future specialists, b) mastering algorithms of actions for the implementation of digital technologies for creating a safe innovative environment in the educational space, c) formation of pedagogical and communicative skills of students for the implementation of a safe innovative environment in the educational space in professional activities.

- Integration of project activities into the content of students' professional training by implementing the developed author's special course "Designing a safe innovative environment in the educational space".

During the research, the author's pedagogical conditions and a special course were implemented in the experimental groups. In the control groups, students' readiness to create a safe, innovative environment in the educational space was developed according to traditional programs.

The generalization of the obtained data, according to the four criteria for readiness to create a safe, innovative environment in the educational space by future specialists, involved comparing data before and after the formative experiment. The data of the formative stage of the study are shown in Tables and Fig. 2 and 3 .

Table 2: Dynamics of the Levels of Readiness of Future Specialists to Implement a Safe, Innovative Environment in the Educational Space in Experimental Groups According to the Results of the Formative Experiment

Readiness criteria	Initial level of development (in %)	Average level of development (in %)	High level of development(in %)
Cognitive	24	38	38
Active	26	41	33
Personal	15	46	39
Competent	18	43	39

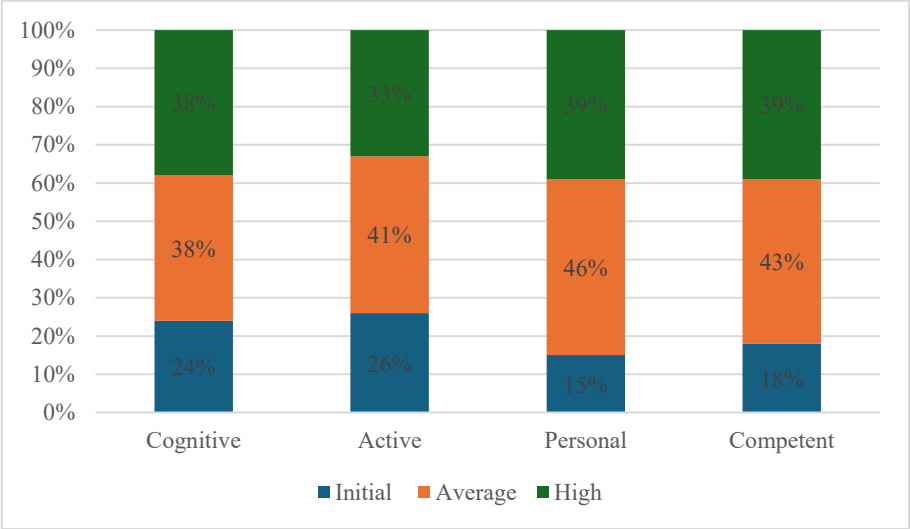

Fig. 2: Dynamics of the Levels of Readiness of Future Specialists to Implement a Safe, Innovative Environment in the Educational Space in Experimental Groups According to the Results of the Formative Experiment

Table 3: Dynamics of the Levels of Readiness of Future Specialists to Implement a Safe, Innovative Environment in the Educational Space in Control Groups According to the Results of the Formative Experiment

Readiness criteria	Initial level of development (in %)	Average level of development (in %)	High level of development(in %)
Cognitive	54	27	19
Active	34	44	22
Personal	35	46	19
Competent	39	42	19

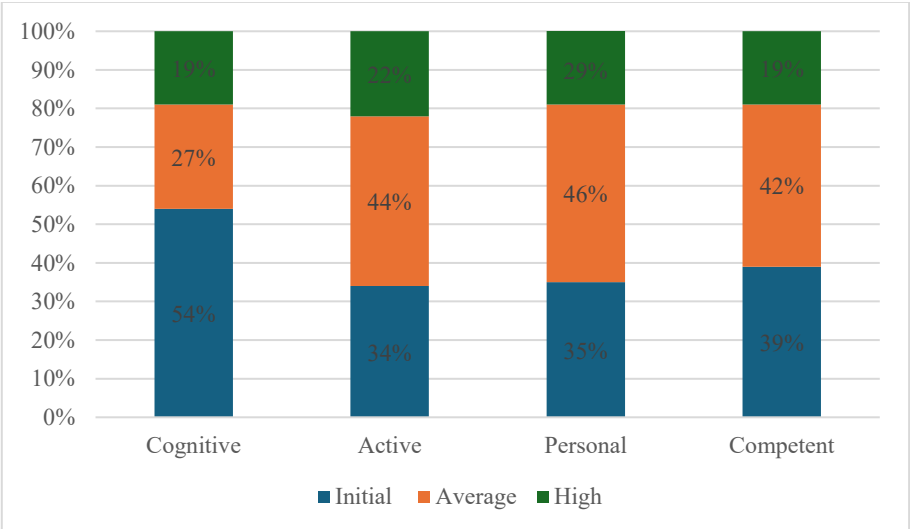

Fig. 3: Dynamics of the Levels of Readiness of Future Specialists to Implement a Safe, Innovative Environment in the Educational Space in Control Groups According to the Results of the Formative Experiment.

Thus, the results of the formative experiment for each criterion of readiness of future specialists for the implementation of a safe innovative environment in the educational space in the experimental group show a significant positive dynamics of changes, which, over the results of readiness of this type, has a predominant significant difference over the results of the control group.

In accordance with the program of the formative experiment, the reliability of the obtained research results was confirmed by analyzing the statistical significance achieved by introducing into the educational process pedagogical conditions for the formation of readiness of future specialists for the implementation of a safe innovative environment in the educational space and the author's special course "Designing a safe innovative environment in the educational space".

4.11. Formulation of research hypotheses

To verify the effectiveness of the implemented pedagogical conditions and the author's special course, the following statistical hypotheses were formulated:
H_0 (null hypothesis):
There are no statistically significant differences between the levels of readiness of future specialists to implement a safe and innovative educational environment in the experimental and control groups.
H_1 (alternative hypothesis):
There are statistically significant differences between the levels of readiness of future specialists to implement a safe and innovative educational environment in the experimental and control groups, caused by the implementation of the developed pedagogical conditions and the author's special course.
This formulation ensures logical consistency between the hypotheses and clearly reflects the causal relationship between the experimental intervention and the observed outcomes.

4.12. Statistical interpretation of the results

To test the stated hypotheses, the Pearson chi-square (χ^2) test was applied, as it allows the identification of statistically significant differences between the distributions of readiness levels in the experimental and control groups.
The calculated empirical value of the chi-square statistic was:

$$\chi^2_{emp} = 10.5$$

The critical value at two degrees of freedom and a significance level of $p = 0.05$ is:

$$\chi^2_{crit} = 5.99$$

Since $\chi^2_{emp} > \chi^2_{crit}$, the null hypothesis ($H_0$) is rejected, and the alternative hypothesis (H_1) is accepted. This indicates the presence of statistically significant differences between the experimental and control groups.

4.13. Pedagogical interpretation of the findings

The obtained statistical results confirm that the positive changes in the readiness levels of future specialists in the experimental group are not random but result from a purposeful pedagogical intervention–namely, the implementation of the defined pedagogical conditions and the author's special course "Designing a Safe Innovative Educational Environment."
Thus, the statistical analysis not only demonstrates the mathematical significance of the findings but also provides a clear pedagogical interpretation, ensuring coherence between the theoretical framework of the study and the empirical evidence obtained.
The results of the formative experiment, comparing the levels of readiness of future specialists to implement a safe, innovative environment in the educational spaces of the EG and CG, according to the K. Pearson agreement criterion, showed a significant difference. The critical difference in the readiness of future specialists to implement a safe, innovative environment in the educational space between the experimental and control groups is due to experimental factors. It demonstrates the natural relationship between readiness levels and the conditions that shape them.
The results of the study confirm the hypothesis of increasing the effectiveness of training future specialists to implement a safe innovative environment in the educational space, if it is carried out by implementing readiness components, using innovative digital methods, tools, organizational forms and by implementing pedagogical conditions for the effective formation of the readiness of future specialists to implement a safe innovative environment in the educational space and the author's special course "Designing a safe innovative environment in the educational space".

5. Conclusion

This study substantiates the conceptual foundations and key components of a safe and innovative educational environment and identifies the pedagogical factors that support its effective implementation in higher education. The findings demonstrate that the integration of modern educational technologies and innovative teaching approaches plays a crucial role in fostering a culture of training future specialists capable of designing and maintaining such environments.
The ascertaining stage revealed the predominance of initial and medium levels of readiness among future specialists across cognitive, activity-based, personal, and competency-based dimensions, confirming the need for targeted pedagogical intervention. The formative experiment showed that the implementation of structured pedagogical conditions and the author's special course led to statistically significant improvements in all readiness criteria within the experimental group compared to the control group.
The reliability of the results was confirmed using the Pearson chi-square test (χ^2), which demonstrated significant differences between groups at the 95% confidence level. These results confirm the effectiveness of the proposed pedagogical conditions in enhancing future specialists' readiness to implement a safe and innovative educational environment.
The study contributes empirical evidence to the field of educational environment design and offers a practically applicable model for higher education institutions.

Further scientific research should be directed at deepening and expanding the results obtained, developing and empirically testing variable models of training future specialists to design a safe and innovative educational environment, taking into account the specifics of different branches of professional training and levels of higher education.

Further research is required to integrate new generation digital technologies (in particular, artificial intelligence, immersive technologies, adaptive learning platforms) into the system of forming the readiness of future specialists, as well as analyzing their impact on the psychological, informational and social security of the educational environment.

A promising direction is also the study of the long-term effect of the implemented pedagogical conditions and special courses, in particular, tracking the sustainability of the formed competencies in the professional activities of graduates.

In addition, it is advisable to expand the diagnostic tools for the readiness of future specialists by developing standardized assessment methods and conducting cross-cultural and inter-institutional comparative studies.

The implementation of the outlined prospects will contribute to further theoretical understanding of the problem and increase the effectiveness of training specialists to create a safe, innovative, and sustainable educational environment in the context of the transformation of modern education.

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