DOI:10.59787/2413-5488-2025-51-3-155-166

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INNOVATIONS AND EVALUATION OF TEACHER EDUCATION PROGRAMS: FROM ANALYSIS TO PRACTICAL RECOMMENDATIONS

Abstract. Contemporary socio-economic and technological transformations underscore the need to develop and refine models of teacher education and continuous professional development. This article explores key factors influencing the innovative activity of university teachers in the context of digitalization, inclusion, and practice-oriented education. Based on a survey of teachers, students, and external stakeholders, the study identifies major drivers and barriers to innovative activity and examines the relationships between individual motivation, professional interaction, and institutional support. Differences in innovation profiles between teachers of natural science programs and those of non-specialized programs are also revealed. An algorithm for monitoring educational programs is proposed to systematically identify competency gaps and areas for professional growth. The findings inform practical recommendations for improving educational programs through the integration of digital, research-based, and inclusive modules, differentiated incentives for innovation, and strengthened institutional support. These measures ensure the practical relevance, methodological value, and adaptability of the proposed approach to contemporary educational challenges.

Keywords: monitoring, innovative activity, teacher education, educational programs, motivation, professional standard, digitalization, inclusive education, institutional support.

Introduction

Socio-economic and technological transformations, the development of digital technologies, and changing professional requirements have had a significant impact on the higher education system, leading to the restructuring of educational processes, increasing the need for personalized learning, influencing the renewal of teaching methods, educational design, and management approaches, and raising the requirements for the quality of teacher training (Al-Raqab, 2022; IGI Global, 2021; Karstina, 2022; Momani et al., 2026). At the same time, universities have become key centers for innovation. The effectiveness of universities' innovation activities is largely determined by how successfully digital and technological solutions are integrated into key areas of work, the availability of resources for staff, faculty, and students, and conditions that support innovation, including effective management, institutional culture, functional infrastructure, and sustainable professional development mechanisms (ISTE, 2019; Karstina, 2023; Karstina et al., 2024a). At the same time, teachers are key figures in innovative transformations at universities. To implement these transformations, modern teachers need digital, methodological, and communication skills, the ability to engage in interdisciplinary interaction, analytical thinking, and the ability to design educational solutions. This set of competencies enables teachers to successfully integrate modern technologies into their professional activities and adapt them to the needs of learners (Karstina et al., 2024b; Kazempour, et al., 2014; Mahmoud, 2022; Shkutina et al., 2025; Yusof et al., 2019), introduce innovative practices, and support the development of differentiated learning environments (Kazempour, et al., 2014). To develop and improve teacher competencies, it is necessary to ensure the effectiveness of training and professional development systems, the effectiveness of professional growth models, and access to high-

quality educational resources and information (Gut et al., 2024; Karstina et al., 2025; Khusainova et al., 2022; Slambekov et al., 2025), as well as the integration of inclusive practices, excluding the fragmented implementation of best practices and innovative solutions (Angelo Mark et al., 2025; Islyamova et al., 2025; Kottmann et al., 2024; Lambriex-Schmitz et al., 2020; Li et al., 2025; Oancea et al., 2021; Palmira et al., 2023; Yulin and Danquah, 2025). At the same time, it is important to ensure regular monitoring and comprehensive analysis of the content of training and professional development programs for teachers, which will allow for the timely identification of training gaps, the updating of curricula, and the assessment of the compliance of learning outcomes with professional standards and modern challenges (Garcia, 2025; Order of the Minister of Science and Education of the Republic of Kazakhstan, 2023), identify barriers and incentives for innovative activity, and regularly apply practice-oriented forms of training (Anderson et al., 2022; Asmayawati, 2024; Elsayary, 2023; Hommey et al., 2020; Karlen et al., 2020; Narayansany et al., 2021; Salleh et al., 2025; Sihinbaeva et al., 2023; Siri et al., 2020; van der Baan NA et al., 2025), and interact with the professional community (Fil'chenkova, 2017; Lambriex-Schmitz et al., 2020; Li et al., 2025).

Thus, contemporary transformations necessitate the development of flexible models for teacher training and continuous professional development based on the integration of digital resources, modern educational solutions, and inclusive approaches, as well as regular monitoring of educational programs and analysis of factors influencing teachers' innovative activity. This allows for the creation of a sustainable foundation for improving the quality of teacher education and ensuring its relevance to current challenges.

Purpose and Tasks of the Present Study

The purpose of this study was to examine the factors and mechanisms that determine the innovative activity of university teachers, as well as to develop approaches to monitoring teacher training programs, taking into account the digital, inclusive, and practice-oriented components required by professional standards.

To achieve this purpose, the following tasks were identified: 1) assessing the perception of factors influencing innovative activity among teachers, students, and external stakeholders; 2) identifying key barriers and incentives for the development of innovative activity among teachers; 3) developing a multi-level algorithm for monitoring teacher training programs, including indicators of motivational, organizational, resource, and institutional conditions; 4) conducting a comparative analysis of survey data from different target groups to assess the effectiveness of teacher training programs and identify areas for improvement; 5) developing recommendations for optimizing training programs and ensuring their practical orientation, as well as strengthening institutional support for teachers' innovative activity.

Method

The research method was based on the initial assumption that the innovative activity of teachers is shaped by digital, institutional, and personal factors and is determined by the nature of their interaction with key participants in the educational process. To empirically test this assumption, questionnaires were developed for three target groups: teachers, students, and external stakeholders.

The study involved 148 teachers and 718 students from the educational programs “Training of Teachers in Natural Sciences” and “Training of Teachers without Subject Specialization.” This ensured the representativeness of the data for analyzing innovative activity in the context of teacher education. An additional survey was conducted with 739 external stakeholders, including school teachers, methodologists, and specialists from education management departments. This allowed us to broaden the context of the study and evaluate the innovative activities of teachers in the system of interprofessional interactions. Taken together, the sample provided sufficient grounds for generalizations in the field of teacher education and humanities education.

The objectives of the survey included 1) assessing perceptions of innovation activities from various professional perspectives, 2) assessing the level of innovation activity among teachers, 3) determining the awareness of respondents from all target groups about the forms and methods of innovation activity, 4) analyzing the degree of involvement in innovation-oriented activities, and 5) identifying factors that stimulate or limit the development of innovation activity. The results of the survey were used to describe the current state of teachers' innovative activity and to develop an algorithm for monitoring teacher training programs.

The questionnaires included open-ended and closed-ended questions. Closed-ended questions used a five-point Likert scale to assess attitudes, engagement, and perceptions of factors influencing teachers' innovative activity, nominal categories to describe socio-demographic characteristics, and multiple choice to identify the main motives and constraints of innovative activity. Open-ended questions allowed respondents to express their own opinions on the issues under study, which enhanced the depth of the analysis and allowed for the context of the professional environment to be taken into account. Thus, the questionnaire format used made it possible to obtain both quantitative and qualitative data for a comprehensive study of teachers' innovative activity in the context of a synergistic model that includes cognitive, behavioral, and institutional components. To comprehensively assess the impact of conditions on the innovative activity of teachers, a progress factor index was calculated based on average values for nine key areas: access to resources, management support, participation in professional communities, grant opportunities, personal motivation, use of inclusive practices, opportunities for professional development, collaborative environment, and fair reward system. The index values obtained were compared with respondents' answers to open-ended questions related to factors motivating innovative activity. At the same time, the study conducted a comparative analysis of the results of a survey of external stakeholders, teachers, and students enrolled in the educational programs “Training of Teachers in Natural Sciences” and “Training of Teachers without Subject Specialization,” an analysis of factors limiting innovative activity, a calculation of correlations between the level of awareness and actions to introduce innovations, and a ranking of factors by degree of influence. A wide range of methods used to analyze the survey results ensured the reliability of the conclusions and a multidimensional interpretation of the data.

A special place in the study was given to the development of an algorithm for monitoring teacher training programs and the formulation of recommendations for their optimization and practical orientation, strengthening institutional support for teachers' innovative activity, and applying effective mechanisms for improving the quality of teacher training.

Overall, the methodology used in the study made it possible to conduct a comprehensive study of teachers' innovative activity as a result of the interaction of individual characteristics, institutional conditions, and external professional influences.

Results and Discussion

In the context of global transformations and challenges outlined in the introduction, the teacher training system faces the need to update program content and mechanisms for developing contemporary professional competencies. At the same time, the integration of digital, inclusive, and practice-oriented approaches into the educational environment increases the demands on fostering innovative activity among teachers as an integrative form of professional engagement, which emerges through the interaction of individual professional characteristics, organizational and resource conditions, and the specific features of the educational environment. This, in turn, underscores the key role of institutional support. In this context, an urgent task is the development of more effective approaches to monitoring teacher training programs for compliance with professional standards and the dynamically changing requirements of the educational environment, as well as the use of comprehensive analytical

tools to objectively assess teachers' innovative activity and their readiness to implement and scale up innovative practices.

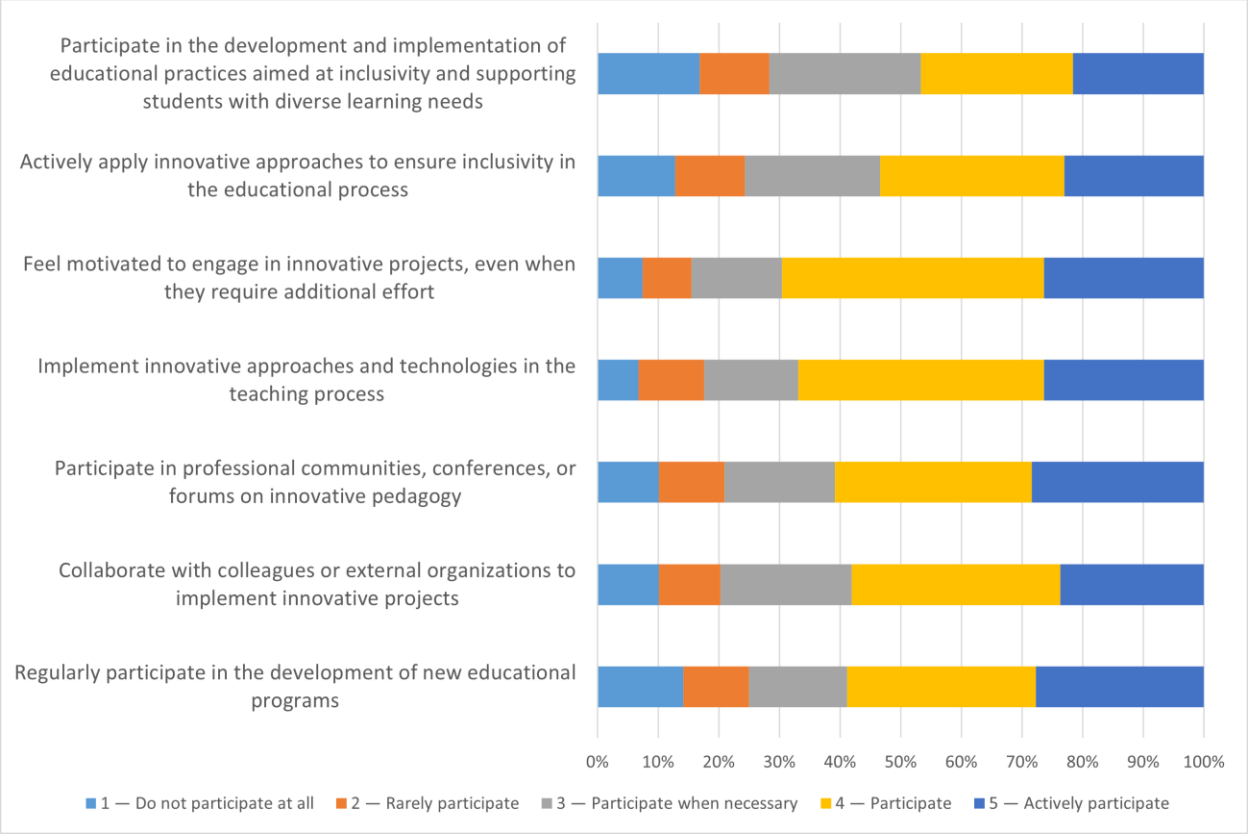
The studies conducted in this work showed that the main incentives for teachers' innovative activity are opportunities to participate in grant programs and professional development programs (4.25 out of 5), as well as personal motivation for professional growth (4.25 out of 5). Institutional conditions, including access to professionally relevant resources (3.95 out of 5), participation in professional communities (4.03 out of 5), and support from leadership (3.75 out of 5), generally facilitate the manifestation of innovative activity but do not constitute its determining factor. When these conditions are insufficiently developed or lack a systematic character, they transform from supporting factors into limiting ones, creating barriers to the realization of teachers' innovative potential. This is confirmed by survey results, in which teachers identified the most significant barriers to innovative activity as high teaching workload (3.33 out of 5), lack of resources (3.35 out of 5), and limited administrative support (2.78 out of 5).

A comparative analysis of the responses of teachers from the educational programs "Training of teachers in natural science subjects" and "Training of teachers without subject specialization" revealed some features in the assessment of the significance of factors influencing the innovative activity of teachers. For example, teachers of natural sciences rate resource provision higher (3.95 points, compared to 3.81 points for teachers without subject specialization). They also attach greater importance to opportunities to participate in grant programs (4.25 vs. 3.95) and in the work of professional communities. For teachers of programs without subject specialization, personal motivation and administrative support were found to be more significant factors influencing their innovative activity. These differences allow us to identify two profiles of innovative teachers: 1) resource-oriented, 2) motivation-oriented. The results of the survey of students and external stakeholders confirmed the identified trends.

An analysis of teachers' involvement in innovative activities revealed its heterogeneity. As can be seen in Figure 1, the highest level of participation is observed in innovative projects (69.69% of teachers participate or actively participate), in the development and implementation of innovative approaches and technologies in the educational process (66.89%), as well as in the activities of professional communities, conferences, and forums on innovative pedagogy (60.81%) and the development of new educational programs (58.78%). At the same time, a lower level of involvement is characteristic of areas related to ensuring the inclusiveness of the educational process (53.37%) and the implementation of teaching practices for students with different educational needs (46.62%). The data obtained underscore the need to strengthen methodological and institutional support for these areas. Overall, the results indicate that the participation of a significant proportion of teachers in innovative activities is selective, while a smaller proportion of respondents demonstrate a high level of activity. In addition, the study revealed inconsistencies between individual, professional, institutional, and public engagement. The highest levels of engagement in innovative activities are observed at the individual and professional levels (63.51% and 67.57%, respectively), reflecting the leading role of personal initiative. Institutional and social engagement remain lower (53.38% and 55.41%). More than 80% of respondents note a mismatch between personal motivation and institutional support opportunities, which hinders the scaling up of innovative practices.

Figure 1

Assessment of teachers' involvement in various types of innovative activities



An analysis of the survey data in terms of length of service and professional experience revealed a number of dynamic trends. For example, novice teachers with up to five years of teaching experience are more likely to feel the need for external methodological and organizational support. Teachers with 5 to 10 years of experience are more focused on using innovative tools as a resource for professional growth. More experienced teachers with 16 or more years of teaching experience focus primarily on resource availability and the presence of a developed research infrastructure in the development of innovative activity. Against the backdrop of these trends, teachers emphasize the need for practice-oriented professional development programs, especially in the areas of modern digital technologies, project-based learning, and stakeholder engagement. At the same time, experienced teachers focus on professional development programs aimed at developing strategic and research competencies, while novice teachers focus on mastering digital tools. The results indicate the advisability of a differentiated approach to the development of professional development programs, including the introduction of modular formats that combine digital, inclusive, and humanities components, which contributes to their adaptability to the current requirements of professional activity.

The correlation analysis conducted in this study revealed consistent relationships between teachers' awareness of innovative practices and the extent of their implementation in professional activities. A moderate positive correlation ($r \approx 0.6$) was observed between general awareness of innovative methods and their practical application. Stronger associations were found between teachers' awareness of digital technologies and project-based learning and the active implementation of these practices in the educational process ($r \approx 0.75$), highlighting the

importance of targeted information provision to promote the adoption of innovative teaching practices.

At the same time, the relationship between teachers' level of awareness and collaboration with external organizations was relatively weak ($r \leq 0.4$), suggesting the presence of additional institutional barriers. Further analysis indicated that general awareness of innovative methods was more strongly linked to the willingness to implement them, whereas knowledge of grant opportunities showed less stable correlations, pointing to a deficit in project-related competencies. Moreover, the study did not reveal statistically significant differences between teachers of natural science programs and those of non-specialized programs, supporting the view that these trends are universal and can be considered typical patterns in broader pedagogical practice.

The analysis of interrelations among actions that foster innovative activity revealed strong correlations ($r = 0.68–0.89$), as illustrated in Figure 2, forming a stable pattern of behavior: increased activity in one area was accompanied by growth in others. The strongest associations were observed between the implementation of digital technologies, the enhancement of pedagogical practices ($r = 0.88$), and the willingness to experiment. These findings indicate that innovative activity is not a collection of isolated actions but a coherent, interconnected system shaped by teachers' level of awareness, access to resources, and individual motivation.

Figure 2

Correlation analysis of teachers' activities in implementing measures that promote innovative activity

	Actively seek new teaching methods to improve the quality of the educational process	Independently initiate projects or research initiatives	Strive to integrate digital and other innovative technologies into teaching	Regularly evaluate and improve my pedagogical practices	Willing to experiment with new teaching formats and methodological approaches
Actively seek new teaching methods to improve the quality of the educational process	1				
Independently initiate projects or research initiatives	0,771018044	1			
Strive to integrate digital and other innovative technologies into teaching	0,888070906	0,770317439	1		
Regularly evaluate and improve my pedagogical practices	0,885040954	0,75028134	0,882159051	1	
Willing to experiment with new teaching formats and methodological approaches	0,88427143	0,680896351	0,862044579	0,880000141	1

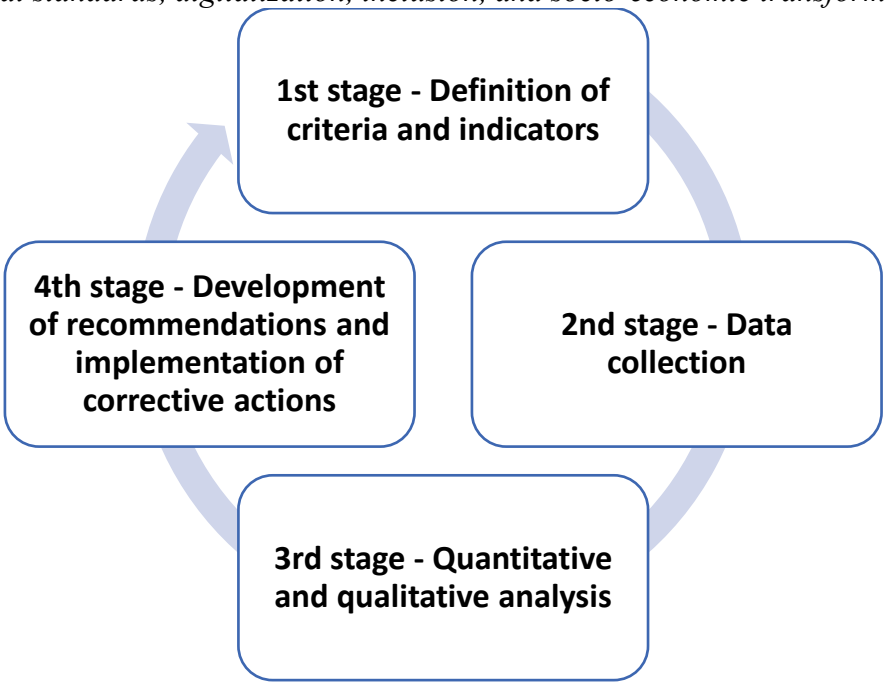
Thus, the results of the study suggest that teachers' innovative activity can be regarded as an integrated professional characteristic, formed through the interaction of individual motivation, professional experience, and institutional conditions. The observed heterogeneity of incentives, barriers, and forms of engagement, as well as differences in teachers' responsiveness to resource- and management-related factors, underscores the need for a comprehensive and differentiated approach to evaluating the quality of teacher training. In this context, indicators of innovative activity may serve as analytical tools for monitoring educational programs, reflecting the alignment of their content, organizational mechanisms,

and practice-oriented components with professional standards and the evolving requirements of the educational environment.

At the same time, when developing key indicators, procedures, and algorithms for monitoring educational programs, it is advisable to use tools that allow identifying their compliance with changes in professional standards and the educational environment, the degree of integration of competency modules, connection with practice, and the consistency of expected learning outcomes with the actual competencies of graduates. Accordingly, this paper proposes a monitoring algorithm covering the full cycle of educational program analysis, from setting goals and forming criteria to implementing corrective measures (Figure 3). The criteria and indicators of the monitoring algorithm include motivational, organizational and resource, professional, and institutional and cultural indicators, as well as the degree of integration of digital, inclusive, and practice-oriented components into educational programs.

Figure 3

Stages of the algorithm for monitoring teacher training programs, taking into account professional standards, digitalization, inclusion, and socio-economic transformations



Data collection is expected to involve faculty, students, and external stakeholders, allowing for the measurement of awareness, engagement, participation in innovative practices, and perceptions of institutional support. The data obtained should be subjected to comprehensive quantitative and qualitative analysis using descriptive statistics, correlation analysis, and analysis of respondents' open-ended answers. This approach makes it possible to identify both the key drivers and barriers to the innovative activity of participants in the educational process, as well as the inconsistencies between educational programs and real professional tasks. Based on the results of the analysis, recommendations and corrective measures should be formulated aimed at updating program content, improving the resource base, and strengthening priority areas, including digitalization, project activities, and inclusive practices. To ensure regular data updates, track changes, and adapt educational programs to new professional and social challenges, monitoring is expected to be cyclical, creating a sustainable basis for continuous improvement in the quality of teacher training.

Summarizing the results obtained in this study, we can formulate a number of recommendations aimed at further improving teacher training programs. These include:

1) strengthening the focus on the development of methodological, digital, and communication competencies, which are equally important for teachers of various profiles and, according to the assessments of students and external stakeholders, are often insufficiently developed;

2) identifying priority factors that influence the formation of teachers' innovative competence and reflecting them in the content of educational programs;

3) adjusting programs to take into account the individual motivation of teachers, as well as digital and inclusive practices;

4) developing targeted programs for professional development and advancement, differentiated by age, experience, and professional profile;

5) evaluating the effectiveness of the educational environment based on indicators of teachers' awareness and involvement in various types of innovative activities;

6) integration of inclusive practices into educational programs with the development of specialized methodological and resource measures;

7) strengthening institutional support for innovative activities by expanding access to professionally relevant resources, grants, and the work of professional communities;

8) developing modular programs that combine digital, research, and inclusive competencies, taking into account the professional experience of teachers;

9) stimulating horizontal professional interaction and cooperation with professional communities;

10) systematically monitoring teachers' levels of awareness and engagement for subsequent adjustment of educational programs.

The proposed recommendations can be considered as a universal basis for the formation of a more sustainable, flexible, and relevant teacher training system and its gradual improvement. Such a system has the potential to adapt to different training profiles and levels of educational organizations, as well as the ability to respond quickly to modern challenges and changes in the educational environment.

A limitation of this study is its predominantly descriptive and correlational nature, which implies the need for further empirical confirmation of the identified relationships and clarification of the causal mechanisms. In addition, the influence of external socio-economic factors was considered only partially and requires further analysis. Overall, the results form the basis for a systematic approach to developing the innovative activity of teachers and may be useful in planning institutional and methodological measures aimed at improving the educational environment and encouraging the sustained participation of teachers in innovative practices.

Conclusion

The study showed that university teachers' innovative activity can be considered an integrated professional characteristic, shaped through the interaction of individual motivation, professional experience, and institutional conditions. It was established that intrinsic professional motivation serves as a key driver of teachers' innovative activity, strengthened by access to resources, participation in professional communities, and leadership support. Differences in the activity profiles of teachers in natural science programs and non-specialized programs indicate the need for a differentiated approach to fostering innovative behavior.

Correlation analysis confirmed stable relationships between teachers' awareness of innovative practices and the degree of their implementation in professional activities. The heterogeneity of incentives, barriers, and forms of engagement, as well as differences in teachers' responsiveness to resource and managerial factors, highlight the importance of a comprehensive approach to evaluating the quality of teacher education. In this regard, a

monitoring algorithm for educational programs is proposed, in which indicators of innovative activity can be used as analytical measures to assess the alignment of program content, organizational mechanisms, and practice-oriented components with professional standards and educational requirements.

Based on the study results, recommendations have been formulated for improving teacher education programs, including the development of key competencies, integration of innovative and inclusive practices, consideration of teachers' motivation and experience, strengthening institutional support, and systematic monitoring of engagement. The implementation of these measures contributes to the formation of a flexible, sustainable, and adaptable teacher education system capable of effectively responding to contemporary challenges and changes in the educational environment.

Funding Information

This research is funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant № AP26101969 – «Development and implementation of a synergetic model of training of an innovative and active teacher and his/her professional development in the conditions of globalization, digitalization and inclusiveness of education»).

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Svetlana G. Karstina: Conceptualization, Methodology, Data curation, Writing – Original draft preparation. Saltanat K. Abildina: Conceptualization, Data curation, Reviewing. Ainura K. Tussupbekova: Reviewing and Editing. Elmira K. Mussenova: Reviewing and Editing.

References

Al-Raqab, Y. (2022). The degree of digital leadership practice by the principals of private schools in the capital Amman from the point of view of teachers. Unpublished Master's Thesis, Middle East University, Jordan.

Anderson, B.K., Meyer, J.P., Goldenberg, I., & Laplante, J. (2022). Development and evolution of commitment profiles among military recruits: implications for turnover intention and wellbeing. Military Psychology, 5(34), 70-590. https://doi.org/10.1080/08995605.2021.2022910

Angelo Mark, P.W., Madronero, J.M., Tapay, A.G.Q., Sales, G.M.G., & Malawi, N.M. (2025). Technology-Enhanced Action Research Training for Science Teachers: An Explanatory Sequential Mixed-Methods Needs Assessment. Journal of Educational Technology and Learning Creativity, 3(2), 269-281. https://doi.org/10.37251/jetlc.v3i2.2301

Asmayawati, Yufiarti, & Yetti, E. (2024). Pedagogical innovation and curricular adaptation in enhancing digital literacy: A local wisdom approach for sustainable development in Indonesia context. Journal of Open Innovation: Technology, Market, and Complexity, 1(10), 100203. https://doi.org/10.1016/j.joitmc.2024.100233

Elsayary, A. (2023). The impact of a professional upskilling training programme on developing teachers' digital competence. Journal of Computer Assisted Learning, 39, 1154-1166. URL: https://onlinelibrary.wiley.com/doi/epdf/10.1111/jcal.12788?src=getftr (data podachi zayavleniya: 09.01.2026)

Fil'chenkova, I. F. (2017). Rezul'taty monitoringa innovacionnoj aktivnosti prepodavatelej vuza. Vestnik Mininskogo universiteta, 3, 18-24. https://doi.org/10.26795/2307-1281-2017-3-4

Garcia, E. (2025). Teacher Training and Support, Classroom Management Strategies, and Innovative Teaching Methods in Junior High School Science Education. Asia Pacific Journal of Management and Sustainable Development, 13 (1), 17-29. https://doi.org/10.70979/ODVW4459

Gut, YU.N., Tursunov, L.E., Lanskih, M.V., & Ahmedova, Sh.B. (2024). Razvitie innovacionnoj aktivnosti prepodavatelej vuza: filosofskaya i psihologicheskaya perspektivy. Vysshee obrazovanie v Rossii,.1(33), 149–163. https://doi.org/10.31992/0869-3617-2024-33-1-149-163

Hommey, C., Ma, J., Asamani, L. & Hanson, P. (2020). The moderating effect of acculturation strategies on the relationship between newcomer adjustment and employee behaviour. Frontiers in Psychology, 11, 2117.https://doi.org/10.1080/08995605.2021.2022910

IGI Global. (2021). Retrieved from https://www.igi-global.com/dictionary/leadership-toadvance-innovation-for-digital-healthcaretransformation/58293

Islyamova, E.A., & Hayalieva, S.Z. (2025). Razvitie tvorcheskoj aktivnosti budushchih pedagogov professional'nogo obucheniya v vysshej shkole. I. Yakovlev Chuvash State Pedagogical University Bulletin, 4(129), 114-120. https://doi.org/10.37972/chgpu.2025.129.4.013

ISTE Bureau of the Basic Education Commission. (2019). International society for technology in education (ISTE). Bangkok: Bureau of the Basic Education Commission.

Karlen, Y., Hertel, S., & Hirt, C. (2020). Teachers' Professional Competences in Self-Regulated Learning: An Approach to Integrate Teachers' Competences as Self-Regulated Learners and as Agents of Self-Regulated Learning in a Holistic Manner. Frontiers in Education, №5, 1–20. https://doi.org/10.3389/feduc.2020.00159

Karstina, S.G. (2022). Engineering Training in The Context of Digital Transformation. IEEE Global Engineering Education Conference (EDUCON), 1062-1068. https://doi.org/10.1109/EDUCON52537.2022.9766473

Karstina, S., Zhetpisbayeva, B., Tussupbekova, A., & Makhanov, K. (2024a). Application of practice-oriented education technologies in training students in engineering and science specialties. Higher education in Kazakhstan, 2(46), 56-67. https://doi.org/10.59787/2413-5488-2024-46-2-56-67

Karstina, S. (2023). The Role of Group Project-Based Learning in Engineering Training. In: Auer, M.E., Pachatz, W., Rüütmann, T. (eds) Learning in the Age of Digital and Green Transition. ICL 2022. Lecture Notes in Networks and Systems, vol. 634, p. 239–245. Springer, Cham. https://doi.org/10.1007/978-3-031-26190-9_24

Karstina, S.G., Shkutina, L.A., Mussenova, E.K., & Tussupbekova, A.K. (2024b). Professional'noe razvitie prepodavatelej i nastavnikov inzhenernyh i estestvenno-nauchnyh dual'nyh programm. Pedagogicheskie nauki, 1(72), 13-31. https://doi.org.10.48371/PEDS.2024.72.1.001

Karstina, S.G., Abil'dina, S.K., Tussupbekova, A.K., & Tamabaeva, M.K. (2025). Transformaciya programm professional'nogo razvitiya prepodavatelej v usloviyah cifrovizacii, globalizacii i inklyuzivnogo obrazovaniya. Gumilyov Journal of Pedagogy, 152(3), 319-340. https://doi.org/10.32523/3080-1710-2025-152-3-319-340

Kazempour, M., & Amirshokoohi, A. (2014). Transitioning to inquiry-based teaching: Exploring science teachers' professional development experiences. International Journal of Environmental and Science Education, 9(3), 285-309. https://doi.org/10.12973/ijese.2014.216a

Khusainova, G.R., Karstina, S.G. & Galihanov, M.F. (2022). Ocenka gotovnosti prepodavatelej k innovacionnoj professional'no-pedagogicheskoj deyatel'nosti. Vysshee obrazovanie v Rossii, 31(7), 42–60. https://doi.org.0.31992/0869-3617-2022-31-7-42-60.

Kottmann, A., Schildkamp, K., & van der Meulen. B. (2024). Determinants of the Innovation Behaviour of Teachers in Higher Education. Innovative Higher Education, 49, 397-418. https://doi.org/10.1007/s10755-023-09689-y

Lambriex-Schmitz, P., Van der Klink, M.R., Beausaert, S., Bijker, M., & Segers, M. (2020). Towards successful innovations in education: Development and validation of a multi-dimensional Innovative Work Behaviour Instrument. Vocations and Learning, 13, 313-340. https://link.springer.com/article/10.1007/s12186-020-09242-4

Li, X., Cheng, S., Chen, N., Wang, & Xi H. (2025). The Promoting Role of Teachers' Emotional Competence in Innovative Teaching Behaviors. Behavioral Sciences (MDPI), 15(10), 1357. https://doi.org/10.3390/bs15101357

Mahmoud, I. (2022). A proposed list of digital leadership practices in Egyptian schools in light of the standards of the International Association for Technology in Education for educational leaders. Journal of Educational Administration, 34, 213-331.

Momani, K.S., Alsadi, M.M., Rady, Y., Siaj, R.W., & Hamadneh, B. (2026). The degree of innovative leadership practice and its relationship to the level of digital leadership among school principals. Humanities and Social Sciences Letters. 1(14), 180-201. https://doi.org/10.18488/73.v14i1.4699

Narayansany, K. & Isa, R.M. (2021). The relationships between onboarding program and newcomers' turnover intention: the role of organizational identification as mediator Hubungan antara Program Onboarding dan Niat Pusing Ganti Pekerja Baru: Peranan Identifikasi Organisasi sebagai Pengantaraan, 63, 1-15.

Oancea, A., Fancourt, N., Robson, J., Thompson, I., Childs, A., & Nuseibeh, N. (2021). Research capacity-building in teacher education. Oxford Review of Education, 1(47), 98-119. https://doi.org/10.1080/03054985.2020.1842184.

Pečiuliauskienė, P., Kaminskienė, L., & Lehtinen, E.. (2023). Science teachers' collaborative innovative activities: the role of professional development and professional experience. Humanities and Social Sciences Communications, 10(324), 1-10. https://www.nature.com/articles/s41599-023-01833-5

Prikaz Ministra nauki i vysshego obrazovaniya Respubliki Kazahstan. (2023). № 591 «Ob utverzhdenii professional'nogo standarta dlya pedagogov (professorsko-prepodavatel'skogo sostava) organizacij vysshego i (ili) poslevuzovskogo obrazovaniya». https://adilet.zan.kz/rus/docs/G23HN000591

Salleh, K. A., Abdul Hamid, S., Yusoff, T., Salleh, R., Kadir, M. N., & Salleh, S. F. (2025). Innovative Approaches And Challenges In Islamic Education: Curriculum Development, Teacher Training, And Strategic Pedagogical Practices In A Global Context. International Journal of Education, Psychology and Counseling, 10 (57), 154-173. https://doi.org/10.35631/IJEPC.1057011

Shkutina, L.A., Karstina, S.G., & Kissabekova, P.A. (2025). Gotovnost' prepodavatelej i nastavnikov k realizacii dual'nyh obrazovatel'nyh programm inzhenernogo i estestvenno-nauchnogo profilej, Vestnik Karagandinskogo universiteta. Seriya «Pedagogika», 30, 1(117), 91–103. https://doi.org/10.31489/2025ped1/91-104

Sihinbaeva, Z., & Zholdasbekova, D. (2023). Development of Readiness of Future Special Teachers to Improve Professional Activities. Bulletin of Yassawi University, №3(129), 224-238. https://journals.ayu.edu.kz/index.php/habarshy/article/view/2729

Siri, A., Supartha, I., Sukaatmadja, & I., Rahyuda, A. (2020). Does teacher competence and commitment improve teacher's professionalism. Cogent Business & Management, №7,

1–13. https://www.econstor.eu/bitstream/10419/244867/1/10.1080-23311975.2020.1781993.pdf

Slambekov, Y.T., Kussainova, Zh. E., Shalginbaeva, K.K., & Dildabekova. I.A. (2025).Modern methods of improving the professional competence of future teachers in college settings. Vestnik Torajgyrov universiteta. Seriya Pedagogicheskaya, 4, 82-100. https://doi.org/10.48081/LATU5565

van der Baan, N.A., Meinke, G., Virolainen, M.H., Beausaert, S., & Gast, I. (2025). Retention of newcomers and factors influencing turnover intentions and behaviour: a review of the literature. Education + Training, .1(67),. 107-136. https://doi.org/10.1108/ET-06-2023-0240

Yusof, M.R., Yaakob, M. F. M., & Ibrahim, M.Y. (2019). Digital leadership among school leaders in Malaysia. International Journal of Innovative Technology and Exploring Engineering, 8(9), 1481–1485. https://doi.org/10.35940/ijitee.I8221.078919

Yulin, N., & Danso, S. D. (2025). Assessing Pedagogical Readiness for Digital Innovation: A Mixed-Methods Study. arXiv preprint arXiv:2502.15781. https://doi.org/10.48550/arXiv.2502.15781

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