

IRSTI 14.35.07

<https://doi.org/10.51889/2960-1649.2026.67.2.010>MAKULOVA AINUR^{*1}, TUSSUBEKOVA KUNSLU²¹*M. Auezov South Kazakhstan University (Shymkent, Kazakhstan)*²*Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)*

*Address of correspondence: Makulova Ainur, doctoral student of the educational program 8D01110-«Pedagogy and Psychology», M.Auezov South Kazakhstan University, 160012, Shymkent, Tauke Khan Avenue, 5, <https://orcid.org/0000-0003-4647-1767>, E-mail: makulovaa@list.ru, Tel.: +7029957227

Methodological Foundations of Meta-Competence Development in Future Educational Psychologists within Digital Learning Environments

Abstract

Introduction. The digital transformation of higher education has changed the professional preparation of future educational psychologists and requires competencies that go beyond the technical use of digital tools. This study aims to substantiate the methodological foundations for developing meta-competence in future educational psychologists within digital learning environments and to propose a conceptual model that reflects the professional specificity of psycho-pedagogical support. *Methodology and Methods.* The research is based on theoretical analysis, comparative interpretation of international competence frameworks, conceptual generalization of contemporary studies on digital competence and innovative professional behavior, and model construction. *Results.* The findings substantiate that digital technologies in the training of future educational psychologists should be conceptualized not merely as instructional tools but as a comprehensive environment of professional development. The article proposes an authorial model of the meta-competence structure of future educational psychologists in the digital educational environment. *The scientific novelty* of the study lies in the theoretical and methodological integration of international digital competence frameworks with the logic of meta-competence development of future educational psychologists. For the first time, the digital training of specialists in this profile is conceptualized not merely as the acquisition of digital literacy, but as the formation of innovation-oriented professional agency. *The practical significance* of the study lies in the applicability of the proposed model for the design of educational modules and courses, the development of assessment criteria, diagnostic rubrics, and tools for subsequent empirical validation in the system of training future educational psychologists.

Keywords: meta-competence, digital technologies, future educational psychologists, digital educational environment, digital competence, innovative professional behavior.

Introduction. The rapid digitalization of higher education is fundamentally changing the content, forms, and conditions of professional training for specialists in pedagogy and psycho-pedagogy. Contemporary educational environments include learning platforms, distance and blended learning systems, digital feedback tools, learning analytics, interactive services, and generative AI technologies, all of which require future specialists not only to possess technical literacy but also to act effectively under conditions of uncertainty, information overload, and technologically mediated interaction (Bond et al., 2018;

Crompton & Burke, 2023; Lee et al., 2024; OECD, 2019; UNESCO, 2023).

International scholarship conceptualizes teachers' digital competence as a complex of knowledge, skills, and attitudes that enables meaningful use of technologies in teaching, assessment, interaction, and professional development (Redecker, 2017; Vuorikari et al., 2022). At the same time, contemporary frameworks such as DigCompEdu, LifeComp, and the OECD Learning Compass 2030 demonstrate that digital training cannot be reduced to instrumental mastery alone, but also involves the development of critical

thinking, reflexivity, responsibility, self-directed learning, and professional agency (OECD, 2019; Redecker, 2017; Sala et al., 2020; Sillat et al., 2021; Zhao et al., 2021). For future educational psychologists, this issue is particularly significant. Their professional activity is associated with psycho-pedagogical support, prevention, counseling, analysis of educational situations, maintenance of psychological safety, and adherence to ethical norms. Consequently, digital technologies in their training should not be treated as an external supplement to professional education, but as a specific environment in which higher-order integrative qualities are formed, namely, meta-competences that ensure the capacity for reflexive analysis, professionally responsible choice, communicative flexibility, support design, and innovative problem solving (Falloon, 2020; Sillat et al., 2021).

An equally important trend in contemporary literature is the growing recognition of the relationship between digital competences and teachers' innovative professional behavior. Studies on digital competence focus on technology use, pedagogical integration, and diagnostic frameworks, whereas studies on innovative work behavior emphasize self-efficacy, engagement, supportive environments, organizational climate, and readiness to generate and implement new ideas (Atatsi et al., 2022; Basilotta-Gómez-Pablos et al., 2022; Dixit & Upadhyay, 2021; Jia et al., 2022). In the context of training future educational psychologists, this connection is crucial: digital competence acquires real professional value only when it becomes a resource for designing, adapting, and implementing new psycho-pedagogical practices (Amhag et al., 2019; Ley et al., 2022; Domínguez et al., 2020).

Despite the growing interest in the digital transformation of education, the problem of meta-competence development in future educational psychologists through digital technologies remains insufficiently elaborated. A gap persists between general digital competence frameworks and the professional specificity of helping practices, where ethicality, reflexivity, psychological safety, the quality of data

interpretation, and readiness for innovation-oriented professional action are decisive (Ng et al., 2021; Timotheou et al., 2023; Zhao et al., 2021). This article aims to provide a theoretical and methodological substantiation for the meta-competence development in future educational psychologists through digital technologies and to propose an authorial model of its structure and levels of formation.

Materials and Methods. The study is theoretical-methodological and conceptual-modeling in nature. Its design is not aimed at testing a specific empirical hypothesis, but at identifying and systematizing the methodological foundations for the meta-competence development in future educational psychologists under conditions of a digital educational environment.

The material of the study included: international frameworks of digital, personal, and educational competences; studies devoted to teachers' digital competence in higher education; studies on innovative professional behavior in educational contexts; publications on teacher agency, AI literacy, data literacy, digital citizenship, professional self-efficacy, and teachers' reflexive development (Basilotta-Gómez-Pablos et al., 2022; Jia et al., 2022; Mishra & Koehler, 2006; Redecker, 2017; Sala et al., 2020; UNESCO, 2023; Vuorikari et al., 2022).

The methodological framework of the study combines several complementary approaches. The competence-based approach makes it possible to interpret the outcomes of professional training as the ability to act in real and variable professional situations. The meta-competence approach shifts the focus from isolated skills to integrative mechanisms of professional thinking, self-regulation, and the transfer of action patterns to new contexts. The systems-activity approach makes it possible to understand competence development as a result of students' participation in various forms of educational and quasi-professional activity. The learner-centered approach emphasizes the subjective nature of professional becoming and the role of reflexivity, self-development, and conscious choice of professional strategies.

The study employed the following methods: theoretical analysis and synthesis of psychological-pedagogical literature; comparative analysis of international frameworks for digital and metacompetence-oriented training; conceptual generalization of contemporary research on digital competence and teachers' innovative behavior; modeling of the structure of meta-competence of future educational psychologists in the digital educational environment. The research was conducted in three stages. At the first stage, scientific sources and international frameworks were analyzed in order to identify contemporary approaches to digital competence, personal and social competences, teacher agency, and innovative professional behavior (Damşa et al., 2021; Jia et al., 2022; Redecker, 2017; Sala et al., 2020). At the second stage, the identified approaches were compared in order to determine those components that are most significant, specifically for the training of future educational psychologists. At the third stage, an authorial structural model of meta-competence and a rubric of its levels of formation were developed.

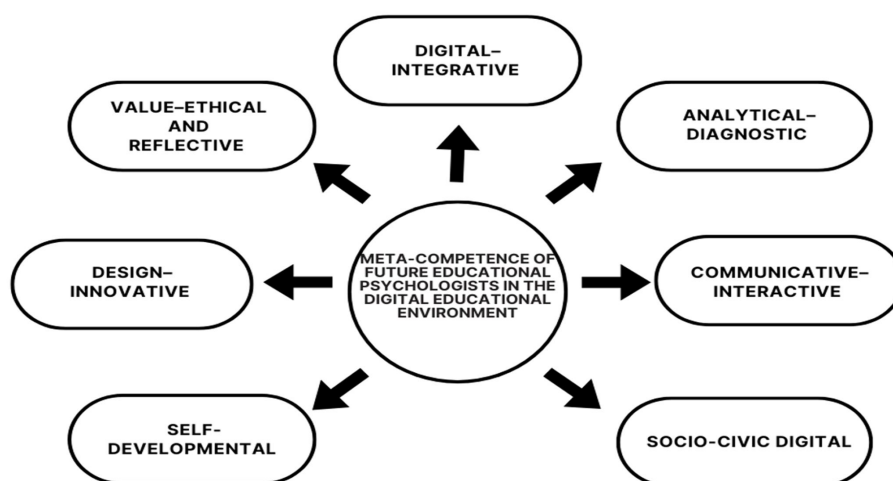
The choice of this design is conditioned by the current state of the research field itself. Contemporary reviews show that studies on teachers' digital competence are predominantly based on cross-sectional self-report designs,

whereas studies on innovative behavior emphasize psychosocial and organizational factors but rarely integrate the digital dimension into a unified explanatory model (Basilotta-Gómez-Pablos et al., 2022; Dixit & Upadhyay, 2021; Jia et al., 2022). Under these conditions, a theoretical-methodological study aimed at conceptually integrating both lines of inquiry constitutes a justified and productive step toward future empirical operationalization of the proposed model.

Results. The results of the theoretical-methodological analysis make it possible to conceptualize the meta-competence of the future educational psychologist as an integrative system formed at the intersection of digital literacy, professional reflexivity, ethical responsibility, analytical thinking, communicative maturity, and readiness for innovative professional action. Unlike broader models of digital competence that focus primarily on the teacher as a user of technologies, the proposed model takes into account the specificity of psycho-pedagogical support, in which technologies mediate not only learning, but also trust-based interaction, diagnosis, prevention, data interpretation, and the maintenance of psychological safety. Figure 1 presents the authorial model of the structure of meta-competence of future educational psychologists in the digital educational environment.

Figure 1

Meta-competence of future educational psychologists in the digital educational environment meta-competence



Based on integrating the provisions of DigCompEdu, TPACK, SAMR, LifeComp, the OECD Learning Compass 2030, and contemporary studies on teachers' digital competence and innovative behavior, seven structural components of the meta-competence of future educational psychologists were identified (Jia et al., 2022; Mishra & Koehler, 2006; Redecker, 2017; Sala et al., 2020; Vuorikari et al., 2022). This selection is also consistent with the SAMR logic of technology integration (Puentedura, 2013): value–ethical

and reflective; digital integrative; analytical diagnostic; communicative interactive; design–innovative; self-developmental; socio-civic digital. Accordingly, the structure of meta-competence of future educational psychologists in the digital educational environment should be understood as an integrative system of interrelated components, including value–ethical, digital-integrative, analytical-diagnostic, communicative-interactive, design-innovative, self-developmental, and socio-civic dimensions (Table 1).

Table 1

Structure of meta-competence of future educational psychologists in the digital educational environment

Metacompetence Component	Content	Digital Technologies and Means of Formation	Indicators of Formation
Value-ethical and reflexive	Evaluates digital practices from the perspective of professional ethics, psychological safety, confidentiality, reliability of information, data protection, and learners' well-being; includes readiness for reflection on one's own decisions in the digital environment	LMS platforms with privacy settings, digital cases on ethical dilemmas, professional situation simulators, reflective tools, and AI services for critical response analysis	Recognizes ethical risks of the digital environment; maintains confidentiality; critically evaluates content; justifies professional decisions; demonstrates a reflexive position
Digital-integrative	Meaningfully integrates digital resources into diagnosis, counseling, prevention, correctional-developmental, and psycho-educational activity	Moodle, Teams, Zoom, interactive boards, online questionnaires, digital psycho-educational resources, VR/AR scenarios, support platforms	Selects digital tools according to professional tasks; integrates technologies into support practice; adapts digital means to age and context
Analytical-diagnostic	Collects, interprets, and ethically uses data on learning progress, behavior, engagement, difficulties, and learners' needs; applies data to substantiate psycho-pedagogical decisions	Electronic journals, learning analytics, online diagnostics, feedback forms, digital observation cards, dashboards, data visualization tables	Interprets data and identifies significant indicators; sees risks and resources; uses results for targeted support; takes into account the limitations of digital diagnostics
Communicative-interactive	Builds empathic, inclusive, psychologically safe interaction in the digital environment, supports educational participants, moderates online communication, and prevents communicative risks	Videoconferencing tools, support chats, forums, shared documents, group-work platforms, and digital counseling scenarios	Maintains dialogue and feedback; conducts online communication within professional boundaries; prevents communicative risks; observes netiquette; creates an atmosphere of trust.

Design-innovative	Develops, adapts, promotes, and implements new digitally mediated forms of psychopedagogical work; generates ideas and creates innovative solutions in support, prevention, and development	Course design tools, authorial online modules, digital simulators, VR/AR, support chatbots, interactive cases, visualization services, digital storytelling, collaborative design platforms	Generates new ideas; adapts digital solutions to the context; develops original classes, cases, and modules; justifies the need for innovation; implements and evaluates outcomes
Subject-developmental	Includes self-organization, self-regulation, professional self-efficacy, continuous self-renewal, mastery of new technologies, resilience to change, and readiness for innovative professional activity	E-portfolios, digital reflective diaries, MOOCs, webinars, professional online communities, self-assessment tools, and individual planning instruments	Sets goals for professional growth; monitors personal progress; masters new digital practices; demonstrates independence, self-efficacy, resilience, and readiness for change
Socio-civic digital	Involves responsible participation in digital professional communities, promotion of psychological safety culture, media literacy, and digital citizenship; readiness for collaboration and professional interaction in the digital environment.	Professional online communities, psycho-educational platforms, social networks, publication services, collaborative project platforms	Participates in professional network communities; disseminates appropriate psycho-educational content; follows norms of digital citizenship; works collaboratively; promotes responsible attitudes toward the digital environment

The content analysis showed that the value-ethical and reflexive component has system-forming significance. For the future educational psychologist, the digital environment is not neutral, since it is associated with confidentiality, trust, learner vulnerability, the proper interpretation of digital data, and responsibility for psychologically safe interaction. Therefore, digital competence in this professional field should be subordinated not to the logic of technological efficiency as such, but to the logic of professional ethics and the humanistic orientation of educational support (UNESCO, 2023; Vuorikari et al., 2022). A second significant result was the identification of the digital-integrative, analytical-diagnostic, and communicative-interactive components. These components reflect a transition from understanding digital technologies as tools for information transmission to understanding them as resources for support, analysis of educational situations, flexible interaction, and

professionally grounded decision-making. This conclusion is consistent with studies emphasizing the importance of pedagogical technology integration, data literacy, online teaching agency, and the development of digital practices sensitive to context and learners' needs (Almerich et al., 2016; Cabero-Almenara et al., 2020; Damşa et al., 2021; Sandoval-Ríos et al., 2026).

Particular attention is given to the design-innovative component, as its inclusion in the model is justified by the fact that digital technologies do not automatically lead to innovation. Innovative effects emerge when the future specialist is able to generate new solutions, adapt them to environmental conditions, implement them, and critically evaluate the results. In this sense, digital competence becomes a resource for innovative behavior rather than an end in itself. This conclusion is in line with studies on innovative work behavior, where innovation is understood as a process of idea generation, promotion, and

implementation, dependent on self-efficacy, engagement, organizational support, and opportunities for professional experimentation (Atatsi et al., 2022; Dixit & Upadhyay, 2021; Jia et al., 2022).

Finally, the self-developmental and socio-civic digital components capture the personal and environmental perspective of meta-competence development. The future educational psychologist must not only master digital practices but also be prepared for continuous professional self-

renewal, participation in network communities, adherence to digital citizenship norms, and the dissemination of responsible psycho-educational content. These components ensure the transition from individual mastery of technologies to stable professional agency in digital space (OECD, 2019; Sala et al., 2020; UNESCO, 2023). For the purpose of subsequent empirical validation of the model, three levels of meta-competence development were distinguished: low, medium, and high (Table 2).

Table 2

Criteria and levels of meta-competence development in future educational psychologists in the digital educational environment

Metacompetence Component	Low Level	Medium Level	High Level
Value-ethical and reflexive	Fragmentarily recognizes ethical risks of the digital environment; has difficulty assessing the reliability of content; and insufficiently considers confidentiality and psychological safety.	Understands basic ethical requirements of digital interaction; in typical situations observes norms of confidentiality and safety; demonstrates partial reflection on personal digital actions	Systematically evaluates digital practices from the standpoint of professional ethics; anticipates risks for learners; makes well-grounded decisions; demonstrates a stable, reflexive, and responsible position.
Digital-integrative	Uses digital tools episodically and mainly as a technical add-on; resource selection is accidental; the link with psycho-pedagogical tasks is weak.	Selects digital means according to particular professional tasks; can use platforms, services, and online resources in support and teaching; needs methodological support for complex integration	Meaningfully integrates digital technologies into diagnosis, prevention, counseling, and support; selects tools according to goals, age, and context; ensures pedagogical and psychological appropriateness of digital solutions.
Analytical-diagnostic	Experiences difficulties interpreting digital data; treats results formally; does not always recognize the limitations of digital diagnostics	Uses feedback data, observation, and platform activity for general assessment; can identify some learner difficulties and resources	Interprets data comprehensively by combining quantitative and qualitative indicators; takes into account the limitations of digital tools; uses results for targeted psycho-pedagogical support and intervention design
Communicative-interactive	Experiences difficulties organizing productive communication in the digital environment; does not always observe netiquette; weakly manages online interaction.	Maintains business-like and benevolent communication; uses digital feedback channels; generally observes norms of digital interaction	Creates psychologically safe and empathic digital communication; effectively moderates interaction; prevents communicative risks; supports inclusion, trust, and professional boundaries.

Design-innovative	Reproduces ready-made digital solutions without adaptation; weakly designs original formats of work; innovation is situational.	Adapts known digital tools to psychological practice; can develop particular elements of classes, cases, and preventive materials.	Designs new digital formats of support, prevention, and development; creates original cases, modules, simulators, and scenarios; transforms professional tasks rather than merely replacing tools
Self-developmental	Depends on external instructions; has difficulty with self-assessment and planning professional growth; is unstable under technological change.	Realizes the need for professional self-development; uses some self-learning opportunities; is capable of partial self-regulation and goal setting	Demonstrates pronounced agency; independently masters new technologies; systematically engages in professional reflection; sets and achieves developmental goals.
Socio-civic digital	Passively participates in the professional digital environment; does not always understand norms of responsible digital behavior and public professional representation.	Observes basic norms of digital citizenship; participates in professional online communities; can disseminate appropriate psychological educational materials	Demonstrates a responsible professional position in digital space; participates in communities of practice; promotes the culture of psychological safety, media literacy, and ethical digital interaction

The proposed level model makes it possible to interpret meta-competence development as a movement from fragmented and predominantly instrumental use of digital means to their meaningful, integrated, ethically regulated, and innovation-oriented implementation. In this process, growth is expressed not only in greater technical confidence but also in the development of reflexivity, agency, analytical thinking, communicative maturity, and the ability to design psychologically safe digital practices. Such an understanding corresponds to the international tendency to describe the development of teachers' digital competence as a dynamic transition from basic technology use to transformative and leadership-oriented practice (Redecker, 2017).

Discussion. The results confirm that the meta-competence development in future educational psychologists within the digital educational environment cannot be reduced to the mastery of isolated digital tools. Contemporary international frameworks and empirical studies demonstrate that teachers' digital competence is increasingly understood as a multidimensional system that combines technological, pedagogical, ethical, critical, and reflexive dimensions (Redecker,

2017; UNESCO, 2023; Vuorikari et al., 2022). However, for the profession of educational psychologist, this logic remains insufficient: the structure of training must also include psychological mechanisms for ensuring trust, safety, targeted support, and professionally grounded choice in technologically mediated environments.

The proposed model is aligned with studies showing that digital competence acquires real professional meaning only when it becomes a resource for transforming practice. Research on digital competence emphasizes technology integration, data literacy, AI literacy, inclusion, and teacher agency, whereas research on innovative work behavior points to the importance of self-efficacy, engagement, collaborative climate, and organizational support in fostering innovative behavior among educators (Cabero-Almenara et al., 2020, 2022; Chan & Lee, 2023; Damsa et al., 2021; Dixit & Upadhyay, 2021; Jia et al., 2022). In this respect, our model integrates both analytical lines and allows digital technologies to be interpreted as a condition for the formation of innovation-oriented professional agency (Ng et al., 2021; Ouyang & Jiao, 2021).

Particularly significant is the identification of the value-ethical and reflexive component as system-forming. For educational psychologists, this component determines the acceptable boundaries of using digital tools, the modes of interpreting data, and the choice of interaction strategies with learners. Whereas more general pedagogical models often emphasize the efficiency of digital integration, psychopedagogical training is centrally concerned with how the digital environment affects psychological well-being, trust, vulnerability, self-relation, and learners' agency. Thus, strengthening the ethical and reflexive dimension is not an optional addition but a methodological necessity (Bond et al., 2024; Lee et al., 2024; Ng et al., 2021). At the same time, the results highlight the importance of the design-innovative and self-developmental components. Contemporary literature on innovative work behavior shows that innovation does not arise automatically from technological mastery; rather, it is mediated by personal resources, motivation, self-efficacy, collaborative culture, and a supportive environment (Atatsi et al., 2022; Jia et al., 2022; Zargar et al., 2025). Applied to the training of future educational psychologists, this means that the digital educational environment should be organized in such a way that students not only master tools, but also engage in case-based problem solving, the design of new support formats, reflexive analysis of practices, and the collaborative construction of professional solutions.

Several methodological limitations should also be acknowledged. First, the study is theoretical-conceptual in nature and does not include empirical validation of the proposed model. Second, the identified levels of formation constitute an authorial analytical rubric and require expert review and testing in real educational practice. Third, the field of digital competence research remains characterized by a predominance of self-report instruments, which limits the ecological validity of conclusions and further confirms the need for mixed-methods, longitudinal, and multilevel studies (Basilotta-Gómez-Pablos et al., 2022; Maderick et al., 2016). In this regard, a promising direction for

future research is the development of diagnostic tools that combine self-assessment, expert observation, analysis of digital products, and the solution of professional cases.

Conclusion. The study made it possible to provide a theoretical and methodological substantiation for the development of meta-competence in future educational psychologists through digital technologies as a multidimensional process of professional development in the digital educational environment. It was shown that digital technologies function not only as learning tools but also as an environment for the development of professional agency, ethical responsibility, analytical thinking, communicative maturity, and readiness for innovative professional action. It was established that the preparation of future educational psychologists requires moving beyond a narrowly instrumental understanding of digital competence. The proposed model comprises seven interrelated components: value-ethical and reflexive, digital-integrative, analytical-diagnostic, communicative-interactive, design-innovative, self-developmental, and socio-civic digital. Taken together, these components reflect both the professional specificity of helping activity and the contemporary challenges associated with the digital transformation of higher education.

The theoretical significance of the study lies in adapting international digital competence frameworks to the profile of the future educational psychologist and integrating these frameworks with the logic of innovation-oriented professional behavior. The practical significance lies in the possibility of using the proposed model in the design of educational modules, assessment criteria, and diagnostic tools in higher education. Further research perspectives include expert validation of the model, development of diagnostic instruments, empirical testing of the proposed levels of meta-competence development, and examination of the relationship between digital competence, self-efficacy, reflexivity, and readiness for innovative professional behavior in future educational psychologists.

References

- Almerich, G., Orellana, N., Suárez-Rodríguez, J., & Díaz-García, I. (2016). Teachers' information and communication technology competences: A structural approach. *Computers & Education*, 100, 110-125. <https://www.sciencedirect.com/science/article/pii/S0360131516301129>
- Amhag, L., Hellström, L., & Stigmar, M. (2019). Teacher educators' use of digital tools and needs for digital competence in higher education. *Journal of Digital Learning in Teacher Education*, 35(4), 203-220. <https://www.tandfonline.com/doi/abs/10.1080/21532974.2019.1646169>
- Atatsi, E. A., Curşeu, P. L., Stoffers, J., & Kil, A. (2022). Learn to innovate: an exploration of individual and team learning as antecedents of innovative work behaviours in Ghanaian technical universities. *Sustainability*, 14(7), 4012. <https://www.mdpi.com/2071-1050/14/7/4012>
- Basilotta-Gómez-Pablos, V., Matarranz, M., Casado-Aranda, L. A., & Otto, A. (2022). Teachers' digital competencies in higher education: a systematic literature review. *International Journal of Educational Technology in Higher Education*, 19(1), 8. <https://link.springer.com/content/pdf/10.1186/s41239-021-00312-8%E2%80%8E.pdf>
- Bond, M., Khosravi, H., De Laat, M., Bergdahl, N., Negrea, V., Oxley, E., ... & Siemens, G. (2024). A meta-systematic review of artificial intelligence in higher education: A call for increased ethics, collaboration, and rigour. *International Journal of Educational Technology in Higher Education*, 21(1), 4. <https://link.springer.com/article/10.1186/s41239-023-00436-z>
- Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O. (2018). Digital transformation in German higher education: student and teacher perceptions and usage of digital media. *International journal of educational technology in higher education*, 15(1), 48. <https://link.springer.com/article/10.1186/S41239-018-0130-1>
- Cabero-Almenara, J., Guillén-Gámez, F. D., Ruiz-Palmero, J., & Palacios-Rodríguez, A. (2022). Teachers' digital competence to assist students with functional diversity: Identification of factors through logistic regression methods. *British Journal of Educational Technology*, 53(1), 41-57. <https://bera-journals.onlinelibrary.wiley.com/doi/abs/10.1111/bjet.13151>
- Cabero-Almenara, J., Gutiérrez-Castillo, J. J., Palacios-Rodríguez, A., & Barroso-Osuna, J. (2020). Development of the teacher digital competence validation of DigCompEdu check-in questionnaire in the university context of Andalusia (Spain). *Sustainability*, 12(15), 6094. <https://www.mdpi.com/2071-1050/12/15/6094>
- Chan, C. K. Y., & Lee, K. K. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers? *Smart learning environments*, 10(1), 60. <https://link.springer.com/article/10.1186/s40561-023-00269-3>
- Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: the state of the field. *International journal of educational technology in higher education*, 20(1), 1-22. https://link.springer.com/article/10.1186/s41239-023-00392-8?utm_campaign=Bundle&utm_medium=referral&utm_source=Bundle
- Damşa, C., Langford, M., Uehara, D., & Scherer, R. (2021). Teachers' agency and online education in times of crisis. *Computers in Human Behavior*, 121, 106793. <https://www.sciencedirect.com/science/article/pii/S0747563221001163>
- Dixit, A., & Upadhyay, Y. (2021). Role of JD-R model in upticking innovative work behaviour among higher education faculty. *RAUSP Management Journal*, 56(2), 156-169. <https://www.emerald.com/rausp/article-abstract/56/2/156/365300>
- Domínguez, M. D. C. M., Navio, E. P., & Rivilla, A. M. (2020). University teachers' training: the Digital Competence/Formación del profesorado universitario en la Competencia Digital. *Pixel-Bit, Revista de Medios y Educación*, (58), 181-216. <https://go.gale.com/ps/i.do?id=GALE%7CA625576091&sid=googleScholar&v=2.1&it=r&linkaccess=abs>
- Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational technology research and development*, 68(5), 2449-2472. <https://link.springer.com/article/10.1007/S11423-020-09767-4>
- Jia, K., Zhu, T., Zhang, W., Rasool, S. F., Asghar, A., & Chin, T. (2022). The linkage between ethical leadership, well-being, work engagement, and innovative work behavior: the empirical evidence from the higher education sector of China. *International journal of environmental research and public health*, 19(9), 5414. <https://www.mdpi.com/1660-4601/19/9/5414>
- Lee, D., Arnold, M., Srivastava, A., Plastow, K., Strelan, P., Ploeckl, F., ... & Palmer, E. (2024). The impact of generative AI on higher education learning and teaching: A study of educators' perspectives. *Computers and Education: Artificial Intelligence*, 6, 100221. <https://www.sciencedirect.com/science/article/pii/S2666920X24000225>

- Ley, T., Tammets, K., Sarmiento-Márquez, E. M., Leoste, J., Hallik, M., & Poom-Valickis, K. (2022). Adopting technology in schools: modelling, measuring and supporting knowledge appropriation. *European Journal of Teacher Education*, 45(4), 548-571. <https://www.tandfonline.com/doi/abs/10.1080/02619768.2021.1937113>
- Maderick, J. A., Zhang, S., Hartley, K., & Marchand, G. (2016). Preservice teachers and self-assessing digital competence. *Journal of Educational Computing Research*, 54(3), 326-351. <https://journals.sagepub.com/doi/abs/10.1177/0735633115620432>
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054. <https://journals.sagepub.com/doi/abs/10.1111/j.1467-9620.2006.00684.x>
- Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, 100041. <https://www.sciencedirect.com/science/article/pii/S2666920X21000357>
- Organisation for Economic Co-operation and Development. (OECD). (2019). OECD learning compass 2030. OECD. <https://www.oecd.org/education/2030-project/teaching-and-learning/learning/>
- Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2, 100020. <https://www.sciencedirect.com/science/article/pii/S2666920X2100014X>
- Puentedura, R. R. (2013). SAMR: A contextualized introduction. Hippasus. http://hippasus.com/resources/sweden2013/SAMR_ABriefContextualizedIntroduction.pdf
- Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu*. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC107466/pdf_digcomedu_a4_final.pdf
- Sala, A., Punie, Y., Garkov, V., & Cabrera, G. M. (2020). LifeComp: The European framework for personal, social and learning to learn key competence. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120911/lcreport_290620-online.pdf
- Sandoval-Ríos, F., Pérez-Romero, N., & López-Núñez, J. A. (2026). Data literacy in Chilean and Spanish teacher education: a cross-sectional study of self-efficacy, digital competencies, and anxiety. *Cogent Education*, 13(1), 2611686. <https://www.tandfonline.com/doi/abs/10.1080/2331186X.2025.2611686>
- Sillat, L. H., Tammets, K., & Laanpere, M. (2021). Digital competence assessment methods in higher education: A systematic literature review. *Education sciences*, 11(8), 402. <https://www.mdpi.com/2227-7102/11/8/402>
- Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., ... & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and information technologies*, 28(6), 6695-6726. <https://link.springer.com/article/10.1007/s10639-022-11431-8>
- UNESCO. (2023). *Guidance for generative AI in education and research*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000386693>
- Vuorikari, R., Kluzer, S., Punie, Y., & Dahl, M. R. (2022). DigComp 2.2: Den digitale kompetenceramme for Borgerne. <https://pure.au.dk/portal/en/publications/digcomp-22-den-digitale-kompetenceramme-for-borgerne/>
- Zargar, P., Daouk, A., & Chahine, S. (2025). Driving innovative work behavior among university teachers through work engagement and perceived organizational support. *Administrative Sciences*, 15(7), 246. <https://www.mdpi.com/2076-3387/15/7/246>
- Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education*, 168, 104212. <https://www.sciencedirect.com/science/article/pii/S0360131521000890>

Information about the authors

Makulova Ainur, doctoral student of the educational program 8D01110 Pedagogy and Psychology, M. Auezov South Kazakhstan Research University, ORCID ID: 0000-0003-4647-1767, Scopus ID: 57863727400, institutional email: MakulovaAinur@aeuzov.edu.kz, email: makulovaa@list.ru

Tussubekova Kunslu, Candidate of Pedagogical Sciences, Senior Lecturer, Abai Kazakh National Pedagogical University, ORCID ID: 0000-0001-9776-6376, Scopus ID: 55945306800, institutional email: k.tusubekova@abaiuniversity.edu.kz, email: kunslu.tusubekova@mail.ru