ISSN 2077-6861
eISSN 2960-1649

ABAI KAZAKH NATIONAL PEDAGOGICAL UNIVERSITY

Pedagogy and Psychology

Vol 65, №4 (December 2025)

ALMATY

Founder: Abai Kazakh National Pedagogical University, re-registered with the Ministry of Information and Public Development of the Republic of Kazakhstan on December 22, 2023, No. KZ22VPY00084314
Publication timeframe: 4 times per year. Editorial office address:
13 Dostyk Ave., 050010, Almaty, +7(727)2919182

CONTENT

Innovative Approaches and Practices in Modern Education

Psychological and Pedagogical Problems of Professional Development of Education Specialists

General Information

About the Journal

Abai journal of Pedagogy and Psychology is a peer-reviewed scientific and methodological journal founded in 2009 by Abai Kazakh National Pedagogical University. The journal focuses on key issues in education at all levels, from early childhood to higher education, and serves as a platform for academic discourse, research dissemination, and professional development in the fields of pedagogy and psychology.

Aims and Scope

The journal publishes original research articles, theoretical analyses, and methodological developments in the following areas:

1. Innovative Approaches and Practices in Modern Education;
2. Psychological and Pedagogical Problems of Professional Development of Education Specialists.

Editorial Strategy

The editorial board adheres to the following principles:

3. Impartial and objective peer-review process;
4. High standards of scientific rigor and methodological accuracy;
5. Collective decision-making based on expert consensus;
6. Efficient and transparent communication with authors;
7. Full respect for intellectual property rights;
8. Strict adherence to the publication schedule;
9. Limitation of publication frequency to a maximum of two articles per author per calendar year.

Indexing and Recognition

Included in the List of peer-reviewed scientific journals recommended by the Science and higher education quality assurance committee of the Ministry of science and higher education of the Republic of Kazakhstan.

Indexed in the Kazakhstan Citation Base (KazCB).

Registration and Publishing Details

1. Initial registration: June 24, 2009 (No. 10219-Ж)
2. Re-registration certificate: No. KZ22VPY00084314 (issued December 22, 2023, by the Information Committee of the Ministry of Information and Public Development of the Republic of Kazakhstan).

Publication Frequency

Pedagogy and Psychology is published quarterly:

1. Issue 1 – March
2. Issue 2 – June
3. Issue 3 – September
4. Issue 4 – December

Review Process

All submitted manuscripts undergo a double-blind peer-review process. The review period typically ranges from 1 to 6 months.

Language of Publication

The journal publishes all articles in English.

Original Article
IRSTI 14.35.09 10.51889/2960-1649.2025.65.4.001

BAIZHANOV NURSEIT[1], ABDRASILOV BOLATBEK[1], HAO JINGANG[2], MAKHMUTOVA ALFIRA[3]*

[1]National Testing Centre, Ministry of Science and Higher Education (Astana, Kazakhstan)
[2]Educational Testing Service (Princeton, New Jersey, USA)
[3]New Uzbekistan University (Tashkent, Uzbekistan)

*Address of correspondence: Nurseit Baizhanov, First Deputy Director, National Testing Centre, Ministry of Science and Higher Education, Rodnikovaya 1/1 St., Astana, Kazakhstan; https://orcid.org/0009-0008-5302-9858, E-mail address: nurseit.baizhanov@testcenter.kz, nurbaizhanov@gmail.com, Tel.: +77020003063

Harnessing the Potential of AI Technologies in the National Educational Assessments in Kazakhstan

Abstract

Introduction: Artificial intelligence (AI) is being rapidly adopted in education, including the evaluation of student performance and the assessment of teacher professional capabilities. The following presents a discussion of AI's potential applications in each stage of Kazakhstan's national educational assessments, from test item development to piloting, adaptive administration, automated scoring, and results interpretation. *Methodology and Methods:* A literature review of academic reports and practical applications reveals that AI has significant potential to enhance the efficiency, objectivity, and analytical depth of assessments. *Results*: These AI solutions enable the development of multi-modal tasks, the identification and addressing of anomalies in piloting, intelligent proctoring during administration, transparent scoring of open-ended responses, and deep learning analytics. At the same time, challenges related to algorithmic bias, data privacy, ethical responsibility, and algorithmic reliability must be addressed to deploy AI successfully. *Scientific Novelty:* This study presents one of the first systematic analyses regarding how AI can be integrated into all stages of Kazakhstan's national assessment cycle and offers a unified conceptual model linking multimodal task development with adaptive delivery, automated scoring, and deep-learning-based diagnostic analytics. *Practical Significance:* It also recognizes the need to upgrade infrastructure, create regulations, train workers, and introduce robust quality assurance systems. When used systematically and progressively, AI can help make assessments more transparent, equitable, and efficient. This would turn extensive evaluation into a flexible instrument for enhancing instruction and learning.

Keywords: Artificial intelligence in national assessment system, national assessment system, test item generation, automated scoring, adaptive testing, learning analytics, AI-based proctoring.

Introduction. Artificial intelligence (AI) technology has developed rapidly in recent years, bringing a substantial impact to the field of education. Research has shown that education has greatly benefited from AI, and AI has already been extensively applied to the learning, teaching, and assessment of students (Chen et al., 2020). The advent of advanced generative models has increased the opportunity for productivity and efficiency. However, it has created a number of problems relating to ethical challenges and different ways of thinking about our assessment of students (Chiu et al., 2023; Cotton et al., 2024; Hao et al., 2024). The system of national educational assessments (surveys), a crucial cornerstone in the quality assurance of schooling, has not been unaffected by these trends.

The main national educational assessments (survey) in Kazakhstan is diversified: the Unified National Test (UNT) as main entrance exam for university; the Teacher Knowledge Test aimed at the assessment of teachers' theoretical professional knowledge (competences); the introductory exam for obtaining master's and doctoral degree; the Monitoring of Educational

Achievements of Students (MODO), a monitoring assessment system for the quality of education in secondary schools. MODO is an autonomous system of surveillance that integrates the phases of preparation, administration, processing, and analysis of results, as well as methodological support, in schools (Csapó & Molnár, 2019). These are helpful tools for all types of education, from secondary to college, and they would all benefit from modern AI technology.

This study aims to explore the potential applications of AI at each level of a national testing system, with a focus on Kazakhstan. AI applications are utilized for test item development, piloting, test administration, and result scoring, as well as for subsequent analysis at various levels of aggregation (class, school, region, and country). This paper discusses recent advancements in AI, including multimodal models, generative models, explainable AI (XAI), federated learning, adaptive testing, and cognitive/emotional analytics. It also provides guidelines on how to integrate these innovations into the operation of national assessment systems.

Materials and Methods. This study is a literature review examining the potential applications of AI in national educational assessments, with a focus on Kazakhstan. We collected data through a systematic search of peer-reviewed sources, including top Scopus and Web of Science journals, as well as thematic databases such as IEEE Xplore and Google Scholar. We searched for phrases related to "artificial intelligence in assessment", "AI in education", "automated scoring", "adaptive testing", and "national examinations". We focused on research studies published from 2015 through 2025, concentrating on pertinent research from the past decade and capturing the most recent studies and debates in the field (Attali & Burstein, 2006; Chiu et al., 2023; Wang et al., 2024). To consider an international perspective, we examined local sources that could lend credence, including regulatory documents, official publications, and ministerial reports, on the Unified National Test (UNT) and the Monitoring of Educational Achievements of Students. We captured current developments through public announcements and news on AI pilots in Kazakhstan. Internal analysis by co-authors and expert opinions also contributed to the study, especially regarding AI's role in reporting education quality (U.S. Department of Education, 2023).

We processed the collected data using qualitative content analysis. We coded and organized the information thematically into five stages of the testing cycle: test construction, piloting, administration, scoring, and results analysis (Martínez-Comesaña et al., 2023). This procedure involved a systematic identification of AI applications within each phase of the assessment process. To ensure trustworthiness, we compared information from international evidence, gathered from the literature, with government documentation and expert review in a triangulation exercise (Perrotta & Selwyn, 2020; Zawacki-Richter et al., 2019). The act of triangulation strengthens the validation process, in turn adding strength to the findings and reducing bias.

The Results section outlines our findings, providing examples from each phase of the testing cycle, along with specific examples of AI applications. Examples include models that generate items, models that make predictions for piloting purposes, models that support proctoring in the administration phase (often referred to as "AI-based proctoring"), natural language processing systems that automate scoring, and advanced learning analytics that are used to analyze results (Cotton et al., 2024; Perrotta & Selwyn, 2020; Martínez-Comesaña et al., 2023). The discussion also addresses potential challenges, such as algorithmic bias, data privacy, and infrastructure limitations, giving a clear view of both opportunities and risks (Perrotta & Selwyn, 2020; Zawacki-Richter et al., 2019).

Results. *Test Item Development.* The development of tests is a time-consuming and intellectually demanding process. Generating thousands of questions across various areas (meeting the right competencies, matching curricula and difficulty levels, and facilitating translation into multiple languages) is a

significant amount of work. The efficiency with which this process can be carried out can be transformed by AI technologies. In Kazakhstan, some initial measures are already being taken in this direction. The Ministry of Science and Higher Education has announced a pilot project that will utilize AI to develop questions during the UNT process (Mukanov, 2025; Nikitin, 2025). A national AI platform is being developed, which will load all textbooks. Draft questions will then be generated by the generative model and be subject to expert review and piloting before being conducted (Mukanov, 2025; Nikitin, 2025)

At this stage of the assessment cycle, the incorporation of AI technologies offers several key benefits. Itembank expansion: Automated generation can produce a large number of distinct questions, preventing candidates from memorizing those from previous years and thereby making the exam fairer. Developers estimate that the number of test items might increase exponentially by cloning and rephrasing stem questions into different forms (Nikitin, 2025).

Decreased error: AI algorithms can produce results aligned with their intended purpose without accounting for arbitrary human factors (random error or writers' personal bias). This also ensures exam material is developed fairly. Reduced labor and time: manual inputs from content experts are removed through automated item creation, freeing up time for them to focus on creative and methodological review. This reduces the time and costs of test preparation (Nikitin, 2025).

There are additional efficiencies to be gained by using more AI and optimizing the quality of the questions themselves. Contemporary AI models can generate multimodal and context-enriched questions that assess a broader range of skills. For instance, an AI could automatically generate questions associated with an image (or graph or video clip) (U.S. Department of Education, 2023).

One test task had a model watch a brief video about an environmental issue (an ocean oil spill) and then perform a set of relevant tasks (describing what caused the spill, selecting the relevant consequences from a list, and suggesting an environmental fix). Appropriate visualization aids were presented for each task (U.S. Department of Education, 2023).

Scenario exercises with an emphasis on soft skills could be an interesting idea that might work. The AI can place the candidate in a situation and then ask the candidate how or why they chose a particular course of action. Then the system takes into account not only the answer, but also the applicant's reasoning and emotional reaction. For example, an AI-written scenario could read, "You are a volunteer at a camp, and one of the participants breaks a safety rule," while the student views a video of the scenario. The student must then select an action and justify their answer. Based on students' responses, the system can evaluate soft skills, including decision quality, justification, and emotional stability, among others (U.S. Department of Education, 2023). Authentic, complex tasks like this are challenging to develop manually and are valuable for a more accurate measure of proficiency.

AI also allows us to construct diagram and figure-based questions. Generative image models, combined with computer vision methods, can also automatically generate illustrations (function graphs or diagrams) and associated questions (U.S. Department of Education, 2023). For instance, a system could draw a speed–time graph based on the physics syllabus and then challenge students with questions that test the concepts and applications of this theoretical knowledge, such as identifying trends, interpreting acceleration, and predicting outcomes under various conditions (U.S. Department of Education, 2023).

Test Piloting. Test questions are generally piloted before they are added to high-stakes tests to ensure they work and produce reliable results. This pilot phase can significantly benefit from AI. Intelligent algorithms can predict how people taking the test will perform and analyze pilot data to identify outliers, culling them before they can negatively impact the results. Notable instances of AI-enabled improvements at this stage include identifying the most frequently answered questions that students get

wrong (or those with the most variable answers), detecting potential biases (such as items that are answered correctly only by a particular group of students), or predicting which items might not be functioning as expected. AI makes sure that only authorized content is live on the exam for this kind of analysis. That decreases the chances of having questions that are inaccurate or discriminatory. AI models can also forecast the difficulty and discrimination of an item through the role of "test taker" that they play in the item descriptions. AI in the pilot is ultimately included in the improved item pool.

Test Administration and Security. Additionally, AI tools can enhance the governance of exams. One of these areas is cheating detection, which many AI-driven proctoring systems aim to improve by leveraging real-time test-taker monitoring via face recognition, gaze tracking, and other computer vision technologies that help a human proctor identify cheating or suspicious behavior. Identity verification can be verified through biometric systems, and AI surveillance may be used to control online examinations to ensure that the rules are followed (preventing unauthorized supports, such as audio or paper) (Perrotta & Selwyn, 2020). Another application is adaptive testing algorithms, which allow the difficulty or order of questions to be adjusted online based on the test taker. This would make the tests more efficient while also providing each student with a personalized experience that maintains the appropriate level of challenge. AI can also be used in tests to make them less stressful and more informative by reducing anxiety and ambiguity. For example, chatbots can help applicants or answer questions they may have about the application process. In aggregate, these AI-driven mechanisms strengthen the reliability and equity of the administrative process and are more pleasant for users. Automated assistants help event organizers keep tabs and identify problems quickly, making things easier for human monitors.

Scoring and Evaluation. Once testing is complete and feedback is gathered, the appraisal process begins. This stage is crucial for open-ended tasks that cannot be scored using correct-answer keys. Most test questions in Kazakhstan's national tests (such as the UNT) have been multiple-choice because they could be graded by computer. There is, however, an increasing demand to incorporate more open-ended tasks, such as essays, short constructed responses, oral responses (in language tests), and applied tasks. The scoring process involves not only handing out marks but also verifying that they have been awarded correctly and responding to challenges and re-marks. AI offers several methods to expedite scoring, reduce costs, and increase objectivity at this stage.

Automatic scoring of constructed responses is a big opportunity. Natural language processing (NLP) has made tremendous progress to the point where it can grade essays, short answers, and even free-form problem solutions with considerable accuracy. In practice, nonhuman scorers of AI-generated essays (such as ETS's E-rater, used in the TOEFL) are already in use in high-stakes standardized testing (Attali & Burstein, 2006). Modern neural network models can be trained on student response datasets graded by human scorers, and then assigned scores to new responses that are highly correlated with human ratings. Adopting such a system in Kazakhstan might help address the issue of smudging written answers in exams (for instance, the essay section of a language exam) or in other national exams that contain open-ended questions. Research suggests that AI may do so faster and more reliably than humans, accelerating scoring turnaround time and allowing human graders to concentrate on cases that game finds contentious or too close to call (Martínez-Comesaña et al., 2023). Automated scoring can also be transparent by applying explainable AI approaches. This is crucial for convincing stakeholders to trust the AI system, as it can explain the reasoning behind its scoring decisions. Grading in the future could be done in a variety of ways, with the AI handling initial scoring and humans reviewing disputed answers or samples. In this way, algorithms can learn from human input and improve their performance - a good strategy if future tests are more diverse in task types.

Another element is the deployment of AI for quality control in scoring. AI may be able

to uncover errors or inconsistencies within the grading process, such as when one group of answers is scored differently from the rest (or, in the worst-case scenarios, when there are signs of human bias in the form of scores). It can also help flag unusual or potentially errant occurrences (such as when one batch of answers appears to have been graded inconsistently) and assist in identifying potential bias. AI can also support the automation of the appeals procedure; for instance, when a student contests a score assigned by AI, an XAI system can explain the features of the answer that affected the score and help human judges determine the final verdict. Overall, AI-based testing solutions maintain the integrity of scores by accurately and equitably grading exams (Perrotta & Selwyn, 2020; Hao et al., 2024; Csapó & Molnár, 2019; U.S. Ministry of Education of the Republic of Kazakhstan, 2023; Martínez-Comesaña et al., 2023; Liang et al., 2025).

Reporting and Feedback. A step that is frequently overlooked when test scores are given is analyzing the test results to improve educational services. AI methods in learning and educational data analytics can transform raw test data into actionable insights at multiple levels. Such AI-based analysis could provide each student with detailed feedback on their work, identifying individual strengths and weaknesses, as well as areas that require improvement. Teachers and schools may also adjust their regimens or teaching styles in response to aggregated analysis that indicates which subjects or skills students struggled with. At the system level (district, region, or country), AI can identify larger patterns and uncover unfairness or bias. For example, AI might identify that students in certain areas struggle with algebra, or that specific demographic groups perform differently, patterns that may not be apparent from overall scores alone. These analyses provide a roadmap for specific actions to improve the quality and equity of education.

Applying AI to large-scale testing data can also help identify "hidden factors" that influence achievement, which regular statistical methods may not capture. AI systems can forecast future results, categorize schools or students based on similar performance profiles, and show how a particular change (such as the introduction of a new curriculum or a teaching intervention) is likely to affect test scores. Policymakers and school officials can draw on the data from these studies to make wise decisions for the future. They are used to inform the allocation of resources and interventions based on evidence, identifying gaps in competency in specific content areas or areas that could benefit from support to reduce inequalities. Conceptually, AI can take national assessments from merely ranking students to diagnosing the overall "educational health" of the system. As recent research suggests, using AI-assisted analytics in conjunction with assessment data can provide multi-level feedback: personalized suggestions for students and teachers on the one hand, and database guidance for system-level improvements on the other. Ultimately, this helps to form the closed loop between learning and assessment by transforming test scores into opportunities to improve teaching and learning.

Discussion. The examination of AI applications reported shows considerable promise for updating the national teaching and learning cycle. Relying on AI can enhance every aspect of the process, from test development to score reporting. Testing fairness and objectivity can improve, save resources, and yield more information from all stakeholders. AI helps tests shift the emphasis from purely recording scores to learning more about how students learn (like their cognitive strategies, learning gaps, and other difficult-to-observe things) (Perrotta & Selwyn, 2020).

However, doing so has several potential challenges and restrictions. For one thing, there are concerns about the reliability and validity of AI solutions. Items must also be highly aligned with the curriculum and at the appropriate difficulty level for automatic item generation. If an algorithm goes wrong, a bad question winds up on an exam. Therefore, what is needed is a multi-tiered quality control system that combines machine efficiency with expert human judgment. Similarly, AI-generated scoring models must be validated to ensure they accurately measure the right things and

yield scores comparable to those of traditional grading. AI tools will have to be tested and calibrated frequently to ensure assessments are valid.

The second question concerns moral responsibility. If an AI system makes a mistake, for example, if it gives the wrong score, or if an algorithm accidentally spits out sensitive information, who is responsible? Guidelines or regulations with clear definitions and the assignment of responsibility are necessary, including the authors of the algorithms, the agency that implements them (such as the Ministry or the National Testing Centre), and, perhaps, the education community as a whole. Matters such as the right of appeal in cases involving AI decisions (a student challenging an essay grade awarded by an algorithm) will need to be explicitly addressed in policy (Perrotta & Selwyn, 2020).

Also, data privacy is a crucial aspect. National exams are based on data from hundreds of thousands of students, and proposals to use more multimodal sensors (such as video, audio, and biometrics from proctoring) raise legitimate privacy concerns. Strong measures should be taken to safeguard personal information, such as encrypting sensitive data, de-identifying data, and potentially employing naïve federated learning methods, which means that personal data should not be consolidated in one place (Perrotta & Selwyn, 2020). Adopting "privacy by design" practices will be crucial from the initial system development stage to ensure the secure storage of student data.

We should also be mindful of the risks associated with bias and discrimination in AI systems. AI models are trained on historical data that may be biased. For example, assume that certain groups - say, students from rural areas - have always performed worse because they went to worse schools. A basic AI model could assume that those are the patterns it was "meant for" and overlook the actual problems. We need special rules for vetting algorithms and curbing bias to ensure that AI does not exacerbate already unfair circumstances. Based on the literature, AI testing should include a diverse range of individuals, and AI should be easily explainable for auditing purposes to prevent unfair disadvantage to any students (Zawacki-Richter et al., 2019). In a school with students from diverse cultures and socioeconomic statuses, trust and fairness must rule. That is why AI systems need to be transparent about the reasons behind their decisions.

Another set of issues concerns people's skills and infrastructure. Introducing AI that works at a national scale in testing will require expertise in both technology (such as AI development and data science) and assessment (test development and psychometrics) to be embedded within the same professionals. Training will be necessary for staff and teachers to use the new systems effectively, ensure they can access AI-generated analytics reports, and understand how to utilize the information. The technical standardization of the infrastructure must be enhanced. All testing sites require fast, reliable internet service, sufficient computers, and secure servers capable of storing large amounts of data simultaneously. Strong cybersecurity is an essential component of the digital assessment environment's security. Without equal infrastructure development, AI solutions may not work as planned or could even worsen inequalities (by which schools with more advanced technology might get a leg up over those with outdated equipment).

Regulations and laws will also have to change in response to these new technologies. It may require revising the rules and regulations governing exams to permit and regulate the use of AI officially. Therefore, the Ministries of Education, Science, and Higher Education may need to establish guidelines outlining the limitations and capabilities of automated systems in testing, the validation process for AI-generated content, procedures for handling appeals against AI-graded results, and data protection standards. Such a sound legal basis will legitimize the procedure and provide clarity for all parties when AI is used in high-stakes testing.

Social acceptance of AI in testing is also a factor to consider. Prospective teacher candidates, parents, and teachers may also show skepticism about the reliability of "machine" grading and content production.

There will be an educational piece required to develop familiarity and understanding among stakeholders to be transparent about how the AI systems work, their usefulness, as well as the safety protocols." Demonstrating, for example, that an automated scoring system can perform as well as human graders, or introducing examples of AI-generated questions that human experts have approved, can help people view AI as a helpful tool rather than a menace.

Kazakhstan's initiatives are part of a broader global interest in utilizing AI in education. Many countries are innovating in their schools by using adaptive testing, automated grading, and big data analysis. Kazakhstan has already initiated several pilot projects, including an AI-powered question-generation system for the UNT and a chatbot to assist university applicants. It appears justified to incorporate AI-driven data analytics into the MODO system and to test automated essay scoring on a multilingual corpus of texts from Kazakhstani learners (Uzbek and Russian). To date, few national assessment systems have implemented AI at scale, positioning Kazakhstan as a potential early adopter that could develop a national assessment with AI at its core; if implemented effectively, Kazakhstan may become one of the early international adopters of such an integrated AI-based assessment model. This demonstrates how to integrate new technology with a human-centered evaluation process. This approach aimed to maximize the utilization of AI technology while keeping humans in the loop to review and explain the results (US. Department of Education, Office of Educational Technology, 2023).

It is also necessary to consider how poorly constructed an AI assessment might be, especially in light of the new challenges that AI (particularly generative AI) creates for essential and routine testing. As has been said before, students can cheat or evade real test problem-solving more readily now that they have tools like ChatGPT at their disposal. This can render conventional tests less helpful. To retain the fidelity of knowledge assessment, even in an era of disruption, assessment formats may also need to adapt. One direction increasingly highlighted in contemporary assessment research is that schools should teach more skills and tasks less prone to automation, such as creativity, collaboration, and vocational skills. If automated intelligence can solve "procedural" fundamental factual problems, it does not make sense to require kids to reproduce those answers on a test. In the future, national assessment systems may need to transition to include more performance-based tasks, project work, or authentic experimental problem-solving involving human creativity or physical interaction, domains where AI tools can assist teachers in judgment, rather than deceiving students. In summary, there are two key providers of AI: it assists us in better measuring, and it challenges us to rethink what we measure and how we do it, so that tests remain fit for purpose in the AI age. In the future, artificial intelligence (AI) could help evaluate this system more accurately and fairly. It could even help students master the higher-order skills education is supposed to teach.

Simultaneously, it is essential to understand AI integration not just as an improvement in technology, but as a shift in the strategic function of assessment. National assessments can shift from a ranking-based approach to directly supporting teaching and learning by providing customized feedback to students and guidance for educational policy. Together with expert and moderated human judgment, AI can enhance the assessment process to be more adaptive, inclusive, and competency-based in the twenty-first century.

Conclusion. This research suggests the potential to integrate artificial intelligence (AI) into Kazakhstan's national assessment system to create a more holistic, equitable, and efficient system. This study demonstrates how and where AI can be integrated within the testing process, from item generation and piloting stages to administration, reporting, and analysis. These integrations could facilitate the development of valid and reliable assessment instruments, enhance transparency within the assessment process, and provide more comprehensive feedback for candidates, teachers, and

policymakers. The primary contribution of this study is to contextualize and systematize the perspective on integrating AI technologies into national educational assessment processes. By synthesizing the expansive international literature on AI within a national context, this study contributes to the scientific development of understanding the role of AI in large-scale assessment. This also provides a conceptual foundation for developing a further empirical research agenda and underpins a pathway to modernize assessment systems that are better aligned with the formative competencies needed for the twenty-first century.

References

Attali, Y., & Burstein, J. (2006). Automated essay scoring with e-rater® V. 2. *The Journal of Technology, Learning and Assessment*, *4*(3). http://ejournals.bc.edu/index.php/jtla/article/view/1650

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, *8*, 75264-75278. https://ieeexplore.ieee.org/abstract/document/9069875/

Chiu, T. K. F., Lin, T. J., & Lonka, K. (2023). Repositioning higher education in an era of AI: Perspectives on ChatGPT. *Journal of Applied Learning & Teaching, 6*(1), 1–22. https://journal.alt.ac.uk/index.php/jalt/article/view/2932

Cotton, D. R., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, *61*(2), 228-239. https://www.tandfonline.com/doi/abs/10.1080/14703297.2023.2190148

Csapó, B., & Molnár, G. (2019). Online diagnostic assessment in support of personalized teaching and learning: The eDia system. *Frontiers in Psychology*, *10*, 1522. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2019.01522/full

Hao, J., von Davier, A. A., Yaneva, V., Lottridge, S., von Davier, M., & Harris, D. J. (2024). Transforming assessment: The impacts and implications of large language models and generative AI. *Educational Measurement: Issues and Practice*, *43*(2), 16-29. https://onlinelibrary.wiley.com/doi/abs/10.1111/emip.12602

Liang, J., Stephens, J. M., & Brown, G. T. (2025). A systematic review of the early impact of artificial intelligence on higher education curriculum, instruction, and assessment. In *Frontiers in Education, 10*, 1522841. https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2025.1522841/full

Martinez-Comesana, M., Rigueira-Díaz, X., Larranaga-Janeiro, A., Martínez-Torres, J., Ocarranza-Prado, I., & Kreibel, D. (2023). Impact of artificial intelligence on assessment methods in primary and secondary education: Systematic literature review. *Revista de Psicodidactica (English ed.)*, *28*(2), 93-103. https://www.sciencedirect.com/science/article/pii/S2530380523000072

Ministry of Education of the Republic of Kazakhstan. (2023). In Kazakhstan, the development of artificial intelligence for automatic checking of students' work has begun. https://www.gov.kz/memleket/entities/edu/press/news/details/537190?lang=ru

Mukanov, B. (2025). How artificial intelligence will be used when passing the UNT. *Zakon.kz*. https://www.zakon.kz/nauka/6468208-kak-iskusstvennyy-intellekt-budut-ispolzovat-pri-sdache-ent.html

Nikitin, S. (2025). Questions for the final UNT exam for schoolchildren will be generated by: The number of questions will increase exponentially. *DigitalBusiness.kz.* https://digitalbusiness.kz/2025-02-24/voprosi-vipusknogo-ent-dlya-shkolnikov-budet-generirovat-ii-kolichestvo-zadaniy-kratno-vozrastet/

Perrotta, C., & Selwyn, N. (2020). Deep learning goes to school: Toward a relational understanding of AI in education. *Learning, Media and Technology*, *45*(3), 251-269. https://www.tandfonline.com/doi/abs/10.1080/17439884.2020.1686017

U.S. Department of Education, Office of Educational Technology. (2023). Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations. https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf

Wang, S., Wang, F., Zhu, Z., Zhao, X., & Hu, Y. (2024). Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications, 252*(Part A), Article 124167. https://doi.org/10.1016/j.eswa.2024.124167

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators?. *International Journal of Educational Technology in Higher Education*, *16*(1), 1-27. https://link.springer.com/article/10.1186/S41239-019-0171-0

Information about authors:

Baizhanov Nurseit, Candidate of Legal Sciences, First Deputy Director, National Testing Center, Ministry of Science and Higher Education of the Republic of Kazakhstan. ORCID ID: 0009-0008-5302-9858, email: nurbaizhanov@gmail.com

Abdrasilov Bolatbek, Doctor of Biological Sciences, PhD in Physical and Mathematical Sciences, Corresponding Member of the National Academy of Sciences of the Republic of Kazakhstan, Chairman of the National Testing Center, Ministry of Science and Higher Education of the Republic of Kazakhstan. ORCID ID: 0009-0002-1371-6211, email: info@testcenter.kz

Jiangang Hao, PhD, Research Director, ETS Research Institute (USA), Associate Editor of Frontiers in Psychology: Quantitative Psychology and Measurement, and a regular reviewer for over ten high-impact journals, including Psychometrika, Journal of Educational Measurement, and Computers & Education. ORCID ID: https://orcid.org/0000-0003-0502-7571, email: jhao@ets.org

Makhmutova Alfira, Assistant Professor, New Uzbekistan University, Tashkent/Republic of Uzbekistan. ORCID ID: https://orcid.org/0000-0002-8597-7667, email: alfira2002@gmail.com

Original Article
IRSTI 14.35.07 10.51889/2960-1649.2025.65.4.002

ASYLBEKOVA MARZIYA[1], SHAIKHYMURATOVA INDIRA[1],*
OSPANOVA DINARA[2], TURYMTAEVA BIBINUR[2]

[1]L.N. Gumilyov Eurasian National University (Astana, Kazakhstan)
[2]East Kazakhstan University named after S. Amanzholov (Ust-Kamenogorsk, Kazakhstan)

*Address of correspondence: Asylbekova Marziya, L.N. Gumilyov Eurasian National University,
K. Munaitpassov Str., 11, Astana, 10000, Republic of Kazakhstan, https://orcid.org/0000-0001-7529-8022,
E-mail address: marziya_asylbekova@mail.ru/Tel.:+77011257971

Comprehensive Prevention of Social Ostracism and Strengthening of Inclusion in the University Environment

Abstract

Introduction. The study focuses on reducing social ostracism and strengthening students' sense of belonging in the university setting by implementing a comprehensive, theoretically grounded programme that combines early identification of risk, mentoring support, and structured collective activities. *Methodology and Methods*. A mixed-method, quasi-experimental before–and–after design without randomization was carried out with 161 undergraduate students and 34 faculty members; standardized assessment of ignoring, exclusion, and rejection via the OES-A scale was supplemented by a structured questionnaire, correlation and regression analyses, as well as brief focused group discussions to interpret and refine the quantitative findings. *Results.* The data showed that participation in the SOCI-Progress programme was associated with a statistically and practically significant reduction in all three components of ostracism (ignoring, exclusion, rejection), a weakening of the interscale correlations that previously reflected a tightly linked pattern of exclusion, and a marked increase in student involvement in mentoring, clubs, and initiative-based activities, particularly among first-year students. *Scientific novelty*. The study empirically substantiates the effectiveness of a multi-level, practice-oriented model in which educational modules, mentoring, and social integration initiatives together lower not only mean levels of ostracism but also the strength of connections between its components, thereby changing both individual experiences and typical patterns of interaction within the institution. *Practical significance*. The SOCI-Progress model can be used to improve the quality of the educational environment, to organize differentiated support for vulnerable groups (especially first-year and minority-status students), and to maintain higher motivation for participation in academic, social, and research activities through the systematic development of mentoring, open student groups, and combined offline/online support formats.

Keywords: adaptation, engagement, inclusivity, integration, interpersonal interaction, mentorship, prevention, social ostracism.

Introduction. Social ostracism, experiences of being ignored, excluded, or rejected, remains a pervasive risk in contemporary higher education, undermining students' motivation, well-being, and engagement. Global evidence indicates that a substantial share of learners encounter hostile or exclusionary climates at school and university, with tangible consequences for safety, mental health, and learning outcomes (UNESCO, 2019). Beyond immediate distress, meta-analytic and longitudinal research shows that even brief episodes of ostracism produce robust ordinal effects on need-threat and pain, while chronic exposure elevates risks of depression and disengagement from academic life (Hartgerink et al., 2015; Rudert et al., 2021).

The present study is grounded in well-established theoretical lenses. Williams' temporal need-threat model conceptualizes ostracism as a sequence of reflexive pain, reflective coping, and potential resignation, illuminating why repeated exclusion is particularly harmful in developmental contexts such as university settings (Williams, 2009). Social identity processes help explain how in-group norms and status hierarchies seed exclusion of perceived

"outsiders" in diverse cohorts (Hornsey, 2008). In parallel, social learning theory suggests that exclusionary or inclusive behaviors are modeled, reinforced, and transmitted through everyday interactions among peers and faculty (Bandura & Hall, 2018). Self-determination theory further predicts that when the basic needs for relatedness, competence, and autonomy are thwarted by ostracism, motivation and adaptive functioning deteriorate (Ryan & Deci, 2000).

Empirical work with adolescents and university students corroborates these mechanisms. School-based studies link ostracism to lower prosocial behavior, poorer self-concept, and conduct problems (Arslan, 2021), while experimental and field evidence shows that excluded individuals become more susceptible to social influence and conformity pressures, responses that may entrench problematic dynamics in classrooms and online groups (Carter-Sowell et al., 2008). In digitally mediated campus life, cyber-ostracism and social-media exclusion replicate and sometimes amplify offline patterns, mediating the relationship between stress and well-being and intensifying loneliness through addictive engagement loops (Smith et al., 2017; Schneider et al., 2017; Tang & Duan, 2023; Çiftci et al., 2023). Minority-status students, especially those with visible ethnic or migratory backgrounds, report higher levels of ostracism and weaker belonging, with downstream academic and psychological costs.

Against this backdrop, we develop and evaluate SOCI-Progress, a structured, context-sensitive intervention that integrates early detection, mentorship, and skills-based collective activities to prevent ostracism and strengthen inclusion in the university environment. To capture prevalence and severity across key dimensions (ignoring, exclusion, rejection), we employ the validated Ostracism Experience Scale for Adolescents (OES-A). Our aims are threefold: to estimate baseline levels and patterns of social ostracism among students; to test whether SOCI-Progress reduces ostracism and disrupts correlations among its components; and to situate observed changes within the theoretical frameworks of need-threat, social identity, social learning, and self-determination. In doing so, the study contributes actionable evidence for universities seeking to translate established psychosocial theory into scalable practices that improve belonging, engagement, and student well-being.

Materials and Methods. A mixed-method, quasi-experimental before–and–after design without randomization was applied to a single cohort. The quantitative strand examined shifts in the level and configuration of social ostracism before and after the SOCI-Progress intervention. The qualitative strand served to clarify the dynamics revealed in the survey data via brief, focused group discussions. Selection and comparison were conducted across subgroups (faculty affiliation and year of study) and according to indicators of academic engagement. Consistent with evidence on belongingness, anticipated differences in exclusion experiences among students with minority status were integrated into the sample stratification plan (Janke et al., 2024).

The research took place at the Faculty of Journalism and Social Sciences of L.N. Gumilyov Eurasian National University in Astana, Kazakhstan. The student sample included 161 undergraduates from the 1st to 4th year enrolled in Psychology, Philosophy, and Sociology programs. Eligibility criteria were full-time enrolment, age between 17 and 23 years, and provision of informed consent. Students who left more than 20% of key questionnaire items unanswered were excluded from the analysis. Additionally, 34 faculty members from the same faculty completed a supplementary survey on interaction practices and support mechanisms. Recruitment was organized via academic groups (announcements during classes) and through online notices on the faculty's information channels.

Experiences of social ostracism were measured with the Ostracism Experience Scale for Adolescents (OES-A), adapted for use with university students. The scale comprises three subscales; ignoring, exclusion, and rejection (Gilman et al., 2013). Responses were given on a 5-point Likert scale, and mean values were computed for each subscale. Internal

consistency (Cronbach's α) for each subscale was evaluated in this sample at both time points.

Along with the OES-A, a structured questionnaire was used to obtain information on:

– sociodemographic characteristics (age, gender);

– year and programme of study;

– frequency of involvement in university activities (clubs, events, projects);

– mentoring experience (as a provider and/or recipient of support);

– self-rated social skills and confidence in interpersonal interaction.

These indicators were used as covariates in the analysis and for a descriptive profile of the sample. The OES-A was chosen because it provides a validated and reproducible measure of core forms of ostracism in youth and student populations (Gilman et al., 2013). Stratification by belongingness and vulnerability is based on empirically established differences in experiences of exclusion and their associations with belonging and well-being among minority-status students, which is essential for designing interventions and examining heterogeneous effects (Janke et al., 2024).

The SOCI-Progress programme was carried out over one academic year and included three interrelated components:

1. Structured engagement: group projects, discussion clubs, and interdisciplinary tasks aimed at increasing positive contact and joint activities among students from different years and departments.

2. Social support and mentoring: pairing senior and first-year students, holding regular mentoring meetings, and providing targeted support during key adaptation periods (such as the first semester and exam sessions).

3. Development of social awareness: lectures and workshops on the mechanisms of ostracism and social exclusion, together with training sessions on empathy and emotional intelligence.

For this study, the procedure was structured into three stages:

– T_0 (baseline). Administration of the OES-A and the supplementary questionnaire to students, along with a short faculty survey on interaction and support practices.

– Implementation stage. Delivery of the SOCI-Progress modules and mentoring activities over the academic year, with monthly monitoring of reach (attendance records and brief feedback notes).

– T_1 (follow-up). Re-administration of the OES-A and the engagement questionnaire to the same cohort of students, complemented by concise, focused subgroup discussions to contextualize the quantitative results and clarify perceived changes in the climate of belonging.

All procedures were carried out in accordance with local regulations governing research involving human participants. Informed consent was obtained from every participant before data collection began. Questionnaires were anonymized using respondent codes, and access to the data set was limited to members of the research team.

Data analysis was conducted in several stages. Initially, descriptive statistics were computed for all variables: proportions and percentages for categorical indicators, and means with standard deviations for continuous measures, including the OES-A subscales. Summary tables were then compiled to show the distribution of ostracism levels by subscale and across different subgroups.

To assess change between T_0 and T_1, relative percentage shifts were computed for each OES-A subscale. Pre–post differences in mean scores were examined using paired t-tests, and where the assumptions of these tests were violated, suitable nonparametric alternatives were employed. The threshold for statistical significance was set at $\alpha = 0.05$ (two-sided).

To explore the interrelations between the components of ostracism, Pearson correlation coefficients were calculated among the three OES-A subscales at T_0 and T_1. This made it possible to assess the "systemic" character of stigma and to determine whether the associations between subscales weakened after the intervention.

Comparisons were also carried out by year of study and academic field (Psychology, Philosophy, Sociology). Where appropriate, linear regression models were estimated to

adjust for demographic factors (age, gender) and engagement-related indicators (participation in initiatives, mentoring experience), to examine heterogeneous effects and minimize potential confounding.

Missing data were addressed in two stages. Cases with only occasional single missing items were handled via listwise deletion in the corresponding analyses. In instances where systematic missingness on key variables exceeded 5%, the option of applying multiple imputation was examined and noted in the analysis log. Measurement reliability was evaluated by computing Cronbach's α for each OES-A subscale separately at T_0 and T_1 (Gilman et al., 2013). This analytical approach enabled us to capture both general shifts in ostracism levels and changes in the structure of links between its components, while also accounting for subgroup variation and the wider context of academic engagement and support.

Results. According to a survey of 161 students and 34 faculty members, episodes of social isolation are widespread: 61% of participants reported at least one instance, 55% reported exclusion in informal communication, and 47% avoided contact due to fear of rejection (Table 1). On the OES-A scale, the most pronounced subscales are Ignoring (3.2) and Rejection (3.5), while Exclusion has a lower value (2.8) (Table 2). The distributions of levels show that 33% of students experience high levels of ignoring, and 45% experience high levels of rejection (Table 3).

Table 1

Survey results on social ostracism among university students

Question	Answer Options	Percentage of Respondents
Your age	18-19 years old	40%
	20-21 years old	35%
	22-23 years old	25%
Your gender	Male	42%
	Female	58%
Have you ever experienced social isolation in a university setting?	Yes	61%
	No	39%
In which situations have you felt excluded?	During academic discussions	30%
	When assigned to group tasks	45%
	In informal communication with classmates	55%
Where do you most often experience social exclusion?	In the academic environment	38%
	In dormitories or student clubs	25%
	On social media	37%
Do you often avoid communication due to fear of rejection?	Yes	47%
	No	53%
What strategies do you use to prevent social isolation?	Active participation in student events	42%
	Communication on social media	35%
Question	Answer Options	Percentage of Respondents
	Seeking support from friends or faculty	23%
How often do you participate in university social initiatives?	Never	30%

	Once per semester	30%
	Regularly	40%
Have you participated in mentorship programs or student support projects?	Yes	29%
	No	71%
Do you discuss social adaptation issues with professors or academic advisors?	Yes	31%
	No	69%
What type of support do you consider most important at the university?	Creating support and mentorship groups	40%
	Developing collective event programs	35%
	Raising student awareness about ostracism	25%
Do you believe the university should actively support students experiencing social isolation?	Yes	85%
	No	15%

The survey reveals a significant underlying vulnerability: 61% of students have experienced social isolation at least once, with the greatest difficulties occurring in informal interactions (55%), suggesting that ostracism is shifting to everyday, less visible contexts. Almost half (47%) avoid social interactions due to fear of rejection, and low engagement in support initiatives (71% did not participate) despite high societal demand (85% believe the university should be more proactive in providing support) demonstrates a gap between needs and the availability of support tools and justifies the urgent need to scale up adaptation and mentoring programs.

Table 2

Average scores for different forms of social ostracism

Scale	Average Score	Level
Ignoring	3.2	Medium
Exclusion	2.8	Below Average
Rejection	3.5	Above Average

The profile of OES-A mean scores shows a predominant contribution from the "Rejection" subscale (3.5 – above average), followed by "Ignoring" (3.2 – average), while "Exclusion" is less pronounced and less common (2.8 – below average). In other words, students are more likely to experience personalized rejection and passive disengagement than overt instances of exclusion from activities. Therefore, the priority for prevention is to regulate everyday communication practices, develop empathic feedback, and reinforce rules for inclusive behavior in groups.

Table 3

OES-A scale results on ostracism experience among students

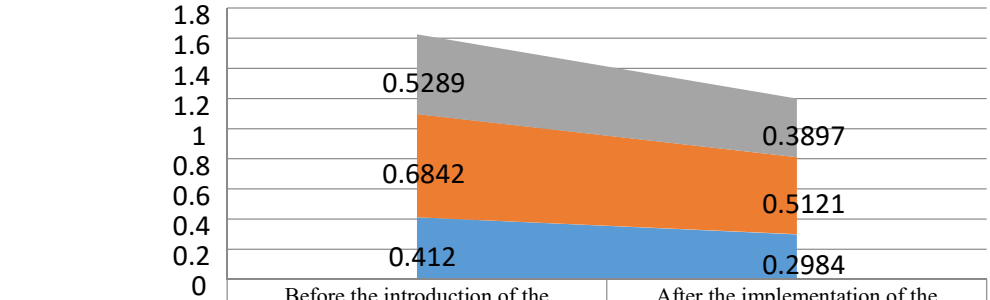
Level of Ostracism Experience	Ignoring (%)	Exclusion (%)	Rejection (%)
Low (1.0 - 2.4)	22%	31%	18%
Medium (2.5 - 3.4)	45%	43%	37%
High (3.5 - 5.0)	33%	26%	45%

The distributions by level confirm the "risk asymmetry": 45% of students scored high on the "Rejection" subscale – the highest proportion among the three dimensions; 33% scored high on "Ignoring", and 26% scored high on "Exclusion". Consequently, the most vulnerable group of students is those with persistent experiences of rejection; for them, targeted support formats (peer mentoring, small groups) are a priority. For the broader group with average "Ignoring" scores, universal measures are advisable – including inclusion rules in classes, structured group assignments, and regular monitoring of the study group climate.

Correlation analysis before the implementation of the method confirmed the holistic nature of the phenomenon: "Ignoring" is strongly related to "Rejection" ($r = 0.6842$; $p < 0.0001$) and to a moderate degree to "Exclusion" ($r = 0.4125$; $p = 0.0023$); the relationship between "Exclusion" and "Rejection" is also statistically significant ($r = 0.5289$; $p = 0.0005$). These dependencies are further compared with changes after the intervention (Figure 1).

Figure 1

Changes in correlation analysis after the implementation of the "SOCI-Progress"



	Before the introduction of the methodology	After the implementation of the methodology
Exclusion - Rejection	0.5289	0.3897
Ignoring - Rejection	0.6842	0.5121
Ignoring - Exclusion	0.412	0.2984

Figure 1 shows that after the implementation of the SOCI-Progress, the interscale correlations of ostracism significantly weakened: the strongest pre-intervention correlation, Ignoring–Rejection, decreased (≈0.68 → ≈0.51), and the correlations Exclusion–Rejection (≈0.53 → ≈0.39) and Ignoring–Exclusion (≈0.41 → ≈0.30) also decreased; with the greatest relative decrease noted for the Ignoring, Exclusion pair. This indicates a "break" in the vicious circle, whereby the experience of one form of exclusion is less likely to provoke others; the social climate becomes less systemically alienating, and individual episodes are less likely to become entrenched as stable patterns. At the same time, the preservation of statistical significance of the relationships emphasizes the need for supportive measures and their focus on the remaining nodes, primarily on the Ignoring-Rejection dyad.

The intervention included discussion clubs, lecture modules on the mechanisms of ostracism, emotional intelligence training, the "Student Mentor" mentoring program, the "Student Unity" and "Open Groups" initiatives, and research projects. A list of key activities and target outcomes is presented in Table 4.

Table 4

Key activities and results of the "SOCI-Progress" implementation

№	Activity Area	Event	Objective	Achieved Result
1	Interactive Educational Projects	Discussion Clubs «SOCI-Dialogues»	Developing an understanding of ostracism and inclusion through group discussions	70% of students reported increased awareness of social isolation issues

		Educational Lectures «Ostracism and Its Impact on Personality»	Raising student awareness about the mechanisms and consequences of social isolation	80% of participants became more conscious of social interactions
		Empathy and Emotional Intelligence Training	Developing skills for understanding others' emotions and effective communication	60% of students noted improvement in communication skills
2	Practical Social Integration Initiatives	Mentorship Program «Student Mentor»	Reducing social isolation among first-year students through senior student support	45% of first-year students participated, and their engagement in student life increased by 30%
		Campus Initiatives «Student Unity»	Creating a supportive and cohesive student environment	25% more students registered in university clubs compared to the previous year
		«Open Groups» Project	Facilitating interdisciplinary interaction and expanding students' social circles	50% of students reported an increase in social connections and reduced feelings of isolation
3	Research Activities	Surveys and Interviews «Student Voice»	Identifying key factors influencing social isolation	Collected data helped adjust anti-ostracism strategies
		Project «Social Barriers and Ways to Overcome Them»	Analyzing isolation issues and developing solutions	15 student projects were presented with practical recommendations to reduce ostracism
		Publication of Academic Articles	Enhancing academic engagement and promoting the topic of social integration	10 student papers were published in the university journal

Table 4 demonstrates that the multi-level implementation of SOCI-Progress resulted in coordinated cognitive, behavioral, and institutional shifts: in the educational block, awareness of stigma increased (70–80%) and communication skills improved (60%); in the practical block, mentoring reached 45% of first-year students and increased their engagement by 30%, registration in student clubs increased by 25%, and 50% of students noted expanded social connections and a decrease in feelings of isolation; in the research block, rapid strategy adjustments based on the collected data, the presentation of 15 applied projects, and the publication of 10 student articles. Taken together, this confirms that the combination of educational modules, structured engagement, and research reflection effectively reduces the risks of social exclusion and reinforces inclusive practices at the institutional level.

Comparison of the means before and after the intervention shows statistically and practically significant decreases: "Ignoring" -17.6% (3.4→2.8), "Exclusion" - 20.8% (2.4→1.9), "Rejection" -18.2% (3.3→2.7) (Table 5; Figure 2).

Table 5

Changes in student involvement in social projects after implementing the "SOCI-Progress" methodology

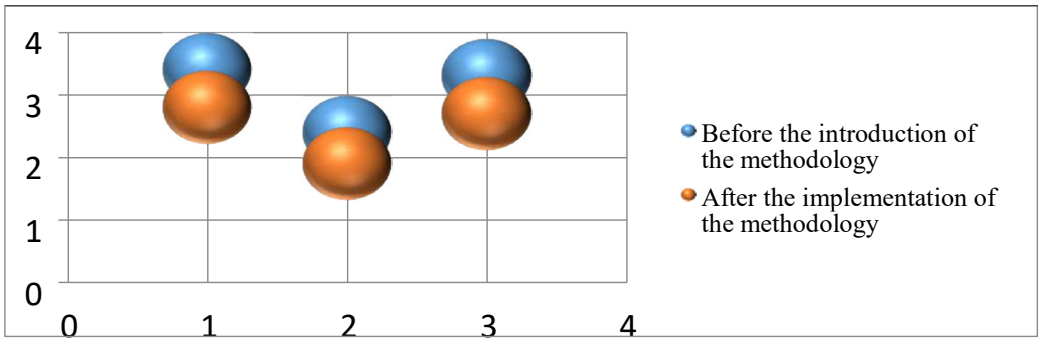
Faculty	Year	Overall Result	Strengths	Weaknesses
Psychology	1st	Social isolation level decreased by 20%	Increased confidence in communication, active participation in adaptation programs	Difficulties in establishing social connections persist
Psychology	2nd	Engagement in group discussions increased by 15%	Ability to apply knowledge of group dynamics in real-life situations	Additional work is needed on conflict resolution skills
Sociology	3rd	Social activity level increased by 18%	Higher involvement in research projects and practical activities	Some students struggle with balancing academic workload and social initiatives
Sociology	4th	Mentorship engagement increased by 25%	Development of leadership qualities, active participation in first-year student support programs	Overload with project activities, requiring better task distribution

Philosophy 1st	Social isolation level decreased by 10%	Increased participation in group discussions	Primarily, a theoretical understanding of social isolation, a low level of practical engagement
Philosophy 2nd	Interpersonal communication skills improved by 12%	Participation in roundtable discussions increased awareness of the ethical aspects of isolation	Low level of involvement in practical initiatives persists

Table 5 records a heterogeneous, but overall positive shift in engagement after the launch of SOCI-Progress. In psychology, a rapid "adaptation" effect is observed in the junior years: isolation decreased by 20% among first-year students, although difficulties in establishing connections remained; participation in group discussions increased by 15% among second-year students, but a deficit in conflict resolution skills was evident. In sociology, an increase in social activity was noted among third-year students (+18%), and a significant transition to mentoring was observed among fourth-year students (+25%), although there was a risk of overload and the need to distribute tasks. Initial improvements were observed in philosophy (-10% isolation among first-year students; +12% interpersonal skills among second-year students), but engagement remains predominantly theoretical with a low level of practice. Conclusion: differentiated support is needed for psychology, an emphasis on networking and conflict management training; For sociology, this means managing academic workload and project time; for philosophy, this means strengthening practice-oriented approaches (case studies, mentoring, service projects) to translate increased awareness into sustainable behavioral changes.

Figure 2

Average scores before and after implementation of the «SOCI-Progress» Methodology



The figure "Average Scores Before and After Implementation of the SOCI-Progress Methodology" shows a significant decrease in all three components of ostracism: ignoring decreased from 3.4 to 2.8 (-17.6%), exclusion from 2.4 to 1.9 (-20.8%; the most significant relative decline), and rejection from 3.3 to 2.7 (-18.2%). Taken together, this indicates an improvement in the social climate and a reduction in both passive and active forms of exclusion. The greatest effect was observed for the "exclusion" indicator, which is targeted for group integration programs, consistent with the objectives of mentoring and structured group activities.

After the intervention, interscale correlations weakened: Ignoring–Exclusion $r = 0.2984$ ($p = 0.015$), Ignoring–Rejecting $r = 0.5121$ ($p < 0.0001$), and Exclusion–Rejecting $r = 0.3897$ ($p = 0.0029$). The greatest relative decline was recorded for the Ignoring–Exclusion pair (~−27.7%), followed by Exclusion–Rejecting (−26.3%) and Ignoring–Rejecting (−25.1%). This indicates a decrease in the systematicity and stability of negative interaction patterns (see Figure 1).

Discussion. The obtained effects are consistent with the transient threat to basic needs model: a decrease in ignoring and rejection indicates a weakening of "reflexive pain" and a partial restoration of a sense of belonging

and control (Williams, 2009; Hartgerink et al., 2015). According to self-determination theory, a decrease in ostracism and an increase in inclusion reflect a more complete satisfaction of the needs for relatedness and competence, supporting intrinsic motivation to participate in academic and social life (Ryan & Deci, 2000). Social identification mechanisms help explain why mixed "open groups" and mentoring blur the boundaries of "insider" and "them" and reduce the stigmatization of students from visible minorities (Hornsey, 2008; Janke et al., 2024). From a social learning perspective, intensive role-playing practices and demonstration of inclusive behavior by teachers and mentors reinforce new norms of interaction (Bandura & Hall, 2018). The digital aspect is also significant: the data are consistent with studies of cyberostracism as a mediator of stress and a factor in loneliness, which justifies combined offline/online support formats (Smith et al., 2017; Schneider et al., 2017; Tang & Duan, 2023; Çiftci et al., 2023). Overall, the results are consistent with meta- and longitudinal findings on the significance of short-term effects and the risks of chronic ostracism for depression and academic motivation (Hartgerink et al., 2015; Rudert et al., 2021).

The study has limitations: a quasi-experimental design within a single department, reliance on self-reports, and a lack of randomization. To generalize the findings, multi-site longitudinal studies incorporating behavioral and administrative indicators are needed. However, the consistent decline in mean OES-A scores and weakening interscale correlations indicate a break in the "vicious cycle" and make the SOCI-Progress model promising for scaling up, with a focus on first-year students as the most vulnerable group.

Overall, the results demonstrate that the SOCI-Progress system acts as a systemic "breaker" for ostracism: it simultaneously increases cognitive awareness and practical engagement, reduces average levels of ignoring, exclusion, and rejection, and weakens the relationships between these components, preventing the entrenchment of persistent exclusionary patterns. The largest relative effect was found for the "exclusion" indicator, consistent with the logic of group integration and mentoring. Differences across programs and courses indicate the need for targeted interventions (priority for first-year students, workload management for seniors, and practice-oriented formats in philosophy). The combination of quantitative and qualitative data suggests that the model is viable for scaling and institutionalization, provided continued monitoring and adaptation to the specific needs of departments.

Conclusion. The study confirmed the effectiveness of the comprehensive SOCI-Progress program in preventing social ostracism in the university environment. Following its implementation, a consistent decrease was observed in all three components of the OES-A: ignoring (-17.6%), exclusion (-20.8%), and rejection (-18.2%), while interscale correlations weakened, indicating a "disconnection" of systemic exclusionary patterns. Practical engagement also increased: social networking expanded, first-year students became more active in mentoring, and student initiatives received sustainable institutional support. The interpretation of the results is consistent with key theories: a reduction in need-threat explains the restoration of a sense of belonging; self-determination mechanisms explain the growth of intrinsic motivation through the satisfaction of relatedness and competence needs; Social learning, the spread of inclusive norms through behavioral modeling by mentors and faculty social identity, the reduction of "us-them" boundaries in mixed groups.

From a practical perspective, the first-year cohort is most vulnerable; a combination of early identification, paired mentoring, empathy/EI training, and blended offline/online support formats has shown the greatest effectiveness, including addressing the risks of cyberostracism. Limitations (single department, quasi-experimental design, self-reports) suggest areas for future work: multi-site longitudinal assessments with administrative and behavioral metrics, analysis of long-term sustainability of effects, and heterogeneity by minority status. Overall, SOCI-Progress can be recommended for scaling and institutionalization as a practice-oriented model that improves the climate of belonging, academic engagement, and psychological well-being of students.

References

Arslan, G. (2021). Social ostracism in the school context: academic self-concept, prosocial behaviour, and adolescents' conduct problems. *The Educational and Developmental Psychologist*, *38*(1), 24-35. https://www.tandfonline.com/doi/abs/10.1080/20590776.2020.1834830

Bandura, A., & Hall, P. (2018). Albert Bandura and social learning theory. *Learning Theories for Early Years*, *78*, 35-36. https://www.torrossa.com/gs/resourceProxy?an=5282231&publisher=FZ7200#page=91

Carter-Sowell, A. R., Chen, Z., & Williams, K. D. (2008). Ostracism increases social susceptibility. *Social Influence*, *3*(3), 143-153. https://www.tandfonline.com/doi/abs/10.1080/15534510802204868

Çiftci, N., Yıldız, M., & Çiftci, K. (2023). The mediating role of social ostracism in the effect of social media addiction on loneliness in adolescents. *Journal of Pediatric Nursing*, *73*, 177-183. https://www.sciencedirect.com/science/article/pii/S0882596323002452

Gilman, R., Carter-Sowell, A., DeWall, C. N., Adams, R. E., & Carboni, I. (2013). Validation of the ostracism experience scale for adolescents. *Psychological Assessment*, *25*(2), 319. https://psycnet.apa.org/fulltext/2012-32337-001.html

Hartgerink, C. H., Van Beest, I., Wicherts, J. M., & Williams, K. D. (2015). The ordinal effects of ostracism: A meta-analysis of 120 Cyberball studies. *PloS One*, *10*(5), e0127002. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0127002

Hornsey, M. J. (2008). Social identity theory and self-categorization theory: A historical review. *Social and Personality Psychology Compass*, *2*(1), 204-222. https://compass.onlinelibrary.wiley.com/doi/abs/10.1111/j.1751-9004.2007.00066.x

Janke, S., Messerer, L. A., Merkle, B., & Rudert, S. C. (2024). Why do minority students feel they don't fit in? Migration background and parental education differentially predict social ostracism and belongingness. *Group Processes & Intergroup Relations*, *27*(2), 278-299. https://journals.sagepub.com/doi/abs/10.1177/13684302221142781

Rudert, S. C., Janke, S., & Greifeneder, R. (2021). Ostracism breeds depression: Longitudinal associations between ostracism and depression over a three-year-period. *Journal of Affective Disorders Reports*, *4*, 100118. https://www.sciencedirect.com/science/article/pii/S2666915321000457

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68. https://psycnet.apa.org/journals/amp/55/1/68.html?uid=2000-13324-007

Schneider, F. M., Zwillich, B., Bindl, M. J., Hopp, F. R., Reich, S., & Vorderer, P. (2017). Social media ostracism: The effects of being excluded online. *Computers in Human Behavior*, *73*, 385-393. https://www.sciencedirect.com/science/article/pii/S0747563217302091

Smith, R., Morgan, J., & Monks, C. (2017). Students' perceptions of the effect of social media ostracism on well-being. *Computers in Human Behavior*, *68*, 276-285. https://www.sciencedirect.com/science/article/pii/S0747563216307828

Tang, X., & Duan, W. (2023). Cyber-ostracism mediates the relationship between perceived stress and emotional well-being among college students. *Journal of American College Health*, *71*(2), 355-362. https://www.tandfonline.com/doi/abs/10.1080/07448481.2021.1891914

UNESCO. (2019). *Behind the numbers: Ending school violence and bullying.* UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000366483

Williams, K. D. (2009). Ostracism: A temporal need-threat model. *Advances in Experimental Social Psychology*, *41*, 275-314. https://www.sciencedirect.com/science/article/pii/S0065260108004061

Information about authors:

Asylbekova Marziya, candidate of pedagogical sciences, associate professor, L.N. Gumilyov Eurasian National University, ORCID ID: 0000-0001-7529-8022, email: marziya_asylbekova@mail.ru

Shaikhymuratova Indira, doctoral students, L.N. Gumilyov Eurasian National University, ORCID ID: 0000-0002-0606-7180, email: gauhar.1982@mail.ru

Ospanova Dinara, senior lecturer, East Kazakhstan University named after S. Amanzholov, ORCID ID: 0009-0007-3219-5665, email: ospdinara2025@mail.ru

Turymtaeva Bibinur, senior lecturer, East Kazakhstan University named after S. Amanzholov, ORCID ID: 0000-0001-2727-7021, email: biko_darhan@mail.ru

Original Article
IRSTI 14.07.09 10.51889/2960-1649.2025.65.4.003

TEMIRKHAN BAKHYTZHAN[1], ZHUMAGULOVA KALAMPYR[1]*

[1]*Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)*

*Address of correspondence: Temirkhan Bakhytzhan, PhD student in the 3rd year of the 8D01513 Biology educational program at the Faculty of Natural Sciences and Geography, Abai Kazakh National Pedagogical University, Almaty, Kazakhstan. https://orcid.org/0000-0002-6735-9339, E-mail address: Biologyniscbd@gmail.com/Tel.: +77754408586

Integrating STEM Education Methods into Biotechnology Teaching

Abstract

Introduction. This study examines the effectiveness of integrating STEM-based interdisciplinary teaching methods into biotechnology education, with a focus on enhancing student engagement, motivation, and conceptual understanding. A pedagogical experiment was conducted among third-year biology students divided into control and experimental groups. The experimental group was taught through STEM-integrated modules combining theoretical content with laboratory-based tasks, including the analysis of fungi infecting *Daucus carota L.* and pectin extraction from Shantane and Alau carrot varieties. Data collection included pre- and post-tests, classroom observations, and student feedback surveys, supported by multimedia tools and collaborative instructional techniques. *Results.* Findings demonstrated that STEM-integrated lessons significantly improved students' motivation, critical thinking, participation, and academic performance compared to traditional instruction. Students in the experimental group showed deeper conceptual understanding and increased confidence in applying scientific knowledge to real-world contexts. *Scientific novelty.* The study provides empirical evidence on the effectiveness of a newly developed interdisciplinary STEM module specifically designed for biotechnology topics, demonstrating its capacity to enhance 21st-century skills and practical competencies. *Practical significance.* The proposed STEM-based instructional approach and educational materials can be incorporated into higher education curricula to modernize biotechnology teaching, support interdisciplinary learning, and strengthen students' readiness for scientific research and professional practice.

Keywords: STEM education, biotechnology teaching, pectin extraction, interdisciplinary methods, student motivation, practical tasks, multimedia tools, experimental learning.

Introduction. The rapid transformation of science and technology in the twenty-first century has amplified the demand for interdisciplinary approaches in education, particularly in the natural sciences. Traditional subject-centered instruction often results in fragmented knowledge, limiting students' ability to apply scientific concepts in practical contexts. In response, STEM and STEAM education have emerged as effective pedagogical models that integrate science, technology, engineering, and mathematics, providing learners with opportunities to develop critical thinking, creativity, and problem-solving skills required for modern scientific practice.

Biotechnology, as an interdisciplinary field combining biology, chemistry, engineering, and digital technologies, offers a particularly relevant context for implementing STEM-based learning. Teaching topics such as plant pathogens or pectin extraction from Daucus carota L. requires not only theoretical understanding but also the ability to engage in practical experimentation, data analysis, and project-based tasks. However, many students struggle to connect theoretical knowledge with real-world applications, resulting in decreased motivation and limited development of scientific competencies.

Addressing this challenge requires the integration of interactive, practice-oriented, and technologically supported learning environments. Previous research emphasizes that active learning strategies, collaborative methods, and problem-based tasks significantly enhance student engagement and deepen conceptual understanding in the natural

sciences. Building on these insights, the present study examines the effectiveness of an interdisciplinary STEM module designed for biotechnology education. The investigation focuses on evaluating how STEM-integrated tasks influence students' motivation, academic performance, and ability to apply scientific knowledge in practice.

Materials and Methods. The methodological framework of the study was structured into three sequential phases to examine the effectiveness of integrating STEM-based interdisciplinary approaches in biotechnology education.

Phase 1 – Determining the research framework.

At the initial stage, the purpose, objectives, subject, and scope of the study were defined. The research focused on evaluating the impact of STEM-integrated modules on students' motivation, academic performance, and practical skills in biotechnology. A theoretical review of international and national literature on STEM/STEAM education and biotechnology teaching was conducted to identify relevant pedagogical principles and instructional strategies.

Phase 2 – Development of STEM-integrated teaching modules.

Based on the theoretical analysis, a set of interdisciplinary modules was designed according to STEM principles. These included: (1) Rules for storing vegetables according to regulatory requirements, (2) Fungi infecting Daucus carota L., and (3) Methods of extracting pectin from carrot varieties Shantane and Alau. The modules incorporated multimedia materials, problem-based tasks, engineering elements, laboratory activities, and collaborative learning methods such as Jigsaw, concept mapping, and interactive lectures.

The participants of the pedagogical experiment were third-year biology students (5B011300 Biology) at Abai Kazakh National Pedagogical University. Students were divided into control and experimental groups. The experimental group studied using STEM-integrated modules, while the control group followed traditional lecture-based instruction.

Phase 3 – Empirical investigation and data collection.

To evaluate the effectiveness of the intervention, several tools were employed: pre-tests and post-tests to measure knowledge acquisition; questionnaires to assess motivation, interest, and confidence; classroom observations to examine engagement; and descriptive–comparative statistical analysis to identify differences between groups. Visual materials, including diagrams, graphs, and student-created videos, were used to support practical tasks. The results were analyzed according to high, medium, and low achievement levels to compare the performance of the control and experimental groups.

Results. The primary objective of this study is to examine the pedagogical features of teaching biotechnology through an integrated STEM approach and to identify effective strategies for incorporating this methodology into university-level biology education. The study seeks to increase students' interest in scientific disciplines, strengthen their confidence in pursuing future professional pathways, and develop key competencies required in the twenty-first century. Additionally, the research aims to provide experimental evidence of the effectiveness of innovative pedagogical technologies in improving learning outcomes in biotechnology.

Research Tasks:

1. To analyze the historical development and conceptual evolution of STEM education.

2. To investigate the theoretical foundations and practical applications of STEM-integrated programs in biology teaching.

3. To develop interdisciplinary modules for biotechnology education and evaluate their pedagogical effectiveness.

4. To design and implement a STEM-based instructional method for teaching the topic of pectin extraction from carrot varieties.

5. To enhance students' academic performance by integrating modern digital tools and interactive instructional methods into biotechnology lessons.

The theoretical background of the study draws on the works of early thinkers who emphasized the interconnected nature of scientific knowledge. According to Yakman

(2019), Descartes was among the first to articulate the idea that all sciences are fundamentally interrelated, arguing that it is more effective to study them collectively rather than in isolation. This philosophical standpoint provides the conceptual foundation for modern STEAM education, where interdisciplinary integration is central to developing holistic scientific understanding.

Historically, scientific disciplines underwent a long period of differentiation beginning in the seventeenth century, leading to a strict separation of research domains. However, since the late 1970s, an opposite tendency toward integration has emerged, driven largely by advancements in biotechnology and the development of synthetic sciences that examine complex interactions within natural and social systems (Sanders, 2008; Vodolazhskaya et al., 2019). These interdisciplinary developments have contributed to the establishment of new high-tech industries and STEM-related professions.

Toffler (1970) predicted that the principal challenge of the twenty-first century would not be the inability to read or write, but the inability to "learn, unlearn, and relearn." He argued that creativity, curiosity, and design thinking would constitute essential skills for the future workforce - a prediction that strongly aligns with the goals of STEM-based pedagogy aimed at fostering adaptability, innovation, and problem-solving competencies among students.

The goals of education evolve continuously in response to societal, economic, and technological transformations. In the current transitional stage, educators are searching for effective pedagogical technologies that correspond to the demands of rapidly changing economic, social, and environmental conditions. One such approach that has gained prominence over the past two decades, particularly within the natural sciences, including biology and geography, is STEM education (Sanders, 2008). This integrative pedagogical model aims to develop key 21st-century competencies by fostering interdisciplinary thinking, technological literacy, and problem-solving skills. Its growing relevance is driven by several global challenges, including the need to enhance national competitiveness, meet the evolving requirements of high-tech labor markets, and address complex social issues through innovative educational solutions (Marr, 2019).

The term STEM education emerged in the United States in the 1990s, initially introduced by bacteriologist Rita Colwell and later adopted by the National Science Foundation (NSF) as a unifying label for science, technology, engineering, and mathematics. Early variations of the acronym, such as SMET and METS, reflected the lack of an established disciplinary order. However, in 2001, Ramaley reorganized the components into the now universally accepted sequence "STEM", which marked the beginning of its widespread incorporation into educational curricula worldwide (Sanders, 2008; Yakman, 2019).

As STEM education developed, various expanded models emerged under the umbrella term STEM+, designed to address additional interdisciplinary needs. The two most common extensions are STEAM, which incorporates the arts, and STREM, which includes robotics. These extensions reflect the growing recognition that creativity, innovation, and design-based thinking significantly enhance learners' ability to achieve deeper, multidimensional learning outcomes (de Vries et al., 2021). In contemporary educational practice, the STEAM model is often considered optimal because it acknowledges the essential role of artistic and creative processes in preparing students for modern professional environments, where aesthetic design, visualization, and creative problem-solving are integral.

The term STEAM education was first introduced at the Rhode Island School of Design (RISD) to emphasize the critical function of art in bridging scientific understanding with creative expression. Below compares the pedagogical characteristics of STEM and STEAM approaches (Table 1).

Table 1

Comparative characteristics of STEM and STEAM approaches in education

Compared features	STEM	STEAM
Goal	Priority in the development of natural sciences, technology, engineering, and mathematics	Mastering the natural sciences in relation to art
Entity	Integration of natural sciences, mathematics, engineering, and technology	Integration of natural sciences, mathematics, engineering, technology, and art
Orientation of educational activity	Development of critical thinking skills through problem-based learning	Development of creative thinking through practice-oriented learning

As part of the pedagogical experiment, an interdisciplinary STEM-based lesson in biotechnology was conducted with third-year students specializing in Biology (5B011300). The lesson focused on the topic "Fungi that infect the plant Daucus carota L." and aimed to introduce students to the main fungal pathogens affecting carrot plants, their biological characteristics, and the diseases they cause. In addition, the lesson sought to develop students' ability to regulate their own learning through active and interactive instructional methods.

The instructional methodology incorporated the Jigsaw technique, interactive lectures, multimedia presentations developed in PowerPoint, and a short educational video on carrot varieties and associated pathogens. Various visual materials were utilized, including a laptop, an interactive whiteboard, handouts, and illustrations of relevant scientists. Interdisciplinary links were established with microbiology, geography, and English language studies to enhance scientific communication skills.

The lesson began with an organizational stage, during which students were assigned to two groups. Using the Jigsaw method, each group examined different sections of the new content and later taught the material to their peers, promoting collaborative learning and mutual responsibility. This activity supported the development of analytical and communicative skills while enabling students to engage actively with scientific content.

Throughout the formative experiment, a comprehensive methodology for integrating modern educational technologies into biology teaching was developed. The biotechnology module consisted of three STEM-oriented topics:

1. Rules for storing vegetables according to regulatory standards,
2. Fungi that infect Daucus carota L.,
3. Methods for extracting pectin from carrot varieties Shantane and Alau.

Each topic employed an interactive demonstration approach supported by a 15 to 20 minute educational video produced using Adobe Premiere Pro CC 2017. The integration of multimedia resources allowed students to visualize biological processes and connect theoretical concepts with practical applications.

A range of innovative digital and interactive tools proved effective in teaching the module, including Quizizz, mind-mapping (associograms), role-playing activities, concept tests, STEM instructional strategies, Jigsaw, Kahoot, Venn diagrams, and critical-thinking technology (STO strategies). These techniques facilitated the development of higher-order thinking skills, increased student motivation, and strengthened their ability to analyze, compare, and synthesize biological information. During the practical sessions, students actively participated in brainstorming activities using the Jigsaw method, where they collaboratively discussed key concepts related to fungal pathogens of Daucus carota L. Instead of visual figures, this stage included a detailed verbal explanation of fungal diseases supported by interactive lecture slides, allowing students to understand the biological mechanisms of infection without relying on static images. Additionally, the educational video illustrating microorganisms relevant to biotechnology lessons was described through narrative commentary, focusing on the structural and functional characteristics of the observed microorganisms. These descriptive

explanations ensured that the learning process remained scientifically informative even without the presence of visual figures.

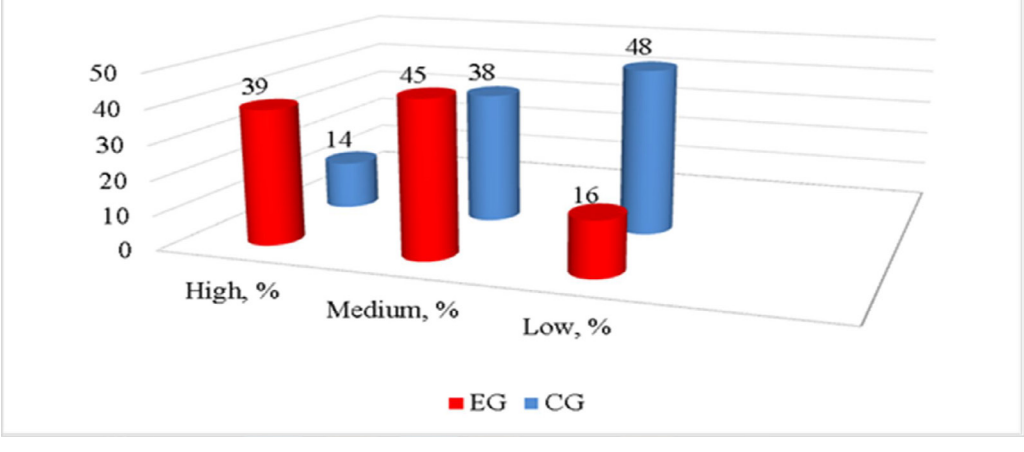
In the validation phase of the lesson, the teacher evaluated the effectiveness of the instructional design using the Interactive Demonstration Lecture Method, originally developed by Dorothy Merrits (Franklin and Marshall College), Robert Walter, and Bob Mack (Clark College). This method combines brief traditional lectures with structured interactive components and is particularly effective for guiding students through complex scientific concepts. It consists of three sequential stages: (1) predicting the outcome of the demonstration, (2) observing and analyzing the demonstration, and (3) reflecting on the results.

During the reflection stage, students were encouraged to engage in metacognitive questioning, responding to prompts such as: "What did I learn from this lesson?" "How can this knowledge be useful to me?" "In what ways can I apply what I have learned?" "Why is this knowledge important?" "How can I develop this knowledge further?", and "What else do I want to explore?" Sharing answers within groups allowed students to consolidate their understanding and co-construct new knowledge based on the learning experience.

Following the implementation of the designed teaching methods across the selected topics, a follow-up survey was administered during the third control stage of the experiment. The results indicated substantial positive changes in students' motivation, engagement, and academic performance. These findings are illustrated in Figure 1, which provides a comparative analysis of achievement levels between the experimental and control groups.

Figure 1

Comparison of student achievement levels in the experimental (EG) and control (CG) groups at the end of the pedagogical experiment



A comparative analysis of student performance revealed substantial improvements in the experimental group (EG) following the implementation of STEM-integrated instructional methods. When comparing the final assessment results with the baseline data collected at the beginning of the experiment, a clear positive shift was observed. The proportion of students demonstrating a high level of achievement increased to 39%, while 45% reached a medium level, and only 16% remained at a low level. In contrast, no meaningful changes were recorded in the control group (CG). By the end of the experiment, the percentage of students achieving a high level remained at 14%, the medium level remained at 38%, and the proportion of students at the low level persisted at 48%. These results indicate that traditional instructional methods used in the control group did not contribute to measurable improvement in student performance, whereas the STEM-based approach used in the experimental group produced significantly better outcomes.

Discussion. The findings of this study demonstrate that the integration of STEM-based instructional methods into biotechnology education significantly enhances student motivation, engagement, and academic performance. These results align with recent empirical studies published in Scopus- and Web of Science-indexed journals, which also report positive effects of interdisciplinary and practice-oriented teaching approaches in the natural sciences. For example, Županec et al., (2022) found that STEM-focused instructional models in biology classes improved conceptual understanding and promoted deeper engagement among primary and secondary school learners. Similar to our results, their study reported a notable increase in the proportion of high-achieving students after the implementation of STEM modules. Likewise, Mims et al. (2025) showed that project-based synthetic biology programs enhanced students' scientific identity, motivation, and ability to apply theoretical knowledge in practical contexts – findings that echo the improved confidence and performance observed in our experimental group.

The present study also corroborates evidence from international research emphasizing the significance of integrating technology-enhanced tools in STEM teaching. Yim et al. (2024) demonstrated that the use of digital platforms such as Kahoot, collaborative learning structures, and creative tasks increased learner participation and supported higher-order thinking. Consistent with their findings, our use of multimedia videos, interactive lectures, and game-based assessments contributed to heightened student engagement and improved learning outcomes.

Despite these similarities, some differences emerge. While previous studies primarily focused on general STEM competence development, our research specifically examined biotechnology topics such as fungal pathogens of Daucus carota L. and pectin extraction from carrot varieties. This provides a novel contribution by demonstrating that STEM integration is effective not only in broad scientific instruction but also in specialized laboratory-based biotechnology modules. Furthermore, compared to studies that rely solely on project-based learning, our approach employed a combination of Jigsaw, interactive demonstration lectures, concept tests, mind maps, and engineering-based problem-solving, offering a more comprehensive instructional framework.

The scientific value of this study lies in its provision of experimental evidence that STEM-integrated pedagogy leads to measurable improvements in academic performance. The shift in the experimental group - from predominantly medium and low achievement levels to 39% high achievement demonstrates the pedagogical efficacy of interdisciplinary, interactive, and technology-supported instruction. Moreover, the decrease in the proportion of low-performing students indicates that the STEM approach supports both advanced and struggling learners, contributing to more equitable learning outcomes.

Another key contribution of this study is its focus on the development of 21st-century competencies. As Rehman et al. (2025) argue, modern STEM programs must cultivate critical thinking, collaboration, creativity, and adaptability to prepare students for rapidly evolving scientific fields. Our findings affirm this claim: students in the experimental group demonstrated increased self-confidence, stronger problem-solving abilities, and greater readiness to apply biotechnology knowledge in real-world and professional contexts. In summary, the comparison with recent international research confirms that the results obtained in this study are scientifically grounded and consistent with global tendencies in STEM education. At the same time, the focus on biotechnology-specific content and the combination of diverse interactive teaching tools contribute new insights to the pedagogical literature and expand the understanding of effective STEM integration in higher education.

Conclusion. The present study provides empirical evidence that integrating STEM-based interdisciplinary pedagogy into biotechnology education yields significant improvements in student learning outcomes. The findings demonstrate that STEM-oriented

modules - supported by multimedia resources, engineering-based problem-solving tasks, and collaborative learning structures - enhance learners' conceptual understanding, practical competencies, and motivation to engage with complex biological content. Compared with traditional instruction, students in the experimental group showed higher levels of achievement, greater confidence in applying scientific knowledge, and stronger engagement with biotechnology topics such as fungal pathogens of Daucus carota L. and pectin extraction techniques.

The study's key contribution lies in expanding current STEM education research by demonstrating its effectiveness within discipline-specific biotechnology instruction rather than general science contexts. This adds new insight to existing literature by confirming that interdisciplinary integration is not only pedagogically beneficial but also adaptable to laboratory-oriented, content-intensive modules. Furthermore, the study highlights the importance of linking biological concepts with technological and engineering processes to foster 21st-century skills, including critical thinking, scientific reasoning, creativity, and communication. From a practical standpoint, the developed instructional modules and digital learning resources can be directly incorporated into higher education curricula to modernize biotechnology courses and improve instructional quality. These materials also provide a scalable framework for strengthening STEM competencies among future biology educators. Future research should explore the long-term effects of STEM integration on students' academic trajectories, examine its applicability across broader areas of natural sciences, and develop systematic teacher training programs that ensure sustainable implementation of interdisciplinary pedagogical technologies in higher education. Additionally, large-scale studies involving diverse student populations would further validate the generalizability of these findings.

References

de Vries, H., et al. (2021). Space for STEAM: New creativity challenge in education. *Education Sciences, 11*(8). https://doi.org/10.3390/educsci11080380

Marr, B. (2019). 8 things every school must do to prepare for the 4th Industrial Revolution. Forbes. https://www.forbes.com/sites/bernardmarr/2019/05/22/8-things-every-school-must-do-to-prepare-for-the-4th-industrial-revolution/

Mims, P. J., Lee, L. E., Kuldell, N., & Franklin, C. (2025). Strengthening the STEM pipeline: impact of project-based synthetic biology program on high school students' science identity and competency. In *Frontiers in Education*, *9*, 1493356. https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2024.1493356/full

Rehman, N., Huang, X., Mahmood, A., Zafeer, H. M. I., & Mohammad, N. K. (2025). Emerging trends and effective strategies in STEM teacher professional development: A systematic review. *Humanities and Social Sciences Communications*, *12*(1), 1-23. https://www.nature.com/articles/s41599-024-04272-y

Sanders, M. E. (2008). Stem, stem education, stemmania. https://vtechworks.lib.vt.edu/items/5763e151-70fb-4b7c-b09b-ee265d952858

Toffler, A. (1970). *Future Shock*. Random House, New York.

Vodolazhskaya, T., et al., (2019). *Approach in education: Ideas, methods, prospects*. Repozitoriy BGPU. http://elib.bspu.by/handle/doc/41934

Yakman, G. (2019). STEAM education: *An overview of creating a model of integrative education.* STEAM Education. https://steamedu.com/research/

Yim, I. H. Y., Su, J., & Wegerif, R. (2024). STEAM in practice and research in primary schools: a systematic literature review. *Research in Science & Technological Education*, 1-25. https://www.tandfonline.com/doi/abs/10.1080/02635143.2024.2440424

Županec, V., Radulović, B., & Lazarević, T. (2022). Instructional Efficiency of STEM Approach in Biology Teaching in Primary School in Serbia. *Sustainability*, *14*(24), 16416. https://www.mdpi.com/2071-1050/14/24/16416

Information about authors:

Temirkhan Bakhytzhan, Doctoral student (3rd year), Educational Program 8D01513 – Biology, Abai Kazakh National Pedagogical University, Faculty of Natural Sciences and Geography, Almaty, Kazakhstan. ORCID ID: https://orcid.org/0000-0002-6735-9339, Email: biologyniscbd@gmail.com

Zhumagulova Kalampyr, Associate Professor, Abai Kazakh National Pedagogical University, Faculty of Natural Sciences and Geography, Almaty, Kazakhstan. ORCID ID: https://orcid.org/0000-0001-5422-5270, Email: k.zhumagulova@abaiuniversity.edu.kz

Original Article
IRSTI 14.07.05 10.51889/2960-1649.2025.65.4.004

YERKINBEKOVA MEIRIMGUL[1], KULANOVA SANDUGASH[1], APLASHOVA ARNA[2*]

[1]Q University (Almaty, Kazakhstan)
[2]Toraighyrov University (Pavlodar, Kazakhstan)

*Address of correspondence: Arna Aplashova, Candidate of Psychological Sciences, Professor, Toraighyrov University, Lomov Str., 64, Pavlodar, 140006, Republic of Kazakhstan, https://orcid.org/0000-0002-5736-6199, E-mail address: aplashova.arna@mail.ru/Tel.:+77059873893

Mechanisms for Building Empathy and Non-Violent Communication as a Factor in Bullying Prevention

Abstract

Introduction. The article explores the role of empathy and non-violent communication as effective tools for preventing bullying in the educational environment. Key theoretical perspectives on these phenomena and their relation to school bullying are examined. *Methodology and Methods.* To test the proposed hypothesis, a combination of qualitative and quantitative methods was applied, including testing, focus group interviews, surveys, and a pedagogical experiment involving control and experimental groups. *Results.* The analysis revealed that the level of empathy tends to increase with age, while students who experienced bullying demonstrate lower communicative competence, reduced self-esteem, and inadequate self-reflection. A significant correlation was found between empathy, communication skills, and the tendency to adopt aggressive behavior patterns. The pedagogical experiment confirmed the effectiveness of the proposed mechanisms: in the experimental group, the frequency of bullying decreased, and higher levels of empathy and non-violent communication skills were observed. *Scientific novelty.* For the first time, the study substantiates the complex role of empathy and non-violent communication as interrelated factors in bullying prevention. *Practical significance.* The findings can be applied in educational programs aimed at developing non-violent interaction, enhancing psychological resilience, and fostering a safer and healthier school climate.

Keywords: empathy, non-violent communication, bullying, empathy formation, mechanisms of non-violent communication, school environment, students, teachers, parents.

Introduction. The relevance of the study is that in recent years in Kazakhstan, there has been a spread of bullying among adolescents and young people, which is accompanied by serious psychological consequences, expressed in depression, anxiety, suicidal thinking, and even its realization. Bullying, as a special type of persecution, hurts the emotional well-being of the participants of the conflict; such phenomena significantly reduce the quality of life of the persecuted, disrupt the development of good social ties, and, in general, create conditions for the development of various forms of aggression and violence against an individual. Based on this, the prevention of bullying becomes an important task of modern Kazakh society.

The problematic nature of this topic lies in the difficulty of identifying mechanisms for the formation of empathy and non-violent communication, which could effectively prevent the emergence of conflict situations and aggressive behavior, both in general and bullying in particular. Despite the significant number of studies conducted in the field of psychology and pedagogy regarding bullying, many of its aspects remain insufficiently studied to date, which indicates the need for further study of this phenomenon. At the same time, this topic is especially important in the context of the development of modern technologies and social networks, which expand the opportunities for the development of easy communication and the simultaneous growth of bullying risks.

The scientific significance of the study of mechanisms for the formation of empathy and non-violent communication is determined by the need to develop effective methods

of bullying prevention, based on a deep understanding of the psychological and pedagogical processes occurring in groups created by modern children and adolescents. Science has established that it is empathy that allows us to better understand the feelings and experiences of another person, and thus contributes to the development of such important abilities as empathy and sympathy in a person or group of persons. This approach allows empathy to be considered an important factor in preventing conflict and aggression. While non-violent communication presents the skills of expressing one's emotions and needs more constructively, without the use of any threats, manipulation, and coercion, which indicates its important key role and place in bullying prevention measures.

The aim of the study is to identify and study the mechanisms of empathy formation and non-violent communication as factors of bullying prevention among schoolchildren.

To achieve the goal, the following tasks are planned to be accomplished:

1. Analyze existing scientific works that define theoretical approaches to the study of empathy, non-violent communication, and bullying.

2. To reveal the peculiarities of the manifestation of empathy and non-violent communication mechanisms in different age groups exposed and not exposed to bullying.

3. To determine the role of empathy and nonviolent communication in children and adolescents as anti-bullying factors.

4. Develop specific mechanisms to build empathy and non-violent communication for bullying prevention.

5. Establish links between empathy, nonviolent communication, and bullying prevention.

The novelty of the study is manifested in the following:

- integrated approach aimed at combining empirical material on various aspects of the problem of bullying of different age groups of students with modern scientific knowledge about the mechanisms of empathy formation and non-violent communication.

- development of practical tools, in the form of mechanisms for the formation of empathy and non-violent communication in educational institutions for the prevention of bullying, which contain innovative solutions for organizing more effective work with students, aimed at the active formation of competencies related to the development of empathy and the mastery of techniques of non-violent communication;

- the possibility of practical implementation of the findings of the study in the educational environment.

Hypothesis of the study: if empathy and training in non-violent forms of communication are increased, bullying among children can be significantly reduced.

The research methodology includes the use of qualitative and quantitative methods of analysis, testing, surveys, observations, and experimental research methods.

The study aims to improve the effectiveness of preventive measures aimed at reducing bullying in schools, and is important for both the theory and practice of education and upbringing of the younger generation.

Materials and Methods. The study is based on a comprehensive approach that combines different scientific directions, pedagogy, and psychology. The main objective of the research methodology is to form a comprehensive understanding of the mechanisms of empathy and non-violent communication that can prevent bullying among schoolchildren of different ages. The basis of this research methodology is modern concepts of social and age psychology (George Mead's theory of social interaction, M. Rosenberg's concept of non-violent communication, modern models of interpersonal influence, S. Hohl's age psychology and others), according to which empathy and communication skills are the key factors that significantly reduce the risk of occurrence or cessation of bullying and violence.

Methodologically, this study is based on three main principles: comprehensiveness, as different levels of empathy and bullying phenomena are taken into account; dynamism, as the development of empathy and non-

violent communication skills in the process of a child's growing up is taken into account; practical orientation, as the study is aimed at developing specific recommendations for teachers and specialists working with children and adolescents, as well as for parents whose children have been bullied.

Diagnosis of the level of empathy by means of standardized tests, using the Davis Interpersonal Reactivity Scale IRI, processed by T.B. Koryagina, to assess such components as cognitive, emotional, and behavioral empathy. They make it possible to establish differences in empathy levels between groups of subjects of different ages and status in relation to bullying. Two groups of subjects were selected according to age, each with 42 subjects: (Group A - under 13 years old, Group B - 13-17 years old). This division was made in order to determine whether there are differences in the levels of empathy and communication between groups of children of different ages. Group C, which included 24 children who had been bullied, was also selected.

Assessment of communicative skills was carried out with the help of special diagnostic scales (Methodology "Personality Directionality in Communication" (PDC-A) (S.L. Bratchenko), conducted to establish the degree of mastery of techniques of non-violent communication, self-esteem, self-confidence, and ability to resolve conflicts, between groups of subjects of different ages and status in relation to bullying. The same groups of children participated.

Focus group survey with participation of experts, including school psychologists, teachers, parents, and bullied children, in order to reveal common patterns in relationships within classroom communities and how they perceive the causes of aggression and support measures against bullying. Focus group participants: school psychologists (3 persons), teachers (4 persons), parents (5 persons), and bullied children (5 persons). A total of 17 people participated in the survey. Targets: general patterns of attitudes observed within classroom communities, reasons for aggression, and necessary support measures against bullying.

The modeling method was used in the development of practical tools, in the form of mechanisms for the formation of empathy and non-violent communication in educational institutions for the prevention of bullying. It contains innovative solutions for organizing more effective work with students, aimed at the active formation of competencies related to the development of empathy and mastering techniques of non-violent communication. They allow for reproducing, for example, a real situation of bullying, empathy, or communication in controlled conditions, with the help of game situations, role training, and computer simulations. This allows us to observe and study the processes of forming empathy and non-violent communication skills for the prevention of bullying, as well as to evaluate the effectiveness of the proposed preventive measures more easily.

The pedagogical experiment, as a research method, is aimed at testing the hypothesis about the influence of mechanisms, in the form of active modern mechanisms aimed at reducing the level of bullying in secondary schools, through the development of empathy and responsible communication skills. Provided that in group C (noticed in bullying) were used activities, within the proposed mechanisms. The data of the experiment were subjected to comparative analysis to identify the effectiveness of the proposed mechanisms to reduce the frequency of bullying by increasing the level of empathy and non-violent communication skills.

Analytical analysis was carried out to draw conclusions and conclusion. Statistical methods were used for quantitative calculations and mean deviations.

The required ethical rules and regulations were followed in the conduct of the study.

Results. The results of diagnostics of empathy level using the Davis interpersonal reactivity scale (IRI) in T.B. Koryagina's adaptation are shown in Table 1.

Table 1

Diagnostic results of empathy level in two age groups

Empathy component	Explanation	Group A	Group B	Group C
Cognitive	Average	S-38,5	S-42,1	32,6
	Mean deviation	SD - 5.3	SD - 4.9	SD = 6.4
Emotional	Average	S-35,7	S-39,4	29,1
	Mean deviation	SD - 6.1	SD - 5.2	SD = 7.3
Behavioral	Average	S-31,9	S-35,8	25,3
	Mean deviation	SD - 4.8	SD - 5.6	SD = 5.9

The values of the arithmetic mean (S) of the index and the standard deviation (SD) are established and reflect the results obtained in the volume of the three components of empathy (cognitive, emotional, and behavioral), which allows comparing the level of empathy between them, highlighting the differences that depend on the age and life experience of the participants. The results of the diagnostics of communication skills in three groups of subjects of different ages and status in relation to bullying are shown in Table 2.

Table 2

Results of communication skills assessment using the personality orientation in communication (POC-A) method

Communication skills	Group A	Group B	Group C
Mastery of communication techniques			
Average score	29,4	33,2	23,8
Standard deviation	4,6	3,8	5,2
Self-esteem			
Average score	32,7	36,1	27,5
standard deviation	5,1	4,3	6,4
Self-confidence			
Average score	31,3	34,9	25,1
standard deviation	4,9	4,1	5,6
Ability to resolve conflicts			
Average score	28,9	32,6	22,3
standard deviation	4,5	3,9	5,4

Mastery of communication techniques, self-esteem, self-confidence, and ability to resolve conflicts are higher for group B, medium for group A, and low for group C, characterized by bullying manifestations.

Overall results of the focus group survey: all participants identified such causes of aggression and bullying in the school environment as lack of empathy and self-regulation skills of aggressors; problems of family upbringing, lack of attention and care on the part of parents and at school on the part of teachers; social climate in the classroom based on passive approval of cruel treatment of individual children; lack of adequate response from the administration and teachers to the first signs of bullying in a particular child; influence on children of information from the Internet and social networks, which creates an idealized image of the child as a victim of bullying.

Classroom community reactions and attitudes towards bullying: most teachers noted that it is difficult to identify signs of bullying early because of children's closed nature and fear of seeking help from teachers or parents; students admitted that they are often afraid to

report incidents of violence to adults for fear of more violence and retaliation from their abusers; parents noted underestimating the danger and not taking children's problems seriously, especially those involved in bullying. In addition, some teachers indicated a lack of professional skills to understand, intervene, and deal with bullying situations promptly.

Psychologists have identified a comprehensive approach to ensure effective anti-bullying measures among bullying children, parents, and teachers. Such approach, in their opinion, includes: regular special lessons and talks on good attitude and inadmissibility of aggression; formation of a culture of mutual help and support among classmates from primary school; professional development of teachers in bullying prevention; activation of parental control and raising their awareness about the child's behavior in social networks and in general when he/she is out of home; creation of a special anti-bullying committee at school, with mandatory participation of parents, teachers and students. Thus, the focus group survey showed a general interest in bullying prevention efforts and emphasized the need for systematic training, interaction, and joint search for ways to address the problem of bullying.

Innovative mechanisms for the formation of empathy and non-violent communication in educational institutions as a prevention of bullying have been developed. They represent an integrated system of organizational and pedagogical innovations aimed at the development of empathy skills, communicative competencies of non-violent communication in students. The distinctive feature of this approach is that it combines traditional elements of educational activities with modern technologies:

1. Interactive diagnostic and remedial tools are offered to conduct regular tests and questionnaires to identify students' level of empathy and non-violent communication skills. Monitoring results are used for individual work with those who need additional support.

2. A crucial component of the mechanism is the creation of public participation platforms to discuss problems arising from bullying (open seminars, theme days, online discussions, self-help groups).

3. Using digital technologies to engage today's youth, who spend a significant part of their time in the digital space. Within their framework, they propose to create special content and mobile applications, with games, communication simulations, and webinars, aimed at building empathy skills and positive communication habits.

4. Pedagogical support of psychologists and teachers specially trained in anti-bullying programs, as a team of professionals able to promptly intervene in potentially dangerous situations and propose preventive measures.

5. Integration of "School of Health and Well-being" courses and classes into the curriculum as an important element of the mechanism aimed at physical and psycho-emotional health improvement of schoolchildren, which allows developing children's attentiveness to their own condition and mood (sports activities, yoga classes, breathing practices, relaxation).

6. Parent-school partnership, where parents have a special role to play, as they have access to counselling and specialized resources that enable them to accompany their child in times of crisis or communication difficulties in a more competent manner.

In the course of the experiment, separate mechanisms of empathy building and non-violent communication at school were used to prevent bullying. At the same time, each of the specific mechanisms has a clear functionality and can be easily integrated into the structure of a regular school. Let us describe some of them:

1. Empathy laboratory, a room with equipment and materials for active training. It is based on the principles of immersive immersion in the emotional states of other people and practicing the skills of understanding and empathy. Students in small groups worked on tasks such as "Mood Picture", "Gratitude Diary", and "Blind Games". Result: they increase the level of empathy, learn to understand the feelings of others, form stable habits of polite communication, and respond to emerging conflicts.

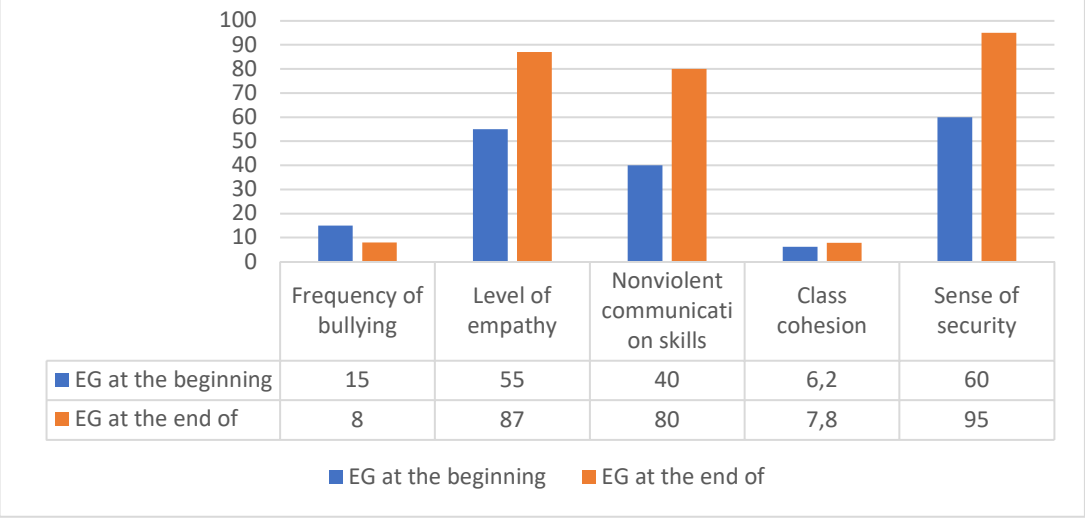
2. Empathy patrols are created on the principles of involving pupils in joint protection of psychological comfort and supporting each

other in difficult situations. For this purpose, teams of 3-4 pupils are formed, who are assigned to be responsible for a specific area of the school or a disadvantaged class. Their task is to monitor the atmosphere, suppress any manifestations of bullying, and promote friendly communication. Every day, the duty officers make notes on incidents and send reports to the psychologist. The result: all children feel a sense of security, and those involved feel a real benefit from their participation in such a mechanism. Through regular changes of personnel, everyone can be trained in responsibility and sensitivity.

3. Peace negotiators, working on the principle of resolving conflicts through diplomatic negotiations, joint discussions, and agreements. A mediation room has been created, where any student can apply for a solution to a conflict. Result: voluntary decisions are made; conditions for hidden resentments and hostility are minimized; the daily life of the school is characterized by a culture of only constructive communication. The results of the pedagogical experiment in group C (n =24) are reflected according to Figure 1.

Figure 1

Results of comparative analysis



The frequency of bullying, by episodes per month, in Group C decreased by 45%. The level of empathy, as measured by the percentage of children surveyed, increased by 32%. Nonviolent communication skills increased by 40%. Class cohesion increased by 25%. Sense of safety increased by 35%.

Discussion. Drawing on the conducted study, this paper examines mechanisms for cultivating empathy and non-violent communication (NVC) as key factors in bullying prevention within educational settings. The findings highlight the beneficial effects of enhanced empathy and NVC competencies in reducing bullying incidents, especially when implemented through a comprehensive approach involving students, teachers, parents, and the wider community.

Diagnostics of empathy level in two age groups and group C. Cognitive empathy scores were higher in the older age group B, thus showing a tendency to become more aware of other people's thoughts and intentions with age. Younger participants (group A) showed less ability to recognize others' states and attitudes consciously. The mean emotional empathy score was also higher in children from the older age group, indicating that they have a greater sensitivity to the emotions of others and a greater desire to maintain emotional contact with people in their environment. Younger children are less likely to actively respond to the emotional states of others. The level of the behavioral component of empathy showed a similar distribution between the groups, as older students showed a greater tendency to show help and support to

people around them compared to younger ones, which is associated with their accumulated experience of socialization and personal growth. Group C (children seen in bullying) has all components of empathy (cognitive, emotional, and behavioral) significantly below the mean values of the other groups, which supports the assumption of a negative relationship between low levels of empathy and a high likelihood of participating in acts of bullying. They have a very low level of cognitive empathy, which indicates a weak understanding and non-acceptance of other people's point of view, limited ability to recognize the motives and feelings of others. While the insufficient level of emotional empathy demonstrates in such children indifference to the feelings of others, low sensitivity to emotional signals, and one can say almost a complete lack of desire to support the victims. Behavioral empathy in this group is also insignificant, which indicates that children probably lack the desire to help and support those around them, and their inability and unwillingness to build conflict-free relationships with peers.

Summarizing the results of diagnostics of the level of empathy, we can conclude that the general level of empathy increases with age, which reflects the positive dynamics in the emotional and social development of adolescents. For example, Espejo-Siles et al. (2020) reported that moral disengagement and low empathy significantly predicted aggressive behavior, aligning with the present study's findings that children with lower empathy levels are more likely to engage in bullying. Similarly, Longobardi et al. (2020) provide additional support by demonstrating that empathy and defending behaviors play crucial roles in reducing bullying within school contexts. At the same time, the noted difference in indicators indicates the presence of significant reserves in the work on the development of empathy and communicative skills in both groups, especially in the younger age group. It is these that should be the object of bullying prevention efforts. At the same time, a clear correlation between the level of empathy and involvement in bullying was found. Low empathy indicators point to the involvement of children in destructive forms of behavior. Thus, the findings support the interim hypothesis that low levels of empathy significantly increase the risk of involvement in bullying. The findings indicate the advisability of including targeted developmental interventions to strengthen empathy and non-violent communication skills among the younger group, and especially among adolescents with low empathy scores.

The study underscores the importance of teaching non-violent communication (NVC) skills. These findings align with those of Nasti et al. (2023), who showed that NVC enables students to articulate their needs and resolve conflicts peacefully, thereby reducing aggression. The significance of such communication training is further supported by Deng et al. (2021), who found that fostering empathy encourages bystander intervention in bullying situations, thus reinforcing the value of intervention-focused approaches. Analysis of the results of diagnostics of the level of communicative communication showed that the overall average score of communicative skills in the younger group was: low level of mastery of techniques of non-violent communication (30.5 points); moderately expressed sense of self-respect (average self-esteem index - 32.7); unstable indicators of self-esteem and self-confidence (31.3); insufficient development of conflict resolution skills (28.9), which indicates that they have weak skills of peaceful settlement of disagreements). Group B children: the overall average score of communication skills is 34.2, which indicates a higher level of mastery of non-violent communication techniques; the average score of self-esteem is 36.1, which indicates a pronounced respect for one's personality. Self-confidence is good, as the stability of self-esteem and self-confidence is 34.9; the ability to resolve conflicts is 32.6, which characterizes developed skills to resolve conflicts without aggression. Group C: the overall average score of communication skills is 24.7, indicating very low non-violent communication skills; average self-esteem is severely underestimated, as they have no sense of their own value (the score was only 27.5); self-confidence (25.1),

corresponding to extremely low self-esteem and lack of self-confidence; conflict resolution ability (22.3), as children's extreme inadequacy in resolving disputes and avoiding conflicts.

The study's finding that empathy increases with age is consistent with conclusions drawn by other scholars, such as Trach et al. (2023), who similarly observed that older students tend to exhibit higher levels of empathy. This has important implications for designing interventions targeting younger children, who may not yet have fully developed empathy or communication skills. Having summarized all the findings on the assessment of communication skills, we can say that children from group C demonstrate the lowest level of communication skills, the lowest self-esteem, and the lowest self-confidence, which may explain their tendency to use aggressive forms of communication and the emergence of such indicators as bullying. Older students have better communication skills and the ability to resolve conflicts peacefully, which may serve as a barrier to the emergence of bullying in their environment. Younger children are not yet prepared with the required communication skills and therefore need special training and lessons to develop effective communication and anti-bullying skills. While children who are exposed to bullying should be monitored to ensure that they develop proper communication skills. As the overall picture of available communication skills confirms a direct link between the presence of non-violent communication skills and the need to protect them from being involved in bullying incidents against some people.

As a result of the discussion based on the focus group materials, a common position was formulated, expressed in a common interest to prevent bullying, and the need for systematic training on measures to prevent bullying, interaction, and joint search for ways to solve the problem of bullying was emphasized. At the same time, the importance of fostering in all children a sense of special responsibility for their behavior, developing an active attitude towards injustice and rejection of violence and threats in all their forms, was identified as a necessary condition for the prevention of bullying. Special attention was paid to the issues of fostering tolerance, developing non-violent communication skills, and improving the climate in the classroom and between classes. The participants expressed the opinion that the work should be carried out jointly by all parties of the educational process: teachers, students, school administration, and parents.

The proposed innovative mechanisms for building empathy and non-violent communication in educational institutions as a prevention of bullying really work; they are simple to implement and require a minimum of resources. They require only a little equipment, a small number of trained personnel, and a small amount of time. Some of the proposed schemes, but in a different format, have proven effects, so tested in pilot programs of foreign schools and confirmed by our experiment. The mechanisms under consideration are designed for mass application; they are suitable for almost any type of school, at its different levels.

The data of the pedagogical experiment and the results of comparative analysis confirmed the effectiveness of the proposed mechanisms, which led in group C to a noticeable decrease in the frequency of bullying, an increase in the level of empathy and the formation of non-violent communication skills among students in the experimental group and confirmed the hypothesis put forward.

The research presents several practical mechanisms, such as empathy labs and peace negotiators, to cultivate empathy and non-violent communication. These approaches align with broader trends in bullying prevention, including those examined by Boboc and Damaševičius (2024), who explored innovative strategies such as the use of extended reality to address bullying in educational settings. Thus, we can say that this study has significant theoretical and practical significance and implications for bullying prevention. The main development trends should be defined as the growth of interest in emotional intelligence, the use of effective tools to increase the level of empathy and communication skills, the creation of supportive communities, and others. The main prospects are defined as: development of

interdisciplinary research; increasing the role of parents and teachers; integration of mediation methods into the school system. Consequences of the research should be considered: reduction of bullying cases in schools, increase of self-esteem and confidence of students, improvement of psychological atmosphere in educational institutions, and growth of general life satisfaction of children during their school years.

Conclusion. The new integrated innovative approach has shown real results. It is important to realize that in order to use the proposed mechanisms, it is important to provide not only a fundamental basis for bullying prevention, but also an applied orientation to really increase the level of empathy and communication skills of today's students. Within the framework of the proposed mechanisms, it is shown that in order to solve the existing problems regarding bullying, it is necessary to create more comfortable conditions for children for successful learning and full development of personality. On this basis, the main idea of the proposed measures is to organically combine time-tested pedagogical techniques with advanced technologies and methods that promote the development of empathy and non-violent communication skills. The proposed mechanisms combine classical teaching methods with innovative tools, with the active involvement of students, parents, the school, and the community. In addition, the data obtained have a high potential for practical application and allow the development of effective strategies for combating negative phenomena in adolescence and open up opportunities for further study of mechanisms for preventing aggression and building a healthier society in Kazakhstan based on mutual understanding and respect.

References

Boboc, R. G., & Damaševičius, R. (2024). Confronting bullying in the digital age: Role of Extended Reality. *Education and Information Technologies*, *29*(14), 1-30. https://link.springer.com/article/10.1007/s10639-024-12557-7

Deng, X., Yang, J., & Wu, Y. (2021). Adolescent empathy influences bystander defending in school bullying: A three-level meta-analysis. *Frontiers in Psychology*, *12*, 690898. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2021.690898/full

Espejo-Siles, R., Zych, I., Farrington, D. P., & Llorent, V. J. (2020). Moral disengagement, victimization, empathy, social and emotional competencies as predictors of violence in children and adolescents. *Children and Youth Services Review*, *118*, 105337. https://www.sciencedirect.com/science/article/pii/S0190740920309634

Longobardi, C., Borello, L., Thornberg, R., & Settanni, M. (2020). Empathy and defending behaviours in school bullying: The mediating role of motivation to defend victims. *British Journal of Educational Psychology*, *90*(2), 473-486. https://bpspsychub.onlinelibrary.wiley.com/doi/abs/10.1111/bjep.12289

Nasti, C., Intra, F. S., Palmiero, M., & Brighi, A. (2023). The relationship between personality and bullying among primary school children: the mediation role of trait emotion intelligence and empathy. *International Journal of Clinical and Health Psychology*, *23*(2), 100359. https://www.sciencedirect.com/science/article/pii/S1697260022000679

Trach, J., Garandeau, C. F., & Malamut, S. T. (2023). Peer victimization and empathy for victims of bullying: A test of bidirectional associations in childhood and adolescence. *Child Development*, *94*(4), 905-921. https://srcd.onlinelibrary.wiley.com/doi/abs/10.1111/cdev.13907

Information about authors

Yerkinbekova Meirimgul, candidate of psychological sciences, associate professor, "Q" University, ORCID: 0000-0002-8351-4546, email: erkinbekova.m@q.edu.kz

Kulanova Sandugash, candidate of philological sciences, associate professor, "Q" University, ORCID ID: 0009-0007-2887-602X, email: kulanova.s@q.edu.kz

Aplashova Arna, candidate of psychological sciences, professor, Toraighyrov University, ORCID: 0000-0002-5736-6199, email: aplashova.arna@mail.ru

Original Article
IRSTI 14.29.01 10.51889/2960-1649.2025.65.4.005

BEKMURAT AIDOS, DUISSEKEYEVA NURGUL*

Kyzylorda University named after Korkyt ata (Kyzylorda, Kazakhstan)

*Address of correspondence: Aidos Bekmurat, Educational program of «Pedagogy, psychology and methods of primary education», Kyzylorda University named after Korkyt Ata, Tole Bi Str., 36, Kyzylorda, 120000, Republic of Kazakhstan, https://orcid.org/0000-0002-1315-5007
E-mail address: bekaidos61@gmail.com / Tel.: +77474567106

The Potential of ABA Therapy in Supporting the Development and Correction of Children with Special Educational Needs in Kazakhstan

Abstract

Introduction. This study addresses the potential of Applied Behavior Analysis (ABA) therapy as a developmental and corrective support tool for children with special educational needs (SEN) in Kazakhstan. While ABA has been widely studied internationally, its application within Kazakhstan's inclusive education framework remains limited, creating a gap between global scientific evidence and national practice: methodology *and Methods.* The research employed a theoretical-methodological review, analyzing international behavioral science literature and Kazakhstan's national classification of SEN learners. Sources were selected to evaluate how ABA principles can be adapted for three SEN groups: children with psychophysical impairments, children with specific learning difficulties and behavioral-emotional problems, and children experiencing socio-cultural, linguistic, or economic barriers. *Results.* The review established that ABA has a strong evidence base in autism, intellectual disabilities, and behavior regulation, while also demonstrating promising applications in speech and motor impairments, learning disorders, and culturally diverse populations. Despite this relevance, ABA remains underutilized in Kazakhstan due to limited professional training, insufficient contextual adaptation, and misconceptions about its scope beyond autism. *Scientific novelty.* The study contributes to the expansion of ABA knowledge by contextualizing it within Kazakhstan's SEN classification system and inclusive education agenda. It extends the global discourse by demonstrating ABA's applicability not only as a clinical intervention but also as a pedagogical framework adaptable to diverse learner needs. *Practical significance.* The findings underscore the necessity of localized ABA models, culturally responsive implementation, and integration of behavioral strategies into teacher training programs. This approach can strengthen inclusive practices and improve developmental and learning outcomes for children with SEN in Kazakhstan.

Keywords: applied behavior analysis, inclusive education, special educational needs, Kazakhstan, behavior intervention.

Introduction. The evolution of inclusive education over recent decades has signaled a global shift toward evidence-based, individualized interventions that uphold the rights and developmental potential of all learners, including children with disabilities. Among the most empirically grounded and systematically applied frameworks within special education is Applied Behavior Analysis (ABA) , a discipline anchored in the principles of operant conditioning and dedicated to improving socially significant behaviors through systematic observation, measurement, and environmental manipulation (Cooper et al., 2007). Originating from the experimental analysis of behavior, ABA matured into an applied science through foundational research in the mid-20th century, shaping behavioral interventions across developmental, clinical, and educational domains (Morris et al., 2013).

ABA's methodological rigor lies in its reliance on observable, measurable behaviors and its focus on establishing functional relationships between environmental variables and behavioral outcomes. Core techniques, such as positive reinforcement, shaping, chaining, extinction, and prompting, enable structured skill acquisition and behavioral modification

in diverse populations (Dyer, 2020). Although initially developed and validated within the context of ASD, where interventions like Early Intensive Behavioral Intervention (EIBI) have demonstrated substantial efficacy in promoting cognitive and communicative development (Lovaas, 1987), ABA's scope is increasingly being reconsidered in light of its theoretical adaptability and empirical robustness across various developmental profiles (Matson & Neal, 2009; Lanovaz et al., 2017).

In Kazakhstan, the legal and institutional landscape provides a supportive yet underutilized framework for implementing such behavioral methodologies. Adilet (2002) affirms every child's right to individualized developmental and educational support, while Presidential Decree No. 1143 of 2024 on the Concept for the Development of Inclusive Education reaffirms the national commitment to expanding scientifically grounded, adaptive educational environments (Adilet, 2002; 2024).

The 2019 methodological guidelines developed by the National Scientific and Practical Center for Correctional Pedagogy classify children with special educational needs into three categories:

1. Children with pronounced and complex developmental disorders requiring special (alternative) curricula and intensive long-term support.

2. Children with moderate, often combined impairments who can master adapted general education programs with specialized assistance.

3. Children with milder developmental deviations who study in mainstream schools but still require pedagogical and psychological support to overcome barriers to learning (Yelisseyeva & Yersarina, 2019).

While the first group has traditionally been the focus of targeted special education interventions, the second and third categories – which comprise the majority of children integrated into general education environments – often lack methodologically sound, evidence-based correctional strategies. Current support models emphasize monitoring and general guidance, but do not provide a structured behavioral framework capable of addressing specific learning and behavioral challenges.

This represents a critical gap in practice that ABA therapy is uniquely positioned to address. Given its emphasis on skill-building, individualized planning, and measurable outcomes, ABA can offer a scalable and adaptable intervention model for children across all three SEN categories in Kazakhstan. Particularly for the second and third groups, where professional consensus on effective methods remains underdeveloped, ABA provides a theoretically robust, research-backed approach that aligns with international standards of inclusive and corrective education. Moreover, Kazakhstan's growing institutional emphasis on inclusive practice highlights the urgency of expanding the methodological toolkit available to educators and school-based support teams. ABA's ecological validity, generalization strategies, and strong outcome evidence make it a compelling candidate for broader implementation provided adaptations are culturally and ethically aligned with the local context (Dyer, 2020; Cooper et al., 2007).

Accordingly, this article undertakes a comprehensive theoretical and methodological review of ABA therapy's applicability in the corrective and developmental education of children with special educational needs in Kazakhstan. By integrating seminal behavioral science literature with national legal mandates and pedagogical priorities, the review aims to articulate both the potential and limitations of ABA as a corrective tool across the full spectrum of SEN categories. The overarching research question guiding this inquiry is: What is the potential of ABA therapy in supporting the development and correction of children with special educational needs in Kazakhstan's inclusive education system?

Materials and Methods. This study employed a theoretical-methodological review design, focusing on the qualitative analysis of both international behavioral science literature and national educational policy documents from Kazakhstan. The purpose of the review was to identify the potential applications of Applied Behavior Analysis (ABA) therapy in supporting children with special educational needs (SEN) and to evaluate the relevance of

these methods within Kazakhstan's inclusive education framework.

The review was based on two main groups of sources:

1) International literature: peer-reviewed journal articles, systematic reviews, and foundational ABA texts addressing interventions across autism spectrum disorder (ASD), intellectual disabilities, speech and sensory impairments, motor difficulties, and emotional-behavioral disorders.

2) National sources: Kazakhstan's legislative acts, ministerial guidelines, and the 2019 methodological guide by the National Scientific and Practical Center for Correctional Pedagogy, which provides a classification of SEN categories.

The primary data collection tools consisted of electronic databases and institutional repositories. Searches were conducted using databases such as Scopus, Web of Science, Google Scholar, and regional academic portals. Keywords included combinations of "Applied Behavior Analysis", "ABA therapy", "special educational needs", "inclusive education", "Kazakhstan", "learning difficulties", and "behavioral intervention".

The literature search covered the period 1980-2024, with emphasis on the most recent two decades to ensure contemporary relevance. Sources were selected through a two-step process:

- initial screening of titles and abstracts to identify studies related to ABA and SEN.

- full-text review to determine alignment with the aims of the study, particularly for applicability beyond autism and within inclusive education contexts.

Inclusion criteria were: (1) studies presenting behavioral frameworks (e.g., DTT, NET, FBA); (2) research with empirical or systematic evidence of ABA applications; (3) national policy and methodological documents directly relevant to Kazakhstan.

Exclusion criteria were: (1) studies focusing solely on medical or pharmacological treatment; (2) reports based on anecdotal evidence without behavioral grounding; (3) sources lacking direct relevance to educational or corrective contexts.

A qualitative thematic analysis approach was applied. Selected literature was analyzed to identify recurring themes regarding ABA's effectiveness, adaptability, and limitations. The analysis proceeded in three steps:

1. Categorization of findings according to Kazakhstan's SEN groups:

Group I: Children with physical and mental impairments (intellectual disability, motor impairments, speech and hearing disorders, emotional regulation problems).

Group II: Children with specific learning difficulties and behavioral/emotional issues (dyslexia, ADHD, aggression, or anxiety).

Group III: Children whose challenges stem from social, linguistic, or economic conditions (migrants, children from at-risk families, or non-native speakers).

2. Comparison of international evidence with national policy and practice in Kazakhstan.

3. Synthesis of theoretical and practical insights to articulate the potential role of ABA in Kazakhstan's inclusive education system.

This structured methodology allowed for a comprehensive understanding of how ABA therapy can be adapted and implemented for diverse learner populations in Kazakhstan.

Results. This section presents a structured synthesis of findings from international scholarly literature and Kazakhstan's national methodological guidelines regarding the potential application of ABA therapy for children across the three officially defined categories of special educational needs (SEN). Each subsection details the alignment between ABA strategies and the educational-corrective needs of children in the respective group, with emphasis on instructional, behavioral, communicative, and contextual dimensions.

ABA is an effective approach for supporting children with intellectual and developmental disabilities (IDD). A systematic review by Ho et al., (2021) found that ABA-based interventions improved communication, social, and daily living skills in young children with IDD, even in the absence of autism. The review highlighted those strategies such as reinforcement, prompting, and structured teaching produced consistently positive outcomes across multiple

developmental areas. Further, Lucock et al., (2019) emphasized that ABA can be adapted for individuals with intellectual disabilities who also face age-related cognitive decline, showing the flexibility of behavior analytic methods across the lifespan. These findings support the use of ABA not only for behavior management but also for long-term learning and adaptive development. Newer approaches, such as AI-assisted ABA systems, offer promising directions for improving precision and accessibility. Ghafghazi et al., (2021) suggested that combining artificial intelligence with ABA may help personalize interventions in real time, which could be especially useful in schools with limited resources and professional support. Together, these studies suggest that ABA is a structured, adaptable, and evidence-based method that aligns well with the needs of Group I children in Kazakhstan, those with complex psychophysical impairments requiring individualized correctional education.

ABA is one of the most widely studied and evidence-based approaches for children with ASD. Over the past several decades, a large number of research studies and clinical trials have confirmed the effectiveness of ABA in improving communication, behavior, and learning outcomes for children with autism. As a result, ABA has become a leading model for early intervention and developmental support in many countries.

In the context of Kazakhstan, however, ABA is still in the early stages of formal recognition and implementation. According to Kosherbayeva et al., (2024), children with autism often face delays in diagnosis and limited access to qualified intervention specialists. While some parents and private centers apply ABA strategies, there is no systematic integration of ABA into the national education system. One of the key recommendations from recent policy studies is to adapt ABA therapy to the Kazakhstani cultural, linguistic, and institutional context, making it more accessible and relevant to local families and educators. To achieve this, Kazakhstan must invest in training programs for teachers, psychologists, and special educators. Schools need to become spaces where ABA methods are not only applied with fidelity but also taught as part of professional development. By building institutional capacity and creating Kazakh language resources, Kazakhstan can move toward inclusive, evidence-based education for children with ASD and related emotional or self-regulation difficulties. In summary, while ABA for autism is well supported by international research, Kazakhstan now faces the important task of developing localized ABA models, creating educational infrastructure, and preparing professionals who can apply these methods effectively within the national education system.

Although Applied Behavior Analysis (ABA) has gained wide acceptance for addressing the developmental needs of children with autism and intellectual disabilities, its application to children with speech, hearing, and visual impairments remains significantly underrepresented in both international scholarship and Kazakhstani educational practice. Despite its proven flexibility and data-driven structure, ABA's use in these populations is often limited by modality-specific barriers and a lack of interdisciplinary integration.

For children with speech and language impairments, ABA methods are commonly paired with augmentative and alternative communication (AAC) tools to build functional communication. Interventions such as mand training, tact instruction, and prompt fading are often used in combination with systems like speech-generating devices (SGDs). Rispoli et al., (2010) and Shillingsburg et al., (2019) have demonstrated that SGDs can effectively support expressive communication in children with developmental disabilities, facilitating both spontaneous and contextually appropriate speech acts. Moreover, Byiers and Reichle (2015) argue for the integration of behavior analytic frameworks in AAC instruction to ensure that communication goals remain functional, socially relevant, and measurable – core ABA principles that align well with the needs of children in Group I and II of Kazakhstan's SEN classification.

In the context of hearing impairments, ABA interventions have been applied with

adaptations such as gesture-based modeling, visual schedules, and sign-supported instruction. These strategies promote rule-following, behavior regulation, and routine acquisition in inclusive classroom settings. However, the research base in this area remains modest, and effective application often depends on collaboration with specialists in deaf education who can tailor ABA methods to fit the child's primary communication modality (Byiers & Reichle, 2015).

Children with visual impairments face additional challenges in ABA-based instruction due to the inherently visual nature of many behavioral supports, such as picture cues and token systems. Nonetheless, adaptations using tactile prompts, auditory stimuli, and verbal discriminative cues have shown promise. Clark-Bischke and Crowley (2011) emphasize that ABA principles can be successfully modified to teach academic, orientation, and self-care skills to students with visual impairments when supported by proper environmental modifications. In one example, Desrochers et al., (2014) applied background music as an antecedent modification to reduce problem behaviors in an adolescent who was blind with multiple disabilities, highlighting the potential of ABA's functional approach even in complex cases.

Despite these promising findings, it is clear that ABA for children with sensory impairments remains underdeveloped, both internationally and especially in Kazakhstan. There is currently no structured national model for implementing behavior analytic practices for children with speech, hearing, or visual challenges in inclusive classrooms. Most services remain confined to specialized institutions, and teachers often lack both the training and the resources to adapt ABA tools to these unique learner profiles.

In conclusion, while the foundational principles of ABA, such as reinforcement, stimulus control, and individualized instruction, are inherently adaptable, systematic research, national adaptation, and interdisciplinary collaboration are required to unlock their full potential for children with sensory impairments. Kazakhstan's inclusive education reform presents an opportunity to pilot and evaluate such adaptations across varied school environments. The application of Applied Behavior Analysis (ABA) for children with motor impairments – such as cerebral palsy, neuromuscular disorders, or physical disabilities affecting mobility and coordination is comparatively limited in both empirical research and practical implementation. Despite this gap, ABA holds theoretical and practical potential when appropriately adapted to meet the functional, educational, and behavioral needs of this population.

Motor impairments typically affect voluntary movement, posture, and sometimes speech or fine motor coordination, but they do not inherently limit cognitive abilities. Thus, children with such conditions often benefit from structured behavioral interventions when these are delivered with careful consideration of physical accessibility, assistive technology, and individual communication needs. ABA can contribute by helping children learn alternative ways to engage in academic, self-help, and social routines – especially when tasks are broken into manageable components through task analysis, and when reinforcement is adapted to their sensory and motor capabilities.

In educational settings, ABA-based strategies may support:

1) Participation in classroom routines through shaping and chaining techniques;

2) Development of adaptive behavior, such as using assistive devices or requesting help;

3) Reduction of escape-maintained behaviors related to task difficulty or physical discomfort;

4) Functional communication training (FCT) when motor limitations restrict verbal or gestural expression.

Crucially, the success of ABA with this population depends on interdisciplinary collaboration particularly with physical therapists, occupational therapists, and assistive technology specialists. These professionals can help modify materials and reinforce strategies that align with the child's motor capabilities. For instance, a child unable to perform a pointing response in a standard DTT session may require eye-gaze tracking, switch access,

or customized motor prompts as part of the ABA intervention. In summary, while the evidence base for ABA in motor impairments is still emerging, the flexibility and structure of ABA make it a potentially valuable tool for supporting learning and behavior in this group, particularly when used as part of a team-based, adapted intervention. In Kazakhstan, there is a strong need to pilot ABA-informed programs for children with motor impairments and to incorporate such approaches into inclusive teacher preparation. Children classified under Group II in Kazakhstan's special educational needs (SEN) framework include those with specific learning difficulties (SLDs) such as dyslexia, dysgraphia, and dyscalculia. These children possess average intellectual abilities but struggle with acquiring core academic skills, particularly in reading, writing, and mathematics. Without targeted support, these challenges can lead to persistent academic underperformance, low self-esteem, and disengagement from school.

Although ABA is often associated with behavioral intervention, its structured, data-driven approach has proven increasingly relevant to academic skill acquisition. ABA procedures such as task analysis, prompt fading, and positive reinforcement can help children with SLDs master foundational academic tasks by breaking them into manageable steps and reinforcing correct responses over time. For example, studies on reading disabilities have shown that behaviorally based interventions significantly enhance reading fluency, comprehension, and decoding when they include reinforcement, modeling, and repetition (Galuschka et al., 2014; Roberts et al., 2015). In a study on dyslexic learners, Ooko and Aloka (2021) found that behavior modification techniques, including tangible rewards and verbal praise, led to improved reading engagement and skill retention in inclusive classrooms. These findings suggest that reinforcement strategies rooted in ABA can be effective for reading-related challenges common in Group II learners. Similarly, mathematical learning difficulties, including dyscalculia, can be addressed through structured behavioral instruction. Giordano et al., (2023) emphasized that cognitive and stepwise instructional programs grounded in repetition and feedback, features central to ABA can improve number sense, arithmetic fluency, and problem-solving strategies in students with persistent math difficulties.

Despite this growing body of international evidence, ABA strategies are rarely integrated into academic instruction in Kazakhstan. Children in Group II often receive generalized psychological support or subject-specific tutoring that does not systematically apply behavior-analytic methods. This gap is further widened by the lack of teacher training in evidence-based academic interventions, such as precision teaching or ABA-informed curriculum adaptation. In sum, ABA offers a powerful framework for addressing the educational barriers faced by children with SLDs, especially when integrated into inclusive classroom practices. Its systematic, skills-based approach aligns well with the individualized support needs of Group II children. However, realizing this potential in Kazakhstan will require investments in teacher training, curriculum adaptation, and interdisciplinary collaboration.

Children classified in Group II within Kazakhstan's national SEN framework often display emotional and behavioral difficulties, including oppositional behavior, aggression, noncompliance, avoidance, anxiety, and difficulties with emotional regulation or peer relationships. These challenges may stem from a range of factors, such as neurodevelopmental vulnerabilities, family dysfunction, trauma, or educational mismatch – yet they often go unaddressed or are misinterpreted as disciplinary problems within school settings.

ABA offers a structured, evidence-based framework for understanding and supporting these learners. A cornerstone of ABA intervention in this domain is the Functional Behavior Assessment (FBA), which identifies the antecedents and consequences that maintain problematic behavior. This process leads to the development of Behavior Intervention Plans (BIPs), which focus on reducing maladaptive behaviors and teaching functionally equivalent replacement behaviors (Inoue et al., 2021).

For example, a child engaging in aggressive outbursts to escape academic tasks may be taught to request a break or use a calm signal.

Meta-analytic findings support the efficacy of such approaches. Gersib and Mason (2023) reviewed behavioral interventions in self-contained settings and found moderate to large effect sizes for ABA-based strategies targeting students with emotional and behavioral disorders. These strategies included differential reinforcement, token economies, self-monitoring, and systematic prompting, which improved not only behavior but also academic engagement and social interaction. Similarly, Nuske et al., (2023) emphasized that children with autism spectrum disorder and co-occurring emotion dysregulation benefit most from ABA interventions that incorporate graded emotional regulation supports, visual cues, and reinforcement tailored to the child's sensory and cognitive profile. Although their review focused on autism, the findings offer critical insights for addressing emotionally driven behaviors in a broader population, including learners in Group II.

In Kazakhstan, however, systematic behavior assessment and intervention remain underdeveloped in general education settings. Children with behavioral challenges are often labeled as "undisciplined" rather than recognized as needing structured support. Teachers frequently lack training in FBA or the tools to implement consistent, proactive behavioral interventions. As a result, behavioral incidents are often addressed through punitive measures or parental discipline, missing the opportunity to build emotional and behavioral competence through positive, function-based strategies.

In conclusion, ABA provides a well-established and adaptable methodology for addressing emotional and behavioral problems in inclusive classrooms. For children in Group II, who frequently fall between clinical thresholds and educational norms, ABA can play a key role in promoting self-regulation, peer relationships, and academic readiness. To harness this potential, Kazakhstan must invest in teacher training and integrate behavior analysis into school-based support systems.

Children in Group III of Kazakhstan's special educational needs (SEN) classification represent a diverse population whose difficulties in education stem not from inherent cognitive or developmental disorders, but from socio-cultural, linguistic, and economic factors. These children include those from low-income or socially vulnerable families, migrant or refugee backgrounds, and households where the language of instruction is not spoken. Despite having the potential to succeed academically, many of these learners face persistent barriers to participation and achievement in general education settings due to systemic inequities, language mismatches, and cultural dissonance. While Applied Behavior Analysis (ABA) has traditionally been associated with developmental and behavioral disorders, its structured, individualized, and skill-based principles can also be effectively adapted to support children facing environmental and socio-cultural disadvantages. ABA strategies, such as modeling, shaping, positive reinforcement, and task analysis can help teach school readiness behaviors, classroom routines, and social communication to children who may not have acquired these skills due to limited prior exposure or cultural mismatch. However, the implementation of ABA in such contexts requires significant cultural sensitivity and contextual adaptation.

As Dennison et al., (2019) emphasize, delivering ABA interventions to culturally and linguistically diverse families demands flexibility in communication style, acknowledgment of family structure and roles, and inclusion of interpreters or culturally competent mediators when needed. In the context of Kazakhstan, where children from migrant families or ethnic minorities may be unfamiliar with the behavioral norms expected in Kazakh or Russian speaking schools, such adaptations are especially critical. Furthermore, Castro-Hostetler et al., (2023) highlight those cultural values such as respect for authority, familial hierarchy, and community belonging must be respected when designing and delivering ABA services. ABA must not impose rigid Western behavioral norms but instead co-create learning pathways with families in ways that honor their values.

Rotheram et al. (2022) similarly emphasize that parent training programs rooted in ABA are more successful when they are seen as culturally acceptable and when parents feel respected and empowered, rather than judged. In Kazakhstan, Group III children often suffer from misinterpretation perceived as "difficult" or "low achieving" when, in reality, they lack equitable access to language-appropriate instruction and individualized support. Integrating ABA into support for this group should involve redefining it not as a correctional tool, but as a flexible instructional method to foster inclusion, engagement, and behavioral competence. To do so, teachers and school-based professionals must be trained not only in ABA techniques but in culturally responsive application of those techniques, using tools and reinforcers that are meaningful in the local context. While ABA has significant potential for use with Group III students, its successful implementation will require systemic change, including professional development, localized material development, and a commitment to social equity in educational access and behavioral support.

Discussion. The present review sought to examine the potential of ABA therapy in supporting the development and correction of children with SEN in Kazakhstan. By synthesizing international literature and national policy documents, the analysis revealed that ABA represents not only a well-established clinical and educational framework but also a methodology with significant yet underutilized potential in the Kazakhstan context. This discussion interprets the findings in light of global evidence, highlights gaps in national implementation, and explores the implications for inclusive education.

The review confirmed that ABA has a strong evidence base in supporting children with ASD and intellectual disabilities. Decades of research, including large-scale systematic reviews and meta-analyses, demonstrate the effectiveness of ABA in improving communication, cognitive functioning, adaptive skills, and behavior regulation (Lovaas, 1987; Cooper et al., 2007; Ho et al., 2020). These findings establish ABA as one of the most empirically validated approaches in the field of special education worldwide.

Beyond autism, emerging studies point to the adaptability of ABA for a broader range of developmental and learning challenges, including speech and hearing impairments, motor difficulties, specific learning difficulties (SLDs), and emotional-behavioral disorders (Byiers & Reichle, 2015; Giordano et al., 2023; Gersib & Mason, 2023). This expansion is particularly relevant for Kazakhstan, where the majority of children with SEN in mainstream schools belong to Groups II and III of the national classification, students with learning difficulties, emotional-behavioral issues, or socio-cultural and linguistic barriers, rather than only children with severe disabilities. Thus, the results underscore that while ABA is globally acknowledged as effective in autism intervention, its broader corrective and pedagogical applications should be considered in Kazakhstan's inclusive education system.

One of the clearest findings of the review is the discrepancy between international integration of ABA and its limited presence in Kazakhstan. In countries such as the United States, Canada, and parts of Western Europe, ABA has been embedded into early intervention systems, school-based supports, and professional training programs (Matson & Neal, 2009; Dyer, 2020). By contrast, Kazakhstan lacks systematic implementation: ABA is primarily applied within private centers and by individual practitioners, with limited recognition in mainstream schools.

This gap can be explained by several factors:

1. Limited professional training : ABA is not yet widely included in teacher education or psychology curricula in Kazakhstan, which restricts the pool of qualified practitioners.

2. Conceptual misunderstandings: ABA is sometimes viewed narrowly as an autism-specific therapy, rather than a general behavioral framework applicable across disabilities and contexts.

3. Resource constraints: Schools face shortages of trained staff, financial resources, and adapted materials needed to deliver ABA-based interventions.

4. Cultural adaptation: Most ABA resources and training are imported from Western contexts, with insufficient localization to Kazakh and Russian languages or adaptation to cultural norms.

This comparison suggests that Kazakhstan is at a formative stage of ABA implementation, with a need for deliberate investment in infrastructure, professional development, and culturally responsive adaptations.

The findings have significant implications for Kazakhstan's inclusive education reform. The 2024 Presidential Decree on the Development of Inclusive Education emphasizes the need for scientifically grounded and adaptive methodologies in schools (Adilet, 2024). However, current practice still relies heavily on general monitoring and remedial guidance rather than structured, evidence-based interventions. ABA could fill this gap by providing teachers and psychologists with concrete tools for skill-building, behavior management, and individualized planning.

For Group I children (those with psychophysical impairments, including intellectual disabilities, autism, and motor or speech difficulties), ABA offers structured approaches that can enhance adaptive skills, functional communication, and classroom participation. For Group II learners (with specific learning difficulties and emotional-behavioral challenges), ABA provides techniques such as task analysis, reinforcement, and functional behavior assessment, which align with the needs of students who otherwise fall between clinical thresholds and academic expectations. For Group III students (facing socio-cultural and linguistic barriers), ABA's emphasis on modeling, shaping, and reinforcement could facilitate school readiness and social integration provided that cultural norms and family values are respected. Taken together, these applications position ABA not merely as a clinical therapy but as a pedagogical framework that can strengthen Kazakhstan's inclusive education system by offering measurable, adaptable, and individualized interventions.

Overall, this discussion emphasizes that ABA therapy offers considerable potential to strengthen Kazakhstan's inclusive education system by providing structured, evidence-based, and adaptable methods for children across diverse SEN groups. However, realizing this potential requires addressing significant barriers, including the lack of trained professionals, limited awareness of ABA's broader applications, and the need for cultural and linguistic adaptation. With targeted investment in professional development, policy alignment, and localized research, ABA could become a cornerstone of Kazakhstan's efforts to ensure equitable and effective education for all learners.

Conclusion. This theoretical-methodological review examined the potential of ABA in addressing the developmental and corrective needs of children with SEN in Kazakhstan. The study contributes to science by broadening the scope of ABA application beyond autism, demonstrating its relevance for children with intellectual and developmental disorders, specific learning difficulties, behavioral-emotional problems, and those facing socio-cultural and linguistic barriers. The review highlights how ABA can serve not only as a therapeutic method but also as a pedagogical framework capable of strengthening inclusive education practices.

The scientific value of this work lies in contextualizing ABA within Kazakhstan's national classification of SEN and educational priorities, thereby creating a foundation for localized models of intervention. It offers a structured basis for integrating behavior-analytic methods into teacher training, curriculum adaptation, and school-based support systems. The findings also point to the importance of developing culturally responsive ABA approaches that reflect local linguistic and social realities. Overall, this study provides a new perspective on how ABA can be systematically adapted for Kazakhstan, contributing to the scientific understanding of inclusive education methodologies and offering directions for future empirical research and practical implementation. In conclusion, ABA represents a valid, adaptable, and evidence-based framework for supporting children with

special educational needs in Kazakhstan. Its effectiveness depends not only on fidelity to behavioral principles, but also on thoughtful integration into the cultural, linguistic, and institutional realities of Kazakhstani schools. With proper adaptation and systemic support, ABA can become a transformative component of the country's inclusive education movement - enhancing equity, participation, and developmental outcomes for all learners.

Acknowledgments. This research is funded by the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. BR28712661 National system for comprehensive continuous support of students with autism spectrum disorder).

References

Adilet. (2002). Law of the Republic of Kazakhstan on the Rights of the Child. https://adilet.zan.kz/kaz/docs/Z020000343_

Adilet. (2024). Presidential Decree No. 1143 on the Concept of Inclusive Education Development in the Republic of Kazakhstan. https://adilet.zan.kz/kaz/docs/P2400001143/info

Byiers, B. J., & Reichle, J. E. (2015). Toward behavior analytic practice in augmentative and alternative communication (AAC). In H. S. Roane, J. E. Ringdahl, & T. S. Falcomata (Eds.), *Clinical and Organizational Applications of Applied Behavior Analysis* (pp. 273–301). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-420249-8.00012-5

Castro-Hostetler, M., Kille, I., Lopez, L. V., & Contreras, B. P. (2023). Understanding the role of cultural values in ABA service delivery: Perspectives from Latino families. *Behavior and Social Issues*, *32*(1), 210-233. https://link.springer.com/article/10.1007/s42822-022-00115-0

Clark-Bischke, C., & Crowley, E. P. (2011). Applied behavior analysis and students with visual impairments: A literature review. *Insight: Research & Practice in Visual Impairment & Blindness*, *4*(1), 2-14. https://jobs.aerbvi.org/wp-content/uploads/2016/01/Winter-2011_aerj-04-01-complete.pdf#page=12

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied Behavior Analysis* (Vol. 2, pp. 37-46). Upper Saddle River, NJ: Pearson/Merrill-Prentice Hall. https://europepmc.org/articles/pmc1285958?pdf=render

Dennison, A., Lund, E. M., Brodhead, M. T., Mejia, L., Armenta, A., & Leal, J. (2019). Delivering home-supported applied behavior analysis therapies to culturally and linguistically diverse families. *Behavior Analysis in Practice*, *12*(4), 887-898. https://link.springer.com/article/10.1007/s40617-019-00374-1

Desrochers, M. N., Oshlag, R., & Kennelly, A. M. (2014). Using background music to reduce problem behavior during assessment with an adolescent who is blind with multiple disabilities. *Journal of Visual Impairment & Blindness*, *108*(1), 61-65. https://journals.sagepub.com/doi/abs/10.1177/0145482X1410800107

Dyer, K. (2020). Applied Behavior Analysis (ABA). In *Encyclopedia of Autism Spectrum Disorders* (pp. 1-8). Springer, New York, NY.

Galuschka, K., Ise, E., Krick, K., & Schulte-Körne, G. (2014). Effectiveness of treatment approaches for children and adolescents with reading disabilities: A meta-analysis of randomized controlled trials. *PloS One*, *9*(2), e89900. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0089900

Gersib, J. A., & Mason, S. (2023). A meta-analysis of behavior interventions for students with emotional-behavioral disorders in self-contained settings. *Behavioral Disorders*, *48*(4), 269-283. https://journals.sagepub.com/doi/abs/10.1177/01987429231160285

Ghafghazi, S., Carnett, A., Neely, L., Das, A., & Rad, P. (2021). AI-augmented behavior analysis for children with developmental disabilities: building toward precision treatment. *IEEE Systems, Man, and Cybernetics Magazine*, *7*(4), 4-12. https://ieeexplore.ieee.org/abstract/document/9586405/

Giordano, G., Alesi, M., & Gentile, A. (2023). Effectiveness of cognitive and mathematical programs on dyscalculia and mathematical difficulties. In *International Review of Research in Developmental Disabilities, 65*, 217-264. https://www.sciencedirect.com/science/article/pii/S221160952300009X

Ho, H., Perry, A., & Koudys, J. (2021). A systematic review of behaviour analytic interventions for young children with intellectual disabilities. *Journal of Intellectual Disability Research*, *65*(1), 11-31. https://onlinelibrary.wiley.com/doi/abs/10.1111/jir.12780

Inoue, M., Kishimoto, T., & Fukuzaki, T. (2021). Interventions for students with problem behaviors: A workshop incorporating applied behavior analysis for Japanese teachers. *Yonago Acta Medica*, *64*(1), 98-106. https://www.jstage.jst.go.jp/article/yam/64/1/64_2021.02.013/_article/-char/ja/

Kosherbayeva, L., Nukeshtayeva, A., & Zakirova-Engstrand, R. (2024). Autism diagnosis and intervention in Kazakhstan: Barriers and policy recommendations. *Journal of Autism and Developmental Disorders, 54*(2), 345–360. https://doi.org/10.1007/s10803-023-05913-3

Lanovaz, M. J., Dufour, M. M., & Argumedes, M. (2017). Behavior analytic methods. In *Handbook of Social Behavior and Skills in Children* (pp. 115-132). Cham: Springer International Publishing. https://link.springer.com/chapter/10.1007/978-3-319-64592-6_8

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology*, *55*(1), 3. https://psycnet.apa.org/fulltext/1987-16420-001.html

Lucock, Z. R., Sharp, R. A., & Jones, R. S. (2019). Behavior-analytic approaches to working with people with intellectual and developmental disabilities who develop dementia: A review of the literature. *Behavior Analysis in Practice*, *12*(1), 255-264. https://link.springer.com/article/10.1007/s40617-018-0270-8

Matson, J. L., & Neal, D. (2009). History and overview. In *Applied Behavior Analysis for Children with Autism Spectrum Disorders* (pp. 1-13). New York, NY: Springer New York. https://link.springer.com/chapter/10.1007/978-1-4419-0088-3_1

Morris, E. K., Altus, D. E., & Smith, N. G. (2013). A study in the founding of applied behavior analysis through its publications. *The Behavior Analyst*, *36*(1), 73-107. https://link.springer.com/article/10.1007/BF03392293

Nuske, H. J., Young, A. V., Khan, F., Palermo, E. H., Ajanaku, B., Pellecchia, M., Vivanti, G., Mazefsky, C. A., Brookman-Frazee, L., McPartland, J. C., Goodwin, M. S., & Mandell, D. S. (2023). Emotion dysregulation and challenging behavior interventions for children and adolescents with autism: A systematic review. *Research Square*. https://doi.org/10.21203/rs.3.rs-2802378/v1

Ooko, P. A., & Aloka, P. J. (2021). Using selected behaviour modification practices to enhance reinforcement of reading abilities among dyslexic learners in Kenya. *African Journal of Disability*, *10*, 707. https://journals.co.za/doi/abs/10.4102/ajod.v10i0.707

Rispoli, M. J., Franco, J. H., van der Meer, L., Lang, R., & Camargo, S. P. H. (2010). The use of speech-generating devices in communication interventions for individuals with developmental disabilities: A review of the literature. *Developmental Neurorehabilitation*, *13*(4), 276-293. https://www.tandfonline.com/doi/abs/10.3109/17518421003636794

Roberts, G. J., Solis, M., Ciullo, S., McKenna, J. W., & Vaughn, S. (2015). Reading interventions with behavioral and social skill outcomes: A synthesis of research. *Behavior Modification*, *39*(1), 8-42. https://journals.sagepub.com/doi/abs/10.1177/0145445514561318

Rotheram F., E., Turner, K., & Ray, J. (2022). Cultural acceptability of ABA parent training for autism spectrum disorders. *International Journal of Autism and Related Disabilities, 5*, 160. https://doi.org/10.29011/2642-3227.100060

Shillingsburg, M. A., Marya, V., Bartlett, B. L., & Thompson, T. M. (2019). Teaching mands for information using speech generating devices: A replication and extension. *Journal of Applied Behavior Analysis*, *52*(3), 756-771. https://onlinelibrary.wiley.com/doi/abs/10.1002/jaba.579

Yelisseyeva, I. G., & Yersarina, A. K. (2019). *Psychological and Pedagogical Support for Children with Special Educational Needs in General Education Schools: Methodological Guide*. National Scientific and Practical Center for Correctional Pedagogy.

Information about the authors:

Bekmurat Aidos, PhD, senior lecturer, Korkyt Ata Kyzylorda University, ORCID ID: 0000-0002-1315-5007, e-mail: bekaidos61@gmail.com

Duissekeyeva Nurgul, PhD, senior lecturer, Korkyt Ata Kyzylorda University, ORCID ID: 0000-0002-0586-7266, e-mail: duisekeevan@gmail.com

Original Article
IRSTI 14.35.09 10.51889/2960-1649.2025.65.4.006

ARZYMBETOVA SHOLPAN[1], ARTYKBAYEVA FAZILA[1], MIRZAKHMEDOVA ZHANNAT[1], TURSYNOVA GULDAR[1], TAITELIYEVA MAIRA[2]*

[1] *Tashenev University* (*Shymkent, Kazakhstan)*
[2] *Zhanibekov University (Shymkent, Kazakhstan)*

*Address of correspondence: Fazila Artykbayeva, corresponding author, Institute of World Languages, Tashenev University, Shymkent City, Ilyayev St 33, Republic of Kazakhstan, ORCID ID: https://orcid.org/0000-0001-8549-828X; E-mail address: fazilaartykbayeva@gmail.com

AI-Driven Digital Transformation of the Inductive Approach to Foreign Language Grammar Teaching

Abstract

Introduction. The article addresses the problem of effective grammar acquisition in foreign language instruction through the inductive method supported by artificial intelligence (AI) technologies. The authors justify the relevance of studying inductive grammar learning in the context of digital transformation, where AI tools enhance learner autonomy, motivation, and analytical engagement. The development of grammatical competence is considered a key component of communicative proficiency in the modern multilingual educational environment. *Methodology and Methods.* The study was conducted during the fall semester of 2025 at the Faculty of World Languages, Tashenev University. A total of 102 undergraduate students majoring in English participated in the experiment. Students were divided into control and experimental groups. The experimental group received inductive grammar instruction supported by AI tools such as Chat GPT and Microsoft Copilot, while the control group followed traditional inductive methods without digital assistance. Quantitative methods were used, including pre-test and post-test assessments of grammatical competence and motivation, as well as a questionnaire survey based on a 5-point Likert scale. Instructor observations were also recorded to assess engagement and interaction quality. *Results.* The study revealed that the use of AI-supported inductive instruction led to a significant improvement in learners' understanding of grammatical structures, increased motivation, and enhanced cognitive involvement. Students in the experimental group demonstrated higher performance and deeper rule internalization compared to the control group. *Scientific novelty.* The research provides empirical evidence that the integration of AI technologies into inductive grammar instruction fosters autonomous learning, supports hypothesis testing, and improves grammatical competence in foreign language education. *Practical significance.* The findings can be applied in school and university language programs to enhance grammar teaching through AI-assisted inductive methods. The study offers methodological recommendations for implementing adaptive digital environments that promote learner-centered grammar discovery.

Keywords: foreign language, teaching methods, inductive approach, grammatical competence, motivation, artificial intelligence (AI), prompt.

Introduction. Over the past decades, foreign language proficiency has been regarded as one of the key qualities of an educated and competitive individual in a globalizing world. In today's educational landscape, there is a growing trend toward learning multiple foreign languages, which necessitates continuous improvement of teaching methodologies and the integration of innovative approaches and technologies. Particular attention is given to the development of learners' grammatical competence and their mastery of the grammatical patterns of the target language. It is precisely the knowledge of grammatical structures that contributes to the advancement of lexical skills and communicative competence (Richards & Rodgers, 2014). However, the mere memorization of grammatical rules is insufficient for achieving a high level of language proficiency. Effective instruction requires methodological solutions that enhance learner motivation and support the integrated development of grammatical

and lexical competence (Firsova, 2023). One of the common challenges in foreign language learning is the mechanical memorization of grammatical constructions, which is especially relevant when mastering the English language and its tense system.

The inductive approach helps overcome these difficulties by activating learners' cognitive engagement and increasing their interest in language learning. In pedagogy, the inductive method is defined as a form of instruction in which learners construct knowledge through the analysis of specific examples followed by generalization. In other words, learners independently arrive at an understanding of grammatical patterns by working with linguistic material. In the works of Nazarova (2019), the importance of the inductive method is emphasized, as it enables learners to derive grammatical rules independently through example analysis. Several Russian researchers, including Trubitsina et al., (2021), point out that a distinctive feature of foreign language learning is the mechanical memorization of large amounts of material, which poses significant challenges for learners at various levels. One of the effective techniques for addressing this issue is the inductive method of instruction (Shermatova, 2022). Richards and Rodgers (2014) identify the key stages of the inductive approach: observation, generalization, hypothesis testing, conclusion formulation, application, and reinforcement. These stages aim to develop learners' autonomy, their ability to formulate and test hypotheses, apply acquired knowledge and skills in practice, and generate new ideas based on personal experience.

The unique feature of the inductive method lies in the active involvement of learners in the educational process, the development of their critical and analytical thinking, problem-solving abilities, and capacity to draw conclusions based on available data (Eshcherkina et al., 2023). With the advancement of digital technologies and the integration of artificial intelligence into educational practice, the inductive approach is acquiring new forms of implementation. AI tools enable the creation of adaptive learning environments in which learners can analyze linguistic examples, receive feedback, and independently formulate grammatical rules (Li et al., 2025; Du & Daniel, 2024).

This study aims to describe the effectiveness and practical applications of the inductive method in teaching English grammar using AI technologies.

Research objectives:

– To describe the features of the inductive method in teaching foreign (English) language grammar using AI technologies (e.g., ChatGPT);

– To analyze the use of the inductive method to improve the effectiveness of grammatical pattern acquisition in English language learning with AI tools;

– To examine pedagogical experiences of applying the inductive method in mastering grammatical patterns through digital solutions based on artificial intelligence.

The object of the study is the process of acquiring grammatical structures in foreign language learning. The subject of the study is the inductive method of acquiring grammatical patterns using AI technologies. Thus, the inductive approach helps learners overcome the challenge of mechanical memorization of grammatical constructions and enables the integration of learned theory into language practice. This is especially effective when combined with AI technologies that provide an adaptive and interactive learning environment.

Materials and Methods. The methodological framework of this study is grounded in a comprehensive constructivist approach that integrates empirical experimentation with theoretical-analytical reflection. It draws upon the principles of inductive grammar instruction and cognitive communicative language teaching, which emphasize learners' active discovery of grammatical patterns through contextualized input and guided analysis (Romanchuk, 2023).

The central hypothesis posits that applying an inductive approach supported by artificial intelligence (AI) technologies facilitates deeper, more conscious, and sustainable acquisition of grammatical structures, while simultaneously enhancing learners' motivation in foreign language learning. The approach was selected for its pedagogical potential to foster cognitive

engagement, linguistic intuition, and long-term retention. Within the context of digital transformation, AI integration further amplifies the effectiveness of inductive instruction by promoting learner autonomy, interactivity, and personalized feedback (Wang et al., 2024; Li et al., 2025; Tram et al., 2024).

This study employed a quasi-experimental research design with control and experimental groups. The model followed a three-stage procedure (pre-test, implementation, post-test) to evaluate the impact of AI-driven inductive grammar instruction on learners' grammatical competence, motivation, and attitudes. The research was conducted at the Faculty of World Languages, Tashenev University, during the fall semester of 2025. A total of 102 undergraduate students majoring in English Language (IP) participated. The sample consisted of 10 male and 92 female students.

Experimental groups (EG): FI-24-9k1 and FI-24-9k2 (n = 52)

Control groups (CG): FI-24-9k4 and FI-24-9k7 (n = 50)

Both groups were comparable in terms of academic achievement and English proficiency, ensuring representativeness of the sample.

Three instruments were employed to collect data:

Pre-test and post-test: Designed to measure grammatical competence and academic progress.

Questionnaire survey: Used a 5-point Likert scale to assess learners' motivation and perceptions of AI-assisted instruction.

Instructor observations: Documented student engagement, task completion, and classroom interaction quality.

The experiment lasted one month and consisted of three phases:

1. *Pre-test phase:* Assessment of grammatical competence and motivation before intervention.

2. *Implementation phase:*

Experimental groups received AI-supported inductive grammar instruction using platforms such as Chat GPT, Microsoft Copilot, and other digital tools.

Control groups continued with traditional inductive instruction without AI integration.

AI tools generated contextualized examples, provided individualized feedback, and facilitated interactive grammar discovery tasks. Prompts were designed to stimulate observation, hypothesis formation, and rule derivation, preserving the logic of the inductive approach.

Grammar topics included the Present Perfect tense and comparative adjectives. Learners analyzed curated examples, identified patterns, formulated rules, and practiced usage through communicative tasks.

The instructor acted as a facilitator, guiding learners through discovery tasks, moderating discussions, and encouraging reflection, while AI tools supported hypothesis testing and language production.

3. *Post-test and survey phase:* Evaluation of grammatical competence, academic performance, motivation, and learners' perceptions of AI-assisted instruction.

Quantitative data: Analyzed using descriptive and comparative statistics, including mean scores, percentage change, and significance testing between pre- and post-test results.

Survey responses: Processed to identify shifts in learner motivation and attitudes toward AI tools.

Qualitative observations: Interpreted to reveal behavioral patterns and engagement dynamics during AI-enhanced instruction.

The study adhered to principles of systematicity, scientific rigor, and competency-based learning. Grammar instruction was treated as an integral component of communicative competence development.

Results. The impact of integrating digital AI tools and pedagogical methods on students' grammatical competence, motivation, and perception of AI tools was examined. The ascertaining stage consisted of diagnosing the initial levels of these indicators through a pre-test and an online survey administered to both the experimental and control groups (Du & Daniel, 2024; Li et al., 2025). Standardized tests were used for preliminary assessments. The diagnostic results are presented in Table 1.

– in both groups, a significant number of students (on average, about 60%) demonstrated

an average level of grammatical competence, which required structured learning interventions.

– a high level of competence was found in an average of 20% of experimental group (EG) students.

– Motivation and positive perception of AI tools were initially moderate in both groups.

The results of the ascertaining stage allowed the researchers to identify areas requiring targeted pedagogical support and the integration of AI tools for enhanced learning. This formed the basis of a month-long experimental program using Chat GPT, Microsoft Copilot, and other AI platforms.

Table 1

Pre- and Post-Experimental Student Indicators

	CG before (n=50)	CG after	EG before (n=52)	EG after
Grammar competence (mean %)	86,1	90,4	87,4	95,2
Motivation (Likert 1–5)	4	4,3	4,1	4,8
Positive perception of AI tools (Likert 1–5)	3,8	4,1	3,9	4,9

The formative stage of the experiment involved active use of AI platforms, integrating subject knowledge with gamified tasks, quizzes, and collaborative exercises. The program emphasized autonomy, engagement, and real-time feedback, allowing students to practice grammar interactively while receiving personalized guidance. After the experimental month, a repeated assessment (post-test and survey) demonstrated significant improvements in the experimental group compared to the control group.

Key observations:

– The percentage of students with high grammatical competence increased from 20% to 72% in the EG, whereas in the CG it rose moderately from 18% to 38%;

– Students in the EG demonstrated higher engagement and positive attitudes toward AI tools;

– Teacher observations confirmed that AI-assisted learning enhanced self-confidence, accuracy in grammar production, and active participation in collaborative tasks.

The results indicate that integration of AI tools into grammar instruction significantly improved learning outcomes, motivation, and students' attitudes toward technology, setting a foundation for further research and pedagogical applications.

At the end of the experimental program, students in both groups participated in reflective sessions and collaborative presentations. Learners from the experimental group shared their experiences of using AI tools (e.g., Chat GPT) and inductive tasks to explore grammatical patterns, while the rest of the class asked questions and offered alternative strategies for rule formulation and hypothesis testing.

Questions for discussion included:

– Which exercises helped you understand grammar better and why?

– Did using AI tools make learning more interesting or easier?

– In which tasks did you feel most involved or motivated?

– What skills did you develop that could be useful beyond school?

The learning environment was intentionally designed to reduce anxiety and cognitive overload by fostering engagement, discovery, collaboration, and digital support. Many tasks were presented in the form of problem-solving activities, mini-research tasks, and creative group discussions, where students analyzed examples, formulated grammar rules, and received immediate AI-generated feedback.

Through the integration of AI tools and inductive learning, students reported increased confidence in using grammar in real contexts. Participation in group-based exploratory tasks contributed to stronger motivation, reduced fear of mistakes, and a sense of ownership over their learning process, which was particularly evident in the experimental group, where students frequently demonstrated the ability to

explain rules independently and justify their conclusions during group reflection.

The tasks encouraged critical thinking, language intuition, and meta-awareness, helping students perceive grammar not as a set of rigid rules, but as a dynamic and meaningful system. Working with AI enhanced individual understanding and created opportunities for peer teaching and collective knowledge construction.

As a result, learners experienced:

1) A more emotionally safe and supportive learning atmosphere

2) Greater willingness to take risks in language production.

3) Noticeable growth in engagement and long-term retention of grammar material

4) Development of metacognitive and research skills

Post-intervention feedback and qualitative reflections revealed a shift in learners' attitudes toward grammar, with many expressing enjoyments in "figuring out the rules themselves" and valuing the interactivity and personalization offered by AI-enhanced grammar tasks. These findings set the stage for a deeper discussion of the observed patterns and their implications for grammar instruction and the use of AI in language learning.

Discussion. The findings of the pedagogical experiment clearly confirm that the inductive approach contributes to more effective comprehension and retention of grammar material in foreign language learning. Rather than memorizing rules mechanically, learners are engaged in identifying patterns and grammatical features independently. Through hypothesis generation and analytical thinking, they construct their own understanding of grammatical rules, which leads to deeper and more meaningful learning (Shermatova, 2022; Firsova, 2023; Richards & Rodgers, 2014). This approach fosters language intuition and metalinguistic awareness, allowing students to move beyond passive knowledge acquisition and take an active role in the learning process. As noted by Eshcherkina et al., (2023), the inductive method supports the extrapolation of rules through reflective and comparative thinking, enhancing students' cognitive engagement.

The use of AI tools, such as Chat GPT, significantly amplifies the effectiveness of this approach, which provides personalized and adaptive feedback, generates custom examples, and supports hypothesis testing, all of which strengthen grammatical awareness and reduce reliance on rote learning (Tran et al., 2024; Du & Daniel, 2024; Wang et al., 2024). According to He (2025), AI-powered environments also encourage emotional resilience and reflective thinking in learners, making them more self-aware and autonomous in their learning.

Furthermore, the integration of digital technologies makes the learning process more motivating, accessible, and individualized. AI can act as a digital assistant, helping learners compare and classify grammatical phenomena, correct mistakes in real time, and engage in more reflective learning (Aisyiyah et al., 2024; Satiti et al., 2024), that supports the development of self-directed learning (SDL) skills, which are essential in modern education and professional development contexts (Richards & Willy, 2010). It is also important to note that while the inductive method is especially effective at beginner and intermediate levels, its efficiency depends on the nature of the grammar concept being taught. Therefore, a blended approach that flexibly combines inductive and deductive methods may be optimal (Nazarova, 2019; Richards & Willy, 2010; Trubitsina et al., 2021). Finally, to promote metacognitive development, learners should be encouraged to plan, monitor, and assess their own learning processes. AI technologies can facilitate this by offering learners tools for reflection and adjustment, thereby cultivating responsibility and autonomy in language learning (Li et al., 2025; He et al., 2025).

Conclusion. The conducted study confirmed the effectiveness of the inductive approach in teaching foreign language grammar. Unlike the mechanical memorization of rules, the inductive method involves independently formulating grammatical patterns based on the analysis of language input. This approach activates learners' cognitive processes, develops their ability to generate hypotheses, make logical generalizations, and apply knowledge

in practical situations. Inductive learning contributes to increased motivation: students become active participants in the learning process, discovering new knowledge on their own. This fosters confidence in their abilities and promotes the development of language intuition. Working with examples, participating in discussions, and analyzing language structures allow learners to immerse themselves more deeply in the linguistic environment and acquire grammar more consciously. The development of language intuition and metalinguistic awareness is a key outcome of the inductive approach. Students learn to recognize grammatical patterns, identify exceptions, and distinguish correct constructions from incorrect ones, relying on explicit rules and on an internal sense of the language.

The results of the experiment showed that learners who followed the inductive method demonstrated higher levels of long-term retention and more frequently used the studied grammatical structures in spontaneous spoken communication. The inductive approach proved particularly effective when supported by AI tools such as ChatGPT, which provide access to diverse linguistic material, assist in the analysis and formulation of rules, and offer interactive feedback. To ensure high effectiveness of inductive learning, it is essential to carefully select linguistic material and organize student collaboration in pairs or small groups, creating conditions for joint analysis, discussion, and rule formulation. It is reasonable to assume that the inductive method could fully replace the traditional approach to foreign language instruction, provided that the methodology and lesson structure are appropriately reformed. All of the above allow us to conclude that the inductive approach is an effective and modern method of teaching foreign language grammar, contributing to both the intellectual and communicative development of learners. Its integration into the educational process requires methodological preparation from the teacher, but when implemented correctly, it significantly enhances the quality of grammar acquisition.

Acknowledgements. The authors express their sincere gratitude to the Ministry of Science and Higher Education of the Republic of Kazakhstan for financial support provided under the research project AP 26197519 “Integration of Digital Technologies and Gamification in Foreign Language Teaching Based on Artificial Intelligence: New Horizons of Language Competence”. The implementation of this study was made possible through funding aimed at advancing innovative approaches in language education.

References

Aisyiyah, S., Novawan, A., Dewangga, V., & Bunarkaheni, S. (2024). Teaching grammar by using technologies: Unlocking language pedagogical potential. *Journal of English in Academic and Professional Communication*, *10*(1), 36-45. https://publikasi.polije.ac.id/jeapco/article/view/4615

Du, J., & Daniel, B. K. (2024). Transforming language education: A systematic review of AI-powered chatbots for English as a foreign language speaking practice. *Computers and Education: Artificial Intelligence*, *6*, 100230. https://www.sciencedirect.com/science/article/pii/S2666920X24000316

Eshcherkina, L. V., Skachkova, E. A., & Kazachenok, Yu. V. (2023). The inductive approach in foreign language teaching: Aspects of extrapolation and synergy. *Management in Modern Systems, 4*(40), 149–156. https://doi.org/10.24412/2311-1313-40-149-156

Firsova, A. V. (2023). Features of the inductive method of teaching English. *International Journal of Humanities and Natural Sciences, 5–4*(80), 99–102. https://sciup.org/osobennosti-induktivnoj-metodiki-prepodavanija-anglijskogo-jazyka-170199464-en?ysclid=miybaevum799262444

He, M., Abbasi, B. N., & He, J. (2025). AI-driven language learning in higher education: an empirical study on self-reflection, creativity, anxiety, and emotional resilience in EFL learners. *Humanities and Social Sciences Communications*, *12*(1), 1-20. https://www.nature.com/articles/s41599-025-05817-5

Li, Y., Zhou, X., Yin, H. B., & Chiu, T. K. (2025). Design language learning with artificial intelligence (AI) chatbots based on activity theory from a systematic review. *Smart Learning Environments*, *12*(1), 24. https://link.springer.com/article/10.1186/s40561-025-00379-0

Nazarova, V. S. (2019). The inductive method of presenting new grammatical material within the communicative methodology. *Young Scientist, 47*(285), 39–41.

Richards, J. C., & Rodgers, T. S. (2014). *Approaches and methods in language teaching*. Cambridge University Press. Richards, J. C., & Willy, A. R. (2010). *Teaching grammar.* In *Methodology in Language Teaching: An Anthology of Current Practice.* Cambridge University Press.

Romanchuk, A. A. (2023). 'Blind Spots' of the 'Scandinavian-Centric'Hypothesis on the Origin of the Old Russian State. *Social Evolution & History*, *22*(2), 94-110. https://cyberleninka.ru/article/n/blind-spots-of-the-scandinavian-centric-hypothesis-on-the-origin-of-the-old-russian-state

Satiti, L. H., Fauziati, E., & Seytaningsih, E. (2024). AI Chatbot as an effective English teaching partner for university students. *International Journal of Educational Research & Social Sciences*, *5*(3), 463-469. https://elibrary.ru/item.asp?id=79836243

Shermatova, Z. N. (2022). Advantages of using the inductive method in grammar teaching. *Science and Innovation, 1*, 934–937. https://scientists.uz/view.php?id=2873#:~:text=Abstract.,%2C%20speech%2C%20phenomenon%2C%20aspects.

Tram, N. H. M., Nguyen, T. T., & Tran, C. D. (2024). ChatGPT as a tool for self-learning English among EFL learners: A multi-methods study. *System*, *127*, 103528. https://www.sciencedirect.com/science/article/pii/S0346251X24003105

Trubitsina, O. I., Kolyadko, S. V., Alina, I. A., et al. (2021). *Methodology of Teaching a Foreign Language.* Moscow: Yurayt Publishing House.

Wang, C., Zou, B., Du, Y., & Wang, Z. (2024). The impact of different conversational generative AI chatbots on EFL learners: An analysis of willingness to communicate, foreign language speaking anxiety, and self-perceived communicative competence. *System*, *127*, 103533. https://www.sciencedirect.com/science/article/pii/S0346251X24003154

Information about authors:

Arzymbetova Sholpan, Acting Professor, Vice-Rector for Strategic Development and Science, Tashenev University, ORCID ID: 0000-0001-9829-8762, email: sh.zh73@mail.ru

Artykbayeva Fazila, corresponding author, Doctor of Philosophy (PhD), Head of the Department of World Languages, Institute of World Languages, Tashenev University, ORCID ID: 0000-0001-8549-828X, email: fazilaartykbayeva@gmail.com

Mirzakhmedova Zhannat, Master, Lecturer, Department of World Languages, Tashenev University, ORCID ID: 0009-0003-7519-3660, email: mirzakhmedova.zhanet@bk.ru

Tursynova Guldar, Master, Senior Lecturer, Department of World Languages, Tashenev University, ORCID ID: 0000-0002-8239-4511, email: guldar.tursynova.74@mail.ru

Taiteliyeva Maira, Senior Lecturer, Department of Translation and Foreign Languages, Zhanibekov University, ORCID ID: 0009-0004-4938-5383, email: mayra_ta@mail.ru

Original Article
IRSTI 14.25.09 10.51889/2960-1649.2025.65.4.007

BAŞ ÖZLEM[1], IBRAIKHANOVA ALUA[2], NURBEKOVA SALTANAT[3]*

[1]Hacettepe University (Ankara, Turkey)
[2]Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)
[3]Kazakh National Women's Teacher Training University (Almaty, Kazakhstan)

*Address of correspondence: Alua Ibraikhanova, 2nd year doctoral student, Abai Kazakh National Pedagogical University, Dostyk ave., 13, Almaty, 050010, Republic of Kazakhstan, https://orcid.org/0009-0004-0745-3667, E-mail address: ibraikhanovaalua@gmail.com / Tel.: +77026023913

Innovative Approaches to the Development of Reading Literacy in Primary School Students

Abstract

Introduction. The article examines the problem of developing reading literacy among primary school students in the context of increasing information flows and the shift to competency-based education; the relevance is justified by the need to enhance students' ability to understand, interpret, and apply written information. *Methodology and Methods*. A mixed-methods approach was used, including an online survey "A Reading Nation!" among 130 students in Grades 3 to 4, diagnostic tasks, and document analysis; quantitative data were analyzed through frequency and percentage distribution, while qualitative responses were processed using content analysis. *Results*. The study showed that most students are interested in reading, although regular reading habits are not fully formed; fairy tales and adventure stories dominate preferences, family support strongly influences motivation and comprehension, while limited access to modern books and insufficient school-based initiatives remain barriers. *Scientific novelty*. The study provides new empirical evidence on the relationship between reading motivation, family reading practices, and the development of functional reading literacy in the early school years. *Practical significance*. The findings can guide the development of reading programs, strengthen school–family cooperation, and support strategies aimed at improving reading motivation and comprehension skills, contributing to the overall quality of primary education.

Keywords: reader, reading literacy, interest in reading, primary school students, text comprehension.

Introduction. In the modern era of the development of the information society, updating the content of education and increasing the demand for high-quality education in accordance with international standards, the problem of developing reading literacy among primary school students is becoming particularly relevant. In the context of the transition to a competency-based model of education, reading literacy is considered a key indicator of students' functional readiness for successful learning and active participation in society.

Reading literacy is a complex competence that includes not only the correct and expressive reading of a text, but also its understanding, content analysis, critical evaluation of the information received, and the application of knowledge in practice (Abildina et.al., 2024; Ruotsalainen et al., 2024). The results of international PIRLS and PISA studies show that the level of text comprehension and critical use of information by Kazakhstani students remains at an average (OECD, 2023). This result is largely explained by factors identified earlier: an insufficiently formed intrinsic motivation to read, a weak family reading culture, and a lack of systemic interaction between school and parents (Sarmurzin et al., 2021).

The pace of development is also influenced by the disparity in resource opportunities between rural and urban schools, differences in equipment levels, Internet access, and teacher qualifications. According to the Central Asia Program, the gap between students in rural and urban schools in Kazakhstan exceeds 30 points, which is equivalent to almost one year of study

(Nurbayev, 2021). In addition, extracurricular activities, project forms, and the home environment that promote the development of reading literacy are still insufficiently systematized (OECD, 2023).

According to scientific research, the concept of reading literacy has been actively studied in pedagogical science since the end of the 20th century. In international studies by the OECD and PIRLS, reading literacy is defined as the ability to understand and use written forms of language, build meaning from a variety of texts, critically evaluate them, and apply the information obtained to achieve one's own goals, develop knowledge, personal potential, and actively participate in society (OECD, 2018; Mullis & Martin, 2019).

Kazakhstani researchers K. Yeraly, A. Konyrova, B. Isanova, A.K. Tolegenova, G.M. Kosybayeva, S.A. Uzakbayeva and others, in their works, emphasize that reading literacy is an integral component of the overall development of a child's personality and is formed in the process of complex interaction between family, school, and the socio-cultural environment. Such interaction is considered an important factor contributing to the growth of learning motivation, active participation in the educational process, and personal development of students (Eraly, 2020; Tolegenova, 2018). Thus, Aldaberdikyzy and Ayazbayeva (2020) define literacy not only as the ability to read and write, but also as part of social practice reflecting the ways a person interacts with the cultural and educational space. Tanatarova (2018) suggests effective methods of developing reading competence in elementary grades based on an activity-based approach and a systematic organization of literary reading lessons.

International experience also confirms the importance of an integrated approach. Keogh & McGillicuddy (2025), in a systematic review, showed that literacy formed at the primary education level has a long-term impact on the educational trajectories of students in secondary school. Studies by Snow et al., (1998), Mullis et al., (2017), and Krashen (2004) indicate that to increase motivation to read, effectively develop a family reading culture, strengthen the role of the school library, and apply project forms of interaction. Despite the sufficient theoretical basis, in many studies, the ways of practical implementation of these ideas in primary schools and specific methodological recommendations require further systematization, which confirms the relevance of this study.

In this regard, the purpose of the study is to identify the pedagogical, psychological and social possibilities of developing reading literacy among primary school students and to develop scientific and methodological foundations for their effective application in the educational process. In the course of the work, the theoretical foundations of the concept of "reading literacy" are revealed, a comparative analysis of international and domestic experience is carried out, and methods aimed at increasing students' interest in reading and developing skills in working with text are systematized. The role of joint activities of teachers and parents is also considered, and the ways of effective organization of the educational environment are determined.

The results of the study can serve as a basis for the development of practical recommendations aimed at improving the content of education, improving academic achievements, and the level of functional literacy of students. The presented work has scientific and practical value for teachers, methodologists, heads of educational organizations, and parents, contributing to improving the quality of primary education.

The significance of the study is determined by its relevance to the modern education system and its scientific justification of effective approaches to developing reading literacy among primary school students, taking into account international experience. The systematic formation of reading literacy plays an important role in improving the academic achievements of students in primary education. This article discusses the main pedagogical capabilities, methods, and forms of interaction necessary for the development of reading literacy in younger schoolchildren. Understanding these aspects will allow teachers, parents, and heads of educational organizations to effectively organize the educational process, increase students' interest in reading, and

develop their functional literacy. In the course of the research, the following question was raised: *"What pedagogical opportunities influence the formation of reading literacy among primary school students?"* Considering the requirements of modern educational modernization and international research, the problem of developing reading literacy remains relevant and occupies an important place in the practice of primary education.

Materials and Methods. A mixed-methods approach integrating qualitative and quantitative research techniques was applied to identify the opportunities contributing to the development of reading literacy among primary school students. The research sample consisted of 3rd- and 4th-grade students from primary schools in Almaty, who participated in an online survey administered via the Google Forms platform.

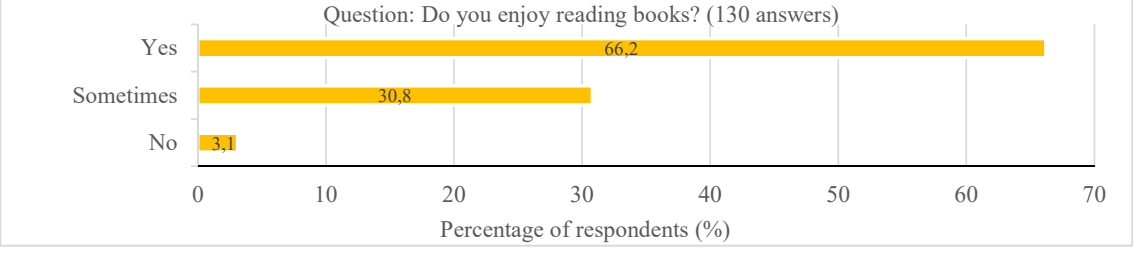
To collect data, survey and document analysis methods were employed. The questionnaire included items aimed at identifying the methods and strategies used by teachers and parents to foster reading literacy, the features of the learning environment, and the degree of parental involvement in promoting reading literacy at home. To assess students' skills in text comprehension and content analysis, specially designed diagnostic tasks and reading comprehension tests were utilized. The collected data was processed using both quantitative and qualitative analysis methods. Quantitative results were presented in terms of frequency, percentage distribution, and mean values, while qualitative data were analyzed using content analysis, which enabled the identification of key thematic categories.

The theoretical framework of the study was based on the competency-based, learner-centered, and activity-based approaches. In addition, a comparative analysis of domestic and international research literature was conducted to systematize effective methodological recommendations. This research aimed to improve the scientific and methodological foundations for developing reading literacy within the primary education system. The validity and reliability of the findings were ensured through the comprehensive application of complementary research methods and triangulation of data sources.

Results. A total of 130 students from Grades 3 and 4 participated in the survey titled *"A Reading Nation!"*. The results provided comprehensive insights into the possibilities for developing reading literacy among primary school students. The findings revealed that 66.2% of students reported that they enjoy reading very much, 30.8% stated that they read occasionally, while 3% admitted that they rarely or never read books (Figure 1).

Figure 1

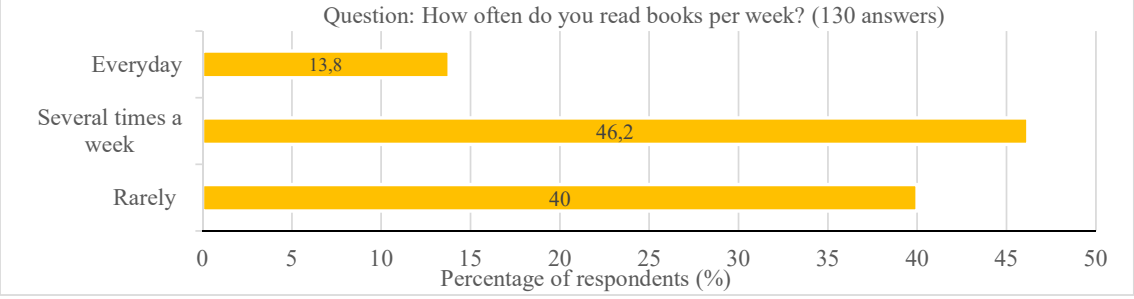
Students' attitude toward reading.



Regarding reading frequency, 13.8 % of students indicated that they read every day, 46.2 % reported reading several times a week, and 40 % said they read rarely or irregularly. These results suggest that while a majority of children read regularly, a significant proportion still engage with books sporadically, which highlights the need for strategies to support continuous reading habits among primary students (Figure 2).

Figure 2

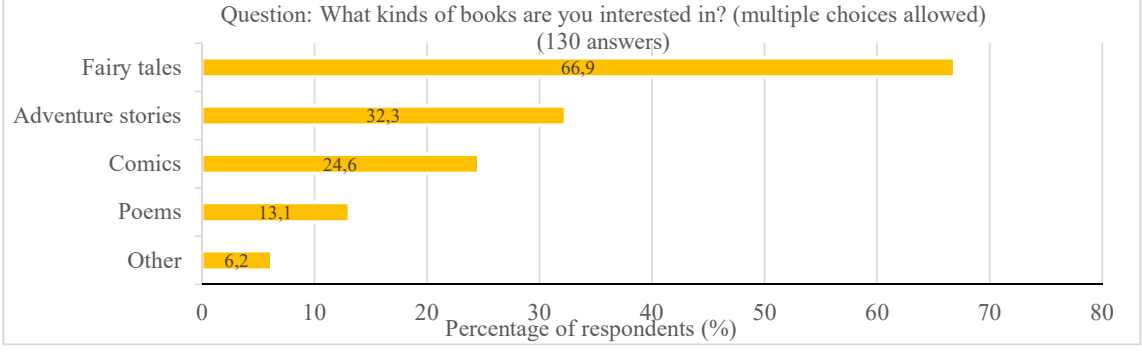
Reading frequency per week



Genre preferences were examined to identify the types of literature that attract primary school students (Figure 3). The results show that 66.9% of respondents preferred fairy tales, while 32.3% selected adventure stories as their favorite genres. This indicates that younger children are especially drawn to imaginative and engaging narratives.

Figure 3

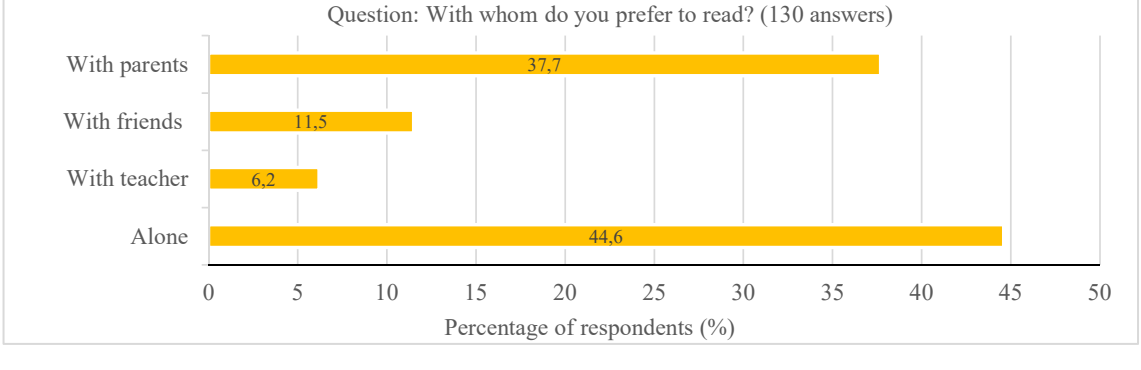
Students' reading preferences by genre.



In terms of family reading experience, 25.4% of students reported reading books with their parents, 63.8% do so from time to time, and 10.8% never read together. To the question "Who do you like to read with?" 37.7% of schoolchildren replied that they prefer to read with their parents, 11.5% with friends, and 44.6% on their own (Figure 4).

Figure 4

Students' preferred reading partners



Regarding the discussion of books read and school forms of reading support, the results showed that 22.3% of students discuss books with friends, 63.1% with parents, and only 13% with teachers. This data indicate that the family plays a leading role in shaping the child's reading culture, while the potential of the school environment is not yet fully utilized. The issue of the availability of school forms of reading support has shown mixed results. Thus, only 27.7% of students reported that their schools actually have reading clubs or special reading hours aimed at developing interest in books and exchanging impressions. Another 28.5% noted that they do not have such forms of work, and 43.8% found it difficult to answer or did not know about the existence of such initiatives.

During the survey, students were asked an open question: "What benefits does reading books bring you?" The answers were free-form and reflected the children's personal ideas about the importance of reading in their lives. Content analysis was used to process the open responses, which made it possible to identify key semantic categories that characterize students' perception of the benefits of reading. During the analysis, all responses were grouped by similar formulations and meanings, after which the frequency of mentions of each category was calculated relative to the total number of respondents (n = 130). The distribution results are shown in Table 1.

Table 1

Categories of students' responses to the question "what is the benefit of reading books for you?"

№	Main categories of students' responses	Typical Examples (Student Quotes)	Number of Mentions (out of 130)	Percentage (%)
1	Acquiring new knowledge and broadening outlook	"To gain knowledge", "It gives me knowledge", "To learn many things", "To get useful information", "To become educated."	52	40.0%
2	Developing thinking and cognitive abilities	"It develops my thinking skills", "It affects my brain", "It improves my mind", "It expands my outlook."	27	20.8%
3	Improving vocabulary, language, and literacy	"My vocabulary increases", "It improves my literacy", "It helps me practice my language", "My speech becomes better."	24	18.5%
4	Improving reading technique and speed	"To read faster", "To increase reading speed", "To learn to read quickly", "To understand faster."	10	7.7%
5	Improving memory and attention	"It improves my memory", "It strengthens my attention", "It helps with concentration."	6	4.6%
6	Developing imagination and creativity	"I learn to imagine", "It gives me new ideas and inspiration", "It develops my imagination."	4	3.1%
7	Personal growth and self-development	"It helps me become calm and thoughtful", "I improve myself", "It helps me achieve success."	4	3.1%
8	Enjoyment, interest, and relaxation	"It's interesting", "It relaxes my mind", "I spend my free time usefully."	3	2.3%

An analysis of 130 open responses from students showed that the majority of participants consider reading primarily as a cognitive and educational activity. The most common response category (40%) is related to gaining knowledge and broadening one's horizons. The second most common category (20.8%) reflects the development of thinking and cognitive abilities. A significant proportion of students (18.5%) noted improvements in vocabulary, speech, and

literacy, while 7.7% indicated improvements in reading technique and speed. The answers related to the development of memory and attention (4.6%), imagination and creativity (3.1%), personal growth and self-improvement (3.1%), as well as interest and recreation (2.3%) were less common.

Among the main factors hindering the reading process, students most often noted a lack of free time (43.8%), which indicates the competition of reading with other activities (homework, gadgets, clubs). In second place is a low interest in the content of books (26.9%), which indicates the lack of attractiveness of the offered school and extracurricular reading. Another 24.6% of the respondents indicated the limited book resources - a lack of interesting, modern, or accessible publications. A small proportion of students (14.6%) noted the lack of comfortable reading conditions at home or at school.

Discussion. A study conducted with the participation of 130 students in grades 3-4 provided a holistic view of the current state of reading literacy in primary school children. The results are generally consistent with the findings of international comparative studies by PIRLS and PISA, according to which family support, a variety of text materials, and a stimulating school environment are key conditions for the successful formation of reading literacy (OECD, 2023; Mullis et al., 2017; Mullis & Martin, 2019). The data obtained confirmed that students who have experience of reading together with their parents demonstrate a higher level of understanding of the text and semantic analysis. This corresponds to the conclusions of Abildina et al. (2024), which show that the development of reading literacy is directly related to pedagogical support and the systemic involvement of the family in the educational process.

The majority of schoolchildren (66.2%) reported that they really enjoy reading, but only 13.8% do it daily, and 40% do it irregularly. This difference between interest and actual practice reflects the need to build stable reading habits. Similar trends are noted in the OECD (2023) reports, which highlight the impact of reduced motivation to read in the context of leisure digitalization. Therefore, the pedagogical task is not only to teach reading techniques, but also to form a positive emotional experience that turns reading into a significant part of a child's personal time.

The genre preferences of the students demonstrate the emotional and imaginative orientation of reading: 66.9% prefer fairy tales, and 32.3% - adventure texts. These results are consistent with the data from Ruotsalainen et al. (2024), which confirm that cognitive and emotional engagement are enhanced when working with artistic and narrative texts, where the child can relate to the characters and actively develop imagination.

The interest in visual formats is noteworthy: about 18% of students chose comics as an attractive form of reading. This fact confirms the concept of "free voluntary reading" (Krashen, 2004), according to which free and voluntary reading, including visually oriented texts, increases motivation and promotes a gradual transition to more complex literary genres. Therefore, the inclusion of comics, adapted short stories, and graphic stories in the educational environment can be considered an effective means of engaging novice readers.

An analysis of open responses showed that 40% of students perceive reading as a source of new knowledge and expanding horizons, 20.8% - as a development of thinking, and 18.5% note the influence of reading on improving speech and literacy. These data indicate the predominance of cognitive motivation, which coincides with the conclusions of Abildina et al., (2024) on the importance of metacognitive components in the formation of functional literacy in elementary school students. At the same time, the relatively low proportion of responses related to the pleasure of reading and emotional experience of the text suggests the need to actively apply playful and creative forms of work that enhance the aesthetic component of the reading experience.

The family involvement factor was particularly pronounced: 25.4% of students read books with their parents, 63.8% read books from time to time, and 10.8% have no such experience. More than 60% of children discuss books with

their families, while only 13% discuss books with their teachers. This highlights the key role of the family environment and the need for a systematic partnership between the school and parents, which is also noted in the works of Aldaberdikyzy & Ayazbayeva (2020), which emphasizes the importance of synergy between pedagogical and socio-cultural practices in the formation of sustained interest in reading.

At the same time, the results show that the school's potential is underutilized: only 27.7% of students noted the presence of clubs or special "reading hours," while 43.8% were unaware of their existence. This is consistent with the research of Sarmurzin et al. (2021), which indicates the need to expand institutional support for reader activity programs. The presence of clubs, library projects, and creative competitions contributes not only to increased motivation but also to the development of critical thinking and communication skills. Among the barriers to reading, students most often cited lack of time (43.8%), lack of interest in the content (26.9%), and limited book resources (24.6%). These data reflect the general socio-economic differences described in the Nurbayev study (2021), which highlights the disparity between urban and rural schools in Kazakhstan in terms of access to resources. Therefore, updating library collections and ensuring equal access to modern children's publications, including digital formats and multimedia texts, should be one of the priorities for the development of the primary education system.

In general, the results of the study confirm that the formation of reading literacy requires an integrated approach based on the interaction of three complementary factors: (1) systematic pedagogical support using interactive and game methods (Abildina et al., 2024); (2) active participation of parents who create a positive emotional atmosphere around reading (Aldaberdikyzy & Ayazbayeva, 2020); and (3) the availability of a supportive school environment conducive to the exchange of reading experiences and motivation (Mullis & Martin, 2019; OECD, 2023). Thus, the conducted research confirms that the development of reading literacy of younger schoolchildren in Kazakhstan is possible only with the combined efforts of the family, school, and the teaching community. The renovation of libraries, the use of modern visual and artistic genres, as well as the introduction of game and project forms of reading, can strengthen children's interest in books and create conditions for the formation of functional literacy that meets international educational standards.

Conclusion. The conducted study made it possible to comprehensively analyze the level of development of reader literacy of Primary School students, the features of the formation of reading culture, and the main factors affecting it. The results of the study showed that most children of primary school age show a positive attitude towards reading; however, the habit of regular reading is not fully formed. It was found that the experience of reading together with parents, support in the family, and a stimulating environment at school contribute decisively to the effective development of reading literacy. The harmonious interaction of these three components - cooperation between the teacher, parents, and the student-will strengthen learning motivation and improve the skills of understanding and analyzing the text.

In addition, the results of the study revealed that the content and emotional aspects of reader interest are important: children often choose fairy tales and adventure texts and perceive the learning process as an interesting and creative experience. In this direction, it was noted that it is important to provide genre and visual diversity of educational materials. In general, the study proved that the formation of reader literacy is not only the development of language or cognitive skills, but also an important part of the child's personal, social, and cultural development. The results of the study can serve as a scientific basis for improving the educational process aimed at improving functional literacy and are an important step in the modernization of pedagogical experience in the system of primary education.

Acknowledgements. The authors express their sincere gratitude to colleagues for their methodological and scientific support during the research, to the school administration

for providing the opportunity to conduct the survey, and to the 3rd–4th grade students and their parents for their active participation and cooperation.

References:

Abildina, S., Sarsekeyeva, Z., Mukhametzhanova, A., Kopbalina, K., & Nurgaliyeva, S. (2024). Enhancing reading literacy among elementary school learners in Kazakhstan: The application and effectiveness of modern teaching techniques. *Journal of Infrastructure, Policy and Development*, *8*(8), 5905. https://rep.ksu.kz/handle/data/19427?show=full

Aldaberdikyzy, A., & Ayazbayeva, A. M. (2020). Reading literacy: definitions and implications. *Bulletin of LN Gumilyov Eurasian National University. Philology Series*, *131*(2), 87-93. https://bulphil.enu.kz/index.php/main/article/download/377/227

Eraly Q. (2020). Ways to develop reading literacy of primary school students. *Bilim Alemi,* (3), 45–52.

Keogh, A. J., & McGillicuddy, D. (2025). The Role of Primary Literacy Education in Students' Educational Trajectories in Secondary School: A Systematic Literature Review. *Reading Research Quarterly*, *60*(3), e70017. https://ila.onlinelibrary.wiley.com/doi/abs/10.1002/rrq.70017

Krashen, S. D. (2004). *The power of reading: Insights from the research*. Bloomsbury Publishing USA.

Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2017). *PIRLS 2016 International Results in Reading.* Boston College & IEA. https://pirls2016.org/download-center/index.html

Mullis, I. V., & Martin, M. O. (2019). *PIRLS 2021 Assessment frameworks*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands. https://eric.ed.gov/?id=ED606056

Nurbayev, Z. (2021). *Inequality between students of rural and urban schools in Kazakhstan: Causes and ways to address it*. Central Asia Program. https://www.centralasiaprogram.org/wp-content/uploads/2021/11/cap-paper-no.-268-zhaslan-nurbayev.pdf

OECD (2018). PISA 2018 Results (Volume I): *What Students Know and Can Do. Paris:* OECD Publishing. https://doi.org/10.1787/5f07c754-en

OECD. (2023). PISA 2022 results (Volume I): *The state of learning and equity in education*. Paris: OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/12/pisa-2022-results-volume-i_76772a36/53f23881-en.pdf

Ruotsalainen, J., Pakarinen, E., Poikkeus, A. M., & Lerkkanen, M. K. (2024). Associations between students' reading performance and literacy instruction in first grade: a cross-lagged study. *European Journal of Psychology of Education*, *39*(3), 2223-2244. https://link.springer.com/article/10.1007/s10212-023-00784-4

Sarmurzin, Y., Amanzhol, N., Toleubayeva, K., Zhunusova, M., & Amanova, A. (2021). The impact of OECD research on the education system of Kazakhstan. *Asia Pacific Education Review*, *22*(4), 757-766. https://link.springer.com/article/10.1007/s12564-021-09715-8

Snow, C. E., Burns, M. S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press. https://nap.nationalacademies.org/read/6023/chapter/1

Tanatarova Sh.M. (2018). *Methodology of teaching literary reading in primary grades*. Almaty: Qazaq universiteti. 180.

Tolegenova, A.Q. (2018). *Ways of forming reading interest of primary school students*. Almaty: Bilim. 56.

Information about the authors:

Baş Özlem, Doctor of Pedagogical Sciences, Professor, Hacettepe University, ORCID ID: 0000-0002-0716-103X, email: ozlembas@hacettepe.edu.tr

Ibraikhanova Alua, Doctoral Student, Abai Kazakh National Pedagogical University. ORCID ID: 0009-0004-0745-3667, email: ibraikhanovaalua@gmail.com

Nurbekova Saltanat, PhD, Senior Lecturer, Leader of the educational program "Pedagogy and Methodology of Primary Education", Kazakh National Women's Teacher Training University, ORCID ID: 0000-0003-4824-8702, email: zav.salta73@gmail.com

Original Article
IRSTI 14.35.09 10.51889/2960-1649.2025.65.4.008

MANAPOVA SALTANAT, AFANASENKOVA IRINA, SHAIKHOVA BAKHYT, DAUTOVA ZUKHRA, TANTYBAYEVA BATIMA*

Sarsen Amanzholov University of East Kazakhstan, Ust-Kamenogorsk, Kazakhstan

*Address of correspondence: Irina Afanasenkova, Department of Chemistry, Sarsen Amanzholov East Kazakhstan University, 30th Guards Division St. 34, Ust-Kamenogorsk, 070002, Republic of Kazakhstan, https://orcid.org/0000-0002-5369-825X, E-mail: iafanasenkova@vku.edu.kz /Tel.: +7 777 578 5787

Pedagogical feasibility of the Systemic-Structural Approach in Ecological-Chemical Education

Abstract

Introduction. The study explores the concept of pedagogical expediency as a system-forming criterion of sustainable didactics, addressing the need for a new educational paradigm in the context of global ecological and cognitive challenges. Traditional linear didactics is shown to lose semantic relevance under conditions of ecological crisis, cognitive overload, and transformation of human subjectivity. *Methodology.* Within the framework of Systemic-Structural Didactics (SSD), a multi-level model of pedagogical expediency was developed, encompassing biophysiological, psychological, social, and ecosystemic levels. The study applies structural modeling, content analysis, and interdisciplinary synthesis to design diagnostic and developmental tools for ecological-chemical education (ECE). *Results.* The research formalizes the SSD architecture, which includes ontological, functional, and operational contours, ensuring systemic alignment of educational values, content, and methods. The proposed matrix of correspondence between levels of expediency supports the design of sustainable learning processes. The model of ecological metacompetence (EMC) is presented as an integrative educational outcome that unites cognitive, ethical, behavioral, and adaptive dimensions. *Scientific novelty.* The study introduces and substantiates the concept of ecological metacompetence and integrates it into the SSD framework as a key indicator of sustainable and ethically grounded learning. The transition from a utilitarian to an ontological logic of pedagogical activity is theoretically justified. *Practical significance.* The proposed SSD-based model can be applied in the design and evaluation of interdisciplinary courses, particularly in ecological and chemical education, ensuring coherence between knowledge acquisition, ethical reasoning, and sustainable behavior.

Keywords: pedagogical expediency, systemic-structural didactics, ecological-chemical education, ecological metacompetence, ontology of education, didactic architecture, three-contour model.

Introduction. Global processes of ecological instability, technogenic pressure, and sociocultural uncertainty impose new demands on education. These demands suggest that knowledge reproduction is no longer sufficient. In this regard, there is a need for the formation of meaningful, sustainable behavioral strategies and critical reflection. It is therefore important to note that modern educational systems, predominantly based on linear, technological, and standardized didactics, often fail to adapt to these challenges (Sterling, 2001; UNESCO, 2017). These issues become particularly salient in ecological-chemical education (ECE), an interdisciplinary field that combines chemistry as the science of matter transformation with ecology as the science of interconnections, sustainability, and biospheric thresholds.

Chemistry is undoubtedly one of the most powerful instruments for transforming nature, while ecology may be interpreted as the moral and systemic corrector of these transformations. However, in educational practice, this synergy is often lost. For instance, chemistry is typically taught as a technical or natural science, and ecology as a set of abstract concepts.

It can be observed that an emerging contradiction exists between the potentially transformative and humanizing capacity of ecological-chemical education and its actual

reduction to a set of factual knowledge, devoid of ontological and ethical density. In pedagogical theory, this contradiction reveals a deeper deficit, which can be interpreted as the absence, at the core of didactic models, of the notion of pedagogical expediency, understood not merely as external efficiency, but as the coherence of goals, means, meanings, and consequences of education. In the philosophy of education, the idea of expediency has deep historical roots. Aristotle, in Nicomachean Ethics, already asserted that an action can be considered virtuous only when it is meaningful and directed toward the good (Brown, 2009). Later, Kant (1785) associated rational activity with the notion of "purposive rationality" (Zweckrationalität) as a practical correlation of means and ends based on the moral law (Kant, 1785). In the 20th century, this tradition was further developed by Jürgen Habermas, who contrasted purposive rationality with communicative rationality, emphasizing the necessity of social legitimacy and ethical justification of educational actions (Habermas, 1981). However, 20th–21st century didactics was dominated by instrumentalism, an orientation toward measurability, standardization, and competencies without a transcendental aim. Even in the competence-based paradigm (OECD, 2005), the axiological dimension is often marginalized. As a result, there is no structural place for the question: why are we teaching this, why in this particular way, and what are the consequences of this education for the future of the world?

Researchers argue that the key to addressing this problem lies in the formalization and implementation of a multi-level structure of pedagogical expediency as the foundational criterion of didactic architecture (Abdimanapov et al. 2024; Manapova et al. 2025). In order to embed expediency as a systemic principle into a didactic model, a corresponding paradigm is required. If such a paradigm does not exist, it must be created. This analysis relies on the proposed concept of Systemic Structural Didactics (SSD), a theoretical and applied model that includes three interrelated levels: the ontological contour, which encompasses goals, meanings, and worldview foundations; the functional contour, which addresses content modules and interdisciplinary links; and the operational contour, which focuses on forms, tools, tasks, and assessment. Each of these levels must be verified in terms of its pedagogical expediency (Sanat, 2022). Unlike traditional didactics, where methods are selected "for the goal" without deep axiological assessment, SSD implies a holistic validation of educational action against the values of sustainability, responsibility, and meaningfulness.

The purpose of our study is to theoretically justify and practically construct pedagogical expediency as the core of systemic-structural didactics within ecological-chemical education. This includes the development and visualization of a multi-level model of pedagogical expediency, the construction of a three-contour didactic architecture of ECE, a comparison of traditional and SSD didactics according to the criterion of expediency, the introduction and structuring of ecological metacompetence as the resultant vector of education, and the proposal of diagnostic and visual tools suitable for implementation in school and university teaching. In our research, we propose a structural and multi-level model of pedagogical expediency, a formalism of three-contour didactics combining philosophy, methodology, and design, the concept of ecological metacompetence as a set of reflexive, practical, and value-based modalities, and an integrative framework for reconstructing chemistry-ecology curricula through the lens of sustainable thinking and semantic reflection.

As previously mentioned, the philosophical concept of expediency stands out sharply in the works of Aristotle, Immanuel Kant, and Jürgen Habermas, where the emphasis is placed on the alignment between goals, means, and the meaning of action. In classical pedagogy, Sanat (2022) considers expediency as an integral category that encompasses physiological, psychological, cognitive, and value-based levels. In traditional approaches, expediency is often reduced to operational efficiency, lacking semantic density and meta-orientation.

It can be observed that modern didactic studies increasingly demonstrate a transition

toward multi-layered models of education. These works typically emphasize the importance of reflection and meaning, yet the formalization of the level of expediency remains absent. The three-contour model of didactics proposed in this study resonates with the ideas of spiral learning (Raisch, 2018) and von Bertalanffy's (1957) system thinking, offering a multi-level approach to designing both lessons and the educational environment. UNESCO emphasizes that Education for Sustainable Development (ESD) must cultivate values and responsibility, not merely knowledge and skills. Nevertheless, in practice, especially within chemical education, this often results in isolated ecological modules. Sterling (2001) highlights the gap between the declared goals of ESD and the current paradigm of education, which remains technocratic and narrowly instrumental.

Green Chemistry, or sustainable chemistry, is recognized as a key direction. Its 12 principles (Anastas & Warner, 1998) and subsequent research outline the necessity of integrating environmental consciousness directly into science curricula. Studies by Parchmann et al. (2006) and Burmeister et al. (2012) provide successful cases of chemistry teaching through the lens of sustainability. Contemporary research calls for the integration of systems thinking into chemistry education. For example, Orgill (2019) emphasizes the need to develop students' ability to perceive systemic connections between chemical reactions and sustainability. Proposals involving concept maps and expert opinion elicitation have proven effective in fostering systemic perception. Thus, based on the review, there was compelling justification for proposing a model that integrates a multi-level structure of pedagogical expediency, embeds it into the didactics of ecological-chemical education, facilitates the formation of ecological metacompetence, and overcomes the limitations of the traditional approach.

Materials and Methods. In the methodology of this study, the researchers proceeded from an understanding of didactics as a form of sociocultural organization of knowledge, meaning, and action. Within the notation of post-nonclassical pedagogy (Benin, 2015), education is not limited to the transmission of content; it rather functions as a reflexive and value-organized system. Such an interpretation requires a shift from a functional logic of instruction to a semantic logic of expediency, in which every pedagogical action must be understood in the context of its consequences, values, and systemic effects. The foundations of this approach lie in classical systems philosophy, axiological pedagogy (Cichosz, 2021), and structural-organizational approaches to educational practice. Here, the research proceeded from the principle of methodological monadism, that is, the correspondence of each methodological unit to a holistic framework of action. This principle allowed us to form a three-contour framework for analysis and design. An important role was also played by the ontological turn in pedagogy (Snaza et al., 2014), which insists on interpreting education as an act of world-formation, rather than merely the transmission of knowledge about the world. We argue that expediency, in this context, is not about pragmatism, but rather a mode of ontological alignment of pedagogical actions with the context of sustainability, life, and being.

As the conceptual core of our study, we adopted the Systemic-Structural Didactics (SSD) model, which synthesizes ideas from activity theory, axiological, and systemic approaches. SSD, as mentioned earlier, presupposes the existence of three interrelated contours: the ontological (goal setting, meanings, values), the functional (content structure, modules, connections), and the operational (technologies, tasks, visual and assessment tools). It is necessary to embed within each of these contours the criterion of pedagogical expediency, which differs by level, from biological feasibility to ecological systemicity. Also essential is the inclusion of a resultant category, ecological metacompetence, as an integral indicator of didactic effectiveness. The present study is qualitative-structural in nature and combines philosophical-normative analysis, modeling, and applied didactic comparative studies as the main methods.

Table 1

Research Methods and Their Functional Justification

Method	Justification and Function
Philosophical-ontological analysis	To identify the hierarchy of value foundations in pedagogical action
Structural modeling	To construct the multi-contour architecture of expediency and SSD-didactics
Comparative analysis	To compare traditional and SSD-didactics in terms of pedagogical validity
Axiological verification	To test the models for alignment with the values of sustainability and semantic richness
Conceptual visualization	To represent the model in the form of schemes suitable for integration into pedagogical practice

The researchers also employed methods of philosophical hermeneutics (Supena, 2022), axiological scaling, and morphological analysis. The present study postulated the following null hypothesis: *pedagogical expediency can be formalized as a multi-level structure embedded within SSD-didactics*. Verification of this hypothesis was interpreted through the construction and formalization of a five-level model of pedagogical expediency, visual representation of the three-contour didactic architecture, comparative analysis with traditional didactics based on criteria of coherence, meta-orientation, and value density, and conceptual validation of the model via philosophical foundations (Aristotle 1984; Habermas, 1981; Kant, 1785) and contemporary didactic theories. Overall, this study's methodological approach is based on structural modeling, which involves the decomposition of pedagogical expediency into levels, the identification of links between levels and didactic actions, the construction of a three-contour model as an architectural framework, and the introduction of a resultant category in the form of ecological metacompetence (Table 1).

Results. Levels of Pedagogical Expediency: Historically, the concept of pedagogical expediency has remained at the periphery of didactics, yielding priority to operationalized notions such as "efficiency, "learning outcomes," and "competence." However, the contemporary crisis in education, amid climatic, bioethical, and cognitive challenges, demands a deeper framework. This research argues that this framework lies in the value-semantic verification of every pedagogical action. Thus, the present study posits that pedagogical expediency should not be interpreted as a one-dimensional criterion, but as a hierarchically organized system of modalities, ranging from biophysical feasibility to systemic ecological mission.

This model is constructed based on:

1) Axiological decomposition as the identification of value modalities governing pedagogical action;

2) Systemic logic in the notation of von Bertalanffy (1957), where each level of expediency serves and is subsumed by a hierarchically superior one;

3) Aristotle's teleological philosophy, where action is considered virtuous when directed toward and performed for the sake of the good;

4) Hans Jonas's ethics of responsibility (1979, as cited in Jonas, 1985), where the imperative ("ought") applies not only to the individual but also to the future world.

Accordingly, this study conceptualized the model of pedagogical expediency through five levels, each functioning as a condition and regulator of pedagogical action, and to visualize their structure, the researchers present the Summary Table 2.

Table 2

Summary Table of Expediency Levels and Categorical Correspondences

Level	Focus	Type of Regulation	Meaning Category	Task Class in ECE
BE	Safety, workload	Physiological	Functional	Accounting for reagents, conditions, and ventilation
PE	Motivation, interest	Psycho-cognitive	Psycho-methodological	Use of visual models, case studies
DE	Method, goal, result	Didactic	Logical-methodological	Designing modular blocks
EE	Value, responsibility	Ethical	Axiological	Bioethics topics, chemistry, and morality
EsE	Contribution to sustainability	Systemic	Ontological	Designing tasks based on SDG themes

Overall, this study's model is hierarchical. Each subsequent level includes and governs the previous ones, similar to multilevel regulation in biology. This is not a mere linear scale, but a modally systemic pyramid, where upper levels set the normative boundaries for lower ones. In ecological-chemical education, our model of pedagogical expediency enables the design of lessons with internally consistent architecture, the diagnosis of "deficient" program fragments (toxic experiments without ethical reflection), integration of sustainability themes on a systemic rather than episodic level, and the formation of ecological metacompetence as an integrative outcome across all levels. Thus, our model systematizes pedagogical expediency for the first time as a multi-layered category. It introduces an ontological level of regulation of pedagogical action, creates a foundation for a new verification pedagogy, where expediency, not efficiency, becomes the meta-criterion, and adapts systemic logic to the context of sustainable education and humanitarian chemistry.

The Three-Contour Model of SSD: The three-contour model of Systemic-Structural Didactics (SSD) developed by us is based on the integration and interpretation of:

1) The systems approach, in which each level functions as a subsystem performing a specific function within the overall didactic architecture;

2) The philosophy of levels of reality (Langacker, 2023), according to which pedagogical activity possesses ontological, functional, and operational layers;

3) The functional morphology of didactics (Vegas, 2021), where each element of the learning process corresponds to an appropriate level of content and meaning;

4) The concept of semantic density of education, in which the quality of didactics is determined by the coherence of levels.

Structurally, our SSD model consists of three contours:

I. Ontological Contour (OC)

Purpose: Forms the goal-based foundation, the value framework, and the worldview axis of educational action.

Content elements: Goals, paradigms, justifications, and future scenarios.

Examples in ECE: "Why do we study chemistry?" "How does chemistry affect the biosphere?" "What is our responsibility as chemists?"

Connection to expediency: Correlates with Ethical (EE) and Ecosystemic Expediency (EsE).

II. Functional Contour (FC)

Purpose: Defines the structure and logic for the implementation of content, forming modules, connections, and progressions.

Content elements: Interdisciplinary links, modularity, and conceptual nodes.

Examples in ECE: Thematic chains such as "atom-molecule-reaction consequence," integration of ecology, biochemistry, and geochemistry in case studies, and construction of progressions like "experiment-explanation-predictive model."

Connection to expediency: Corresponds to Didactic (DE) and Psychological Expediency (PE).

III. Operational Contour (OpC)

Purpose: Specifies the forms, methods, and tools for content implementation.

Content elements: Methodologies, tasks, visualizations, and assessment.

Examples in ECE: Micro-experiments with safe reagents, assignments on ecological footprints of substances, and visualization of reaction chains through diagrams.

Connection to expediency: Linked with Biological (BE), Psychological (PE), and partially with Didactic Expediency (DE). We can highlight several key features of the SSD model that directly emerge from its three-contour structure.

Thus, our model functions as a multi-level architecture for designing, implementing, and evaluating education. It is not limited to the function of instruction but includes projective, ethical, and transformational dimensions. Let us illustrate the SSD architecture dynamically, from design to concrete action, through a stepwise scheme.

1) Stage 1: The teacher constructs the course/lesson beginning from the ontological level, defining value orientations and worldview frameworks.

2) Stage 2: These orientations are formalized into functional modules with didactic logic (progressions, links, task types).

3) Stage 3: Operational implementations are selected: forms, visualizations, methods.

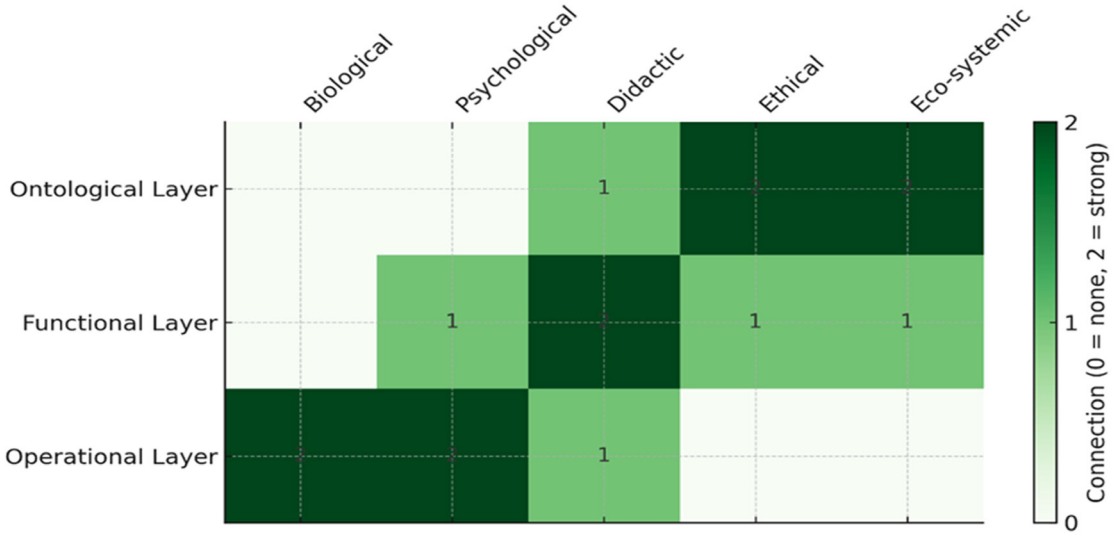
At all stages of this architectural scheme, the model of levels of pedagogical expediency is applied as a diagnostic tool: Does the chosen action correspond to the value vector?

This example demonstrates that our model enables formal verification of didactics using axiological criteria, integrates the value level into didactic design, adapts to schools, colleges, universities, and online environments, and can serve as a foundation for didactic audits, methodical development, and innovative educational programs. Indeed, in traditional didactics, a chemistry lesson is typically structured as: Goal- Content Method Assessment.

In the present research's SSD model, this sequence is replaced with the architecture: Value-Worldview Framework (OC), Modular Content Structure (FC), Operational Implementation (OpC). Each pedagogical action is verified through the model of pedagogical expediency levels.

Figure 1

Matrix of Correspondence Between SSD Layers and Levels of Pedagogical Expediency [Insert visualization here – Matrix grid with saturation zones: 2 = dark green (high), 1 = light green (moderate), 0 = absent]



In the matrix of Figure 1, green zones with high saturation (value 2) visually indicate areas of main semantic and didactic load. Light zones (value 1) indicate secondary or indirect interactions. For instance, the functional contour influences ethical expediency, albeit not directly. From the matrix, we can infer that the Ontological Layer has the strongest association with both Ethical (2) and Ecosystemic (2) expediency. This confirms that value foundations of pedagogical decisions are formed primarily within the ontological contour. The Functional Layer occupies a bridge position, being connected to four levels, especially to Didactic (2) and Psychological (1). The Operational Layer is primarily linked to Biological (2) and Psychological (2), that is, with immediate impact on the body and perception of the learner. Thus, coherent lesson design requires engaging at all levels, from physiological safety to systemic responsibility. Overall, the matrix we propose can be used as a tool for auditing and self-assessment in lesson, module, or course design. Specifically, each pedagogical action can be checked for its inclusion in the contours and correspondence to the levels of expediency.

As for the model as a whole, it is particularly well-suited for the development of didactic maps and checklists, analysis of curricula by the principle of structural density, and visualization of the educational ecosystem. Moreover, integrating the three-contour model into ECE lessons transforms chemistry education from a "science of formulas" into a pedagogy of sustainable thinking, ensures structural expediency of every didactic element, introduces a reflective ecological framework previously absent in formal chemistry, and offers a scalable model for schools, colleges, universities, and online learning. Traditional and Systemic-Structural Didactics in Terms of Pedagogical Expediency: Throughout the 20th and 21st centuries, the dominant model in science education, including chemistry, has been technological didactics, which follows a linear logic: goal-content-method assessment. It must be acknowledged that this scheme proved relatively effective under conditions of standardized and mass instruction. However, in today's world, characterized by increasing complexity, transdisciplinarity, and a crisis of values, this model appears to be losing didactic validity. In contrast, our Systemic-Structural Didactics (SSD) is built on an architectural, nonlinear, and multi-level principle: ontological framing functional modules operational forms. Each step in this structure is assessed against a multi-level scale of pedagogical expediency. This distinction can be illustrated through the following comparative tables 3 and 4.

Table 3

Traditional vs. SSD Didactics

Criterion	Traditional Didactics	SSD Didactics
Educational Goal	Knowledge transmission and assessment	Formation of meaning and systemic responsibility
Lesson Structure	Linear, fragmented	Modular, contour-hierarchical
Expediency	Single-level, operational	Five levels, from physiology to ecosystem
Outcome Assessment	Reproductive testing	Diagnostics of competences and meta-outcomes
Work with Values	Episodic, optional	Central component of the ontological contour
Visualization and Digital Tools	Auxiliary function	Structuring and design instrument
Role of the Student	Passive recipient	Meaning-making agent
Sustainable Development (SDG)	Thematic inclusion	Integrated into lesson logic and structure

We can now compare both models across each level of pedagogical expediency (Section 4.1).

Table 4

Comparison of Models by Level of Expediency

Level of Expediency	Traditional Model	SSD Didactics
Biological (BE)	Often violated (stress, overload)	Principle of gentle and mindful instruction
Psychological (PE)	Partially ensured via motivation	Active use of psycho-design principles
Didactic (DE)	Predominantly frontal method	Methodical flexibility and alignment
Ethical (EE)	Almost absent	Core system-forming component
Ecosystemic (EsE)	Thematically introduced	Embedded into the didactic structure

Overall, we identify eight key parameters by which Systemic-Structural Didactics (SSD) fundamentally differs from traditional models.

1. The goal of education shifts from information transmission to the formation of meaning and responsibility, aligning with the paradigm of education as transformation of consciousness, not just knowledge instrumentation.

2. The lesson structure evolves from linear to modular, allowing flexible integration of interdisciplinary connections, progressions, and contexts.

3. Expediency becomes an internal structural category, formalized through a five-level model, from biological feasibility to ecological systemicity.

4. Assessment transforms from a control mechanism into a verification tool for meta-effects, including ecological metacompetence.

5. Work with values in SSD is embedded into the ontological contour, while in traditional didactics, it is optional or absent.

6. Visualization assumes a central role, not as decoration, but as a semantic scaffold and didactic interface.

7. The student is no longer a passive recipient but a subject of design, interpretation, and action.

8. Integration of sustainable development (ESD) in traditional models is possible only thematically, while in SSD it is structurally systemic.

Indeed, some researchers argue (Burmeister, 2012) that the implementation of Sustainable Development Goals (SDGs) is impossible if traditional didactics remains the sole model. Only systemic educational architectures capable of accounting for value, ethical, and systemic dimensions can cultivate the necessary level of student competence.

SSD didactics does not dismiss the achievements of traditional approaches. Rather, it incorporates them into a broader action architecture, where efficiency is combined with ethical responsibility, and knowledge with sustainability.

In general, transitioning to the SSD model requires:

1) Redesigning curricula and modules;

2) Retraining teachers with an emphasis on the philosophy and structure of pedagogical action;

3) Developing diagnostic tools based on levels of pedagogical expediency;

4) Implementing digital visual interfaces that support architectural instructional design.

Ecological metacompetence: It is not difficult to observe that, under the conditions of climate, resource, and ethical instability, the world is entering an era of transformation. In this context, educational systems are expected not only to train professionals but also to form subjects capable of thinking in terms of sustainability and interconnection, acting upon ecological values, and adapting to rapidly changing environmental and technological conditions.

The competency-based approach, adopted in educational systems since the 2000s, has proven insufficient, as it focuses primarily on operational capabilities (knowing, doing, applying), while neglecting the ontological and ethical foundations of action. We argue that within the framework of Systemic-Structural Didactics (SSD), integrated with a five-level model of pedagogical expediency, a transition is possible from standard competencies to ecological metacompetence (EMC) as the

integrative outcome of ecological-chemical education (ECE).

We define ecological metacompetence (EMC) as the learner's sustained ability to recognize and reflect on the consequences of chemical and technological decisions in the biosocial context; to act based on values of sustainability, ethical responsibility, and systemic interdependence; and to adapt behavioral and professional practices in conditions of ecological uncertainty.

Based on this definition, the structure of EMC can be interpreted as follows (Table 5):

Table 5

Structure of Ecological Metacompetence

Component	Description	Link to SSD and Expediency
Awareness	Knowledge of ecological problems and chemical consequences	Operational contour (BE, PE)
Understanding	Comprehension of interconnections and systemic effects	Functional contour (DE)
Responsibility	Ethical evaluation of actions and recognition of consequences	Ontological contour (EE)
Eco-behavior	Application of sustainable solutions and choice of alternatives	All contours, predominantly OpC
Adaptation	Ability to transform behavior in response to changing environments	Meta-component integrating all levels

It should be emphasized that the EMC model is not autonomous. Rather, it emerges as a result of integrating all three contours and all five levels of pedagogical expediency. This makes it a valid indicator of didactic maturity and the sustainability of education. Moreover, we can assert that in the era of automation and employment crisis, ecological metacompetence may become a new form of post-economic subjectivity, shaping not only profession but also ways of thinking, acting, and assuming responsibility. Specifically, EMC can be integrated into national education standards as a multidisciplinary outcome, uniting natural sciences, philosophy, pedagogy, and digital literacy. It may also serve as a basis for international benchmarking of the quality of environmental education. Thus, we consider ecological metacompetence not as a by-product of ecological-chemical education, but as its primary didactic-humanistic outcome. It cannot be cultivated within linear didactics, but only through architectural and systemic approaches, such as multi-contour and multi-layered pedagogical models (SSD). In this context, EMC combines value-based, cognitive, and behavioral modalities, enabling the learner not only to know but to act responsibly (Table 6). To support practical implementation, we offer a model for assessing ecological metacompetence within an ECE course. This model is designed in both academic and practical formats and can be integrated into assessment systems at the level of lessons, courses, programs, and modules. Let us recall that ecological metacompetence is interpreted here as a multi-level integrative quality that encompasses cognitive, ethical, behavioral, and adaptive elements. It cannot be evaluated through traditional tests or standard assessments. Instead, it requires a mixed model, combining quantitative and qualitative indicators, formative and summative assessment, reflective, behavioral, and project-based tools, and validation through the levels of pedagogical expediency. We propose the following assessment framework for ecological metacompetence.

Table 6

EMC Assessment Components

Component	Assessment Indicator	Assessment Method
Awareness	Recognition of environmental issues and chemical consequences	Survey, oral questioning

Understanding	Comprehension of systemic relations and consequences	Concept maps, systems-based essays
Responsibility	Ethical reasoning on chemistry and ecology issues	Ethical case analysis
Eco-behavior	Selection of sustainable solutions in practical contexts	Scenario-based tasks, project assignments
Adaptation	Flexibility, reflection, and behavior adjustment	Reflective essays, feedback mechanisms

Each component may be evaluated on a 4-point scale.

Level	Criterion
0	Absence of the component
1	Fragmented or partial understanding
2	Holistic but unstable application
3	Stable behavior/reflection/action

Accordingly, the total EMC score is the sum of points across five components (range: 0–15). Additionally, competence profiles can be generated, displaying individual scores for each component, e.g., using radar charts. Group profiles can also be constructed, as well as before/after course comparisons and week-by-week progress tracking. General methodological recommendations for implementation are as follows.

1) Integrate EMC assessment throughout the module, not only at the end, with reflection after each phase;

2) Use mixed methods, including observation and self-assessment;

3) Engage learners in co-developing assessment criteria to enhance metacognitive awareness;

4) Visualize progress. This helps learners recognize and value their own development.

The EMC model is based on the five-level structure of pedagogical expediency, validated through the three-contour SSD framework, aligned with global SDG frameworks and ethical pedagogy, and has strong instrumental potential for implementation in schools, colleges, universities, and digital learning platforms.

Discussion. The model of expediency adopted in our study is not functional-instrumental but ontological. It is grounded in a philosophical reconstruction of the concept of telos as both meaning and purpose embedded in being itself. This radically distinguishes our approach from utilitarian interpretations of education as mere "preparation for the market" or "training in applicable skills" (Biesta, 2010). Thus, any form of instruction that does not incorporate the category of the good cannot be considered pedagogical in the strict sense. This brings our concept close to the tradition of ontological pedagogy (Klafki, 1998) and modern post-normal pedagogy of sustainability (Sterling, 2001), in which education is conceived as a transformation of the subject, not merely the transmission of content. It is important to emphasize that the SSD model, as demonstrated in our study, is not simply another taxonomy or skills matrix. Its novelty lies in multi-level, nonlinear, and topological thinking about the educational process. Here, the operational contour corresponds to tactical actions, the functional contour to strategic construction of relations and contexts, and the ontological contour to existential foundations - values and worldview.

This aligns SSD with synergetic didactics (Haken, 2006), where learning is not a linear progression but a self-organizing cognitive attractor, integrating knowledge into the structure of the subject. In this sense, we shift didactics from a discipline of methods to a discipline of architectures and transitions, and the role of the teacher becomes that of an architect of the semantic educational field. Modern critiques of the competency-based approach (Hyland,

2007) point out its reduction of the subject to a carrier of functions. In contrast, we propose moving beyond this horizon by introducing the concept of ecological metacompetence (EMC) - the ability of a subject not merely to act, but to think in categories of sustainability and interdependence, to make decisions under ethical and ecological uncertainty, and to reflectively adapt to the evolving landscape of planetary challenges. Unlike so-called "green competencies," this research's EMC model is founded on ontological grounds (SSR-contours), has a clear structure with cognitive-ethical components, and proposes a didactic design and assessment model embedded into the architecture of the course. In this way, in our interpretation, EMC becomes not an auxiliary result but a new pedagogical paradigm. Specifically, the SSD model demands the abandonment of the linear logic of the lesson, where one goal corresponds to one method and one form of assessment. Instead, we propose a matrix architecture, where the contours (operational, functional, ontological), levels of expediency (from basic to eschatological), and components of EMC are interconnected, forming a topological educational field, by analogy with fields in physics or systems biology.

The present study proposes that such a conditional field is subject to design (through didactic pathways), navigation (through learning tracks), and evaluation (through competence profiles and meta-indices). The model has certain limitations, such as a limited empirical base, the need for adaptation across educational levels, and possible challenges in subject-oriented systems, yet it offers prospects for integration into SDG 4.7 metrics, application within UNESCO ESD2030 and the Earth Charter initiatives, and incorporation into digital platforms as a flexible competence-semantic track, demonstrating its transversality (Santesmases, 2020). The model can be adapted not only to ECE but also to biology (via the concept of a "biocenosis of thinking"), social studies (through systemic analysis of decisions), and mathematics (through topology and models of sustainability).

The findings of the present study confirm the hypothesis that pedagogical expediency is a transcendental criterion of the scientific nature of educational action. It is the inclusion of expediency, at all levels, from task formulation to result evaluation, from content to course architecture, and from instruction to ontological assembly of the subject, that ensures a transition from pedagogy as function to pedagogy as transformation of thought and being (Freire, 1970). Thus, Systemic-Structural Didactics, implemented through the lens of pedagogical expediency, not only responds to the challenges of sustainability but also reassembles the very nature of education, restoring its status as ethically conscious, ontologically embedded, and transformatively directed action. Let us once again emphasize expediency as the criterion of true education and express this position in the form of a maxim: "Education without ontology is merely operation; ontology without education is merely silence."

Classical 20th-century didactics, grounded in technocratic models, relied predominantly on instrumentalist epistemology, treating knowledge as an object to be transmitted, measured, and acquired. However, the challenges of the 21st century, climatic, civilizational, and cognitive, require not more knowledge, but a transformation of the very form of thinking (Silva, 2009). Accomplishes precisely this: a transition from knowledge as information to knowledge as an ontological stance. It restores the lost ontological vector of education, in which learning is not only about mastering the external but also about assembling the internal. In essence, the model we propose raises a radical question. Is everything we teach pedagogically justifiable? Pedagogical expediency becomes a filter for epistemic validity. That is, knowledge that does not lead to understanding, action, responsibility, and adaptation is not genuine knowledge in the pedagogical sense. This leads to an epistemological shift, from an emphasis on verifiable truth (in the logical-positivist model) to transformative truth, aligned with the horizon of the subject, their environment, and values. Hence, education in our model should

be viewed as a process of epistemogenesis, not only assimilation of knowledge but the generation of new forms of epistemological relations to the world: from singularity to multiplicity of perspectives, from transmission to constructive generation, and from object to meaning and ontological dimension. This directly aligns the SSD approach with the paradigms of radical constructivism (Jarvinen, 1998), cognitive epistemology (Luhmann, 2017), and meta-education (Jayadi, 2022), where the learner does not merely receive the world but constructs it. Ultimately, the most significant philosophical threshold emerges in connection with ecological metacompetence. Here, knowledge ceases to be neutral and becomes ethically charged (every knowledge entails consequences), ecologically embedded (knowledge alters the biosphere), and ontologically responsible (knowledge shapes the image of reality).

Thus, ecological-chemical education cannot be a mere transmitter of concepts and formulas. It must become a platform for the redefinition of the human-nature relationship. And this demands a new epistemology of education - one that is responsible, holistic, and expedient. What began as a local investigation into didactics in ecological-chemical education has ultimately brought us to the limits of pedagogical rationality itself. Our SSD model may be interpreted not only as a tool for course design but as a mode of thinking - an epistemological threshold demanding redefinition of what we consider knowledge, what we recognize as outcomes, and what we call education. In this sense, pedagogical expediency becomes a new criterion of truth, and truth itself is no longer static but cultivated and revealed within the structure of the subject.

Conclusion. Thus, our study has convincingly demonstrated that pedagogical purposiveness should be interpreted not as an auxiliary category but as a foundational principle for educational design. This approach enables us to distinguish formal instruction from genuinely pedagogical action by relating each didactic practice to its value-based, adaptive, and meta-level context. Conceptually, the proposed model of system-structural didactics (SSD) constitutes an architecture of three interrelated contours (operational, functional, and ontological), and this architecture is authentically validated through a five-level structure of purposiveness, ranging from biological foundations to ecosystemic responsibility. We believe that this structure not only ensures the logical and semantic coherence of educational actions but also generates new trajectories of pedagogical thinking. Overall, the concept of ecological metacompetence (EMC) developed in this study captures the integral outcome of ecological-chemical education by linking cognitive, ethical, and adaptive components. In our view, it can serve as an indicator of pedagogical maturity and be applied both in student assessment and in course design, particularly within the frameworks of sustainable education and global SDG targets. Accordingly, we may confidently affirm that our SSD and EMC models possess transversality, are applicable across disciplines, are scalable to digital environments, and can serve as a foundation for a new generation of educational programs oriented toward value-laden meaningfulness and structural adaptability.

References

Abdimanapov, B., Kumarbekuly, S., & Gaisin, I. (2024). Technology for Achieving Learning Objectives Through a System-Activity Approach and the Development of Critical Thinking in Geography Studies. *Journal of Ecohumanism, 3*(8), 11989-12003. https://doi.org/10.62754/joe.v3i8.5797

Anastas, P. T., & Warner, J. C. (2000). *Green chemistry: theory and practice*. Oxford University Press. https://academic.oup.com/book/53104

Aristotle. (1984). Nicomachean Ethics, Book II, Chapter 4, 1105a b. Translated by W.D. Ross. In: The Complete Works of Aristotle, ed. J. Barnes. Princeton University Press, 1984.

Benin, V. L. (2015). Pedagogy in the Era of the Post-Non-Classical Science. *The Education and Science Journal*, (6), 122. https://doi.org/10.17853/1994-5639-2012-6-122-135

Biesta, G. (2010). A new logic of emancipation: The methodology of Jacques Rancière. *Educational theory*, *60*(1), 39-59. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1741-5446.2009.00345.x

Brown, L. (Ed.). (2009). *The Nicomachean Ethics*. Oxford University Press. https://books.google.com/books?hl=en&lr=&id=TUX7uoQyPUMC&oi=fnd&pg=PR5&dq=Aristotle.+Nicomachean+Ethics,+Book+II,+Chapter+4,+1105a%E2%80%93b.+Translated+by+W.D.+Ross.+In:+The+Complete+Works+of+Aristotle,+ed.+J.+Barnes.+Princeton+University+Press,+1984.&ots=mOJNcKQz7R&sig=2iWH9nH9KqqIjHDiOV4AaIPi7sg

Burmeister, M., Rauch, F., & Eilks, I. (2012). Education for Sustainable Development (ESD) and chemistry education. *Chemistry Education Research and Practice*, *13*(2), 59-68. https://pubs.rsc.org/en/content/articlehtml/2012/rp/c1rp90060a

Cichosz, M. (2021). Axiological Foundations of Social Pedagogy: Search Areas. *Roczniki Pedagogiczne*, *13*(4), 35-43. https://www.ceeol.com/search/article-detail?id=1019440

Freire, P. (1970). Pedagogy of the Oppressed. The Continuum International Publishing Group. *Inc.: New York, NY*.

Habermas, J. (1981). Theorie des kommunikativen Handelns, Frankfurt a. *M.: Suhrkamp*.

Haken, H. (2006). Synergetics of brain function. *International journal of psychophysiology*, *60*(2), 110-124. https://www.sciencedirect.com/science/article/pii/S0167876006000067

Hyland, K., & Tse, P. (2007). Is there an "academic vocabulary"?. *TESOL Quarterly*, *41*(2), 235-253. https://onlinelibrary.wiley.com/doi/abs/10.1002/j.1545-7249.2007.tb00058.x

Jarvinen, E. M. (1998). The Lego/Logo Learning Environment in Technology Education: An Experiment in a Finnish Context. *Journal of Technology Education*, *9*(2), 47-59. https://eric.ed.gov/?id=EJ563616

Jayadi, K., Abduh, A., & Basri, M. (2022). A meta-analysis of the multicultural education paradigm in Indonesia. *Heliyon*, *8*(1). https://www.cell.com/heliyon/fulltext/S2405-8440(22)00116-5

Jonas, H. (1984). *The imperative of responsibility: In search of an ethics for the technological age*. University of Chicago Press. https://www.amazon.com/Imperative-Responsibility-Search-Ethics-Technological/dp/0226405974

Kant, I. (1785). *Grundlegung zur Metaphysik der Sitten*. Riga: Johann Friedrich Hartknoch

Klafki, W. (1998). Characteristics of critical-constructive Didaktik. *Didaktik and/or curriculum: An international dialogue*, 307-330.

Langacker, R. W. (2023). Levels of Reality. Lublin Studies in Modern Languages and Literature, 47(1), 11–36. https://doi.org/10.17951/LSMLL.2023.47.1.11-36

Luhmann, N. (2017). Evolution of science. *Epistemology & Philosophy of Science*, *52*(2), 215-233. https://www.pdcnet.org/eps/content/eps_2017_0052_0002_0215_0233

Manapova, S., Shaikhova, B., Kumarbekuly, S., Mikushina, I., & Afanasenkova, I. (2025). A set of online tools for teaching chemistry, considering a systematic approach to the educational process. *International Journal of Innovative Research and Scientific Studies*, *8*(1), 1363-1379. https://elibrary.ru/item.asp?id=82154838

OECD (2005). *The Definition and Selection of Key Competencies. Executive Summary*. Paris: OECD

Orgill, M., York, S., & MacKellar, J. (2019). Introduction to systems thinking for the chemistry education community. *Journal of Chemical Education*, *96*(12), 2720-2729. https://pubs.acs.org/doi/abs/10.1021/acs.jchemed.9b00169

Parchmann, I., Gräsel, C., Baer, A., Nentwig, P., Demuth, R., & Ralle, B. (2006). "Chemie im Kontext": A symbiotic implementation of a context-based teaching and learning approach. *International journal of science education*, *28*(9), 1041-1062. https://www.tandfonline.com/doi/abs/10.1080/09500690600702512

Raisch, S., Hargrave, T. J., & Van De Ven, A. H. (2018). The learning spiral: A process perspective on paradox. *Journal of Management Studies*, *55*(8), 1507-1526. https://onlinelibrary.wiley.com/doi/abs/10.1111/joms.12397

Sanat, K., Nurbol, U., Bakhadurkhan, A., Anargul, S., Zukhra, D., & Gulfat, K. (2022). World Journal on Educational Technology: Current Issues. https://www.ceeol.com/search/article-detail?id=1074260

Santesmases, JS (2021). Study of the transversality of content in Physical Education through competency-based curricula. *Challenges: new trends in physical education, sport, and recreation*, (40), 419-429. https://dialnet.unirioja.es/descarga/articulo/7706238.pdf

Silva, S. R. D. (2001). Review: Edgar Morin: The seven necessary knowledges for the education of the future. *ETD-Educação Temática Digital* , *2*(3), 138-142. https://www.ssoar.info/ssoar/bitstream/handle/document/10554/ssoar-etd-2001-3-rez-silva.pdf?sequence=1

Snaza, N., Sonu, D., Truman, S. E., & Zaliwska, Z. (2016). *[Introduction to] Pedagogical Matters: New Materialisms and Curriculum Studies*. Peter Lang Publishing, Inc.. https://scholarship.richmond.edu/bookshelf/219/

Sterling, S., & Orr, D. (2001). *Sustainable education: Re-visioning learning and change* (Vol. 6). Totnes: Green Books for the Schumacher Society. https://www.researchgate.net/profile/Stephen-Sterling-2/publication/289505456_Sustainable_education/links/609bf59e458515a04c59a648/Sustainable-education.pdf

Supena, I. (2022). Gadamer's Philosophical Hermeneutics on Religious Language and COVID-19. *Filosofija. Sociologija*, *33*(3), 310-317. https://www.ceeol.com/search/article-detail?id=1064875

UNESCO (2017). Education for Sustainable Development Goals: Learning Objectives. Paris: UNESCO Publishing.

Vegas, R. A. M. (2022). Knowledge of morphology, morphological awareness, and lexical learning." Diffused" objectives in Secondary Education. *Tejuelo*. https://www.academia.edu/download/94817387/4106_Texto_del_articulo_15656_2_10_20211209.pdf

Von Bertalanffy, L. (1957). Quantitative laws in metabolism and growth. *The quarterly review of biology*, *32*(3), 217-231. https://www.journals.uchicago.edu/doi/abs/10.1086/401873

Information about authors:

Manapova Saltanat, Doctoral of Pedagogical Sciences of Sarsen Amanzholov East Kazakhstan University, Department of Chemistry, 070002, Republic of Kazakhstan, Ust-Kamenogorsk, 30th Guards Division st.34, ORCID ID: 0000-0002-2641-8347, email: smanapova@vku.edu.kz,

Bakhyt Shaikhova, Candidate of Pedagogical Sciences, Associate Professor of Sarsen Amanzholov East Kazakhstan University, Department of Chemistry, 070002, Republic of Kazakhstan, Ust-Kamenogorsk, 30th Guards Division st.34, ORCID ID: 0000-0001-8567-6752, email: bshaihova@vkgu.kz

Afanasenkova Irina, Candidate of Pedagogical Sciences, Associate Professor of Sarsen Amanzholov East Kazakhstan University, Department of Chemistry, 070002, Republic of Kazakhstan, Ust-Kamenogorsk, 30th Guards Division st. 34, ORCID ID: 0000-0002-5369-825X, email: iafanasenkova@vku.edu.kz

Dautova Zukhra, Candidate of Pedagogical Sciences, Associate Professor of Sarsen Amanzholov East Kazakhstan University, Department of Chemistry, 070002, Republic of Kazakhstan, Ust-Kamenogorsk, 30th Guards Division st.34, ORCID ID: 0000-0003-2017-7009, email: zdautova@vku.edu.kz

Tantybayeva, Batima, Candidate of Pedagogical Sciences, Associate Professor of Sarsen Amanzholov East Kazakhstan University, Department of Chemistry, 070002, Republic of Kazakhstan, Ust-Kamenogorsk, 30th Guards Division st.34, ORCID ID: 0000-0001-5750-6481, email: bati_54@mail.ru

Original Article
IRISTI 14.35.07 10.51889/2960-1649.2025.65.4.009

KOZHAMBERDIYEVA NURZADA[1], KUDAIBERGENOVA ALIYA[1]*

[1]Al-Farabi Kazakh National University (Almaty, Kazakhstan)

*Address of correspondence: Kozhamberdiyeva Nurzada, Department of Pedagogy and Educational Management, Al-Farabi Kazakh National University, Masanchi street, 39, Almaty, Kazakhstan, 050000. ORCID ID: https://orcid.org/0009-0003-6261-1448; E-mail: nurzada_k8@mail.ru/ Tel.: +77089131609

Professional Competence as an Object of Research in Higher Education: A Systematic Review

Abstract

Introduction. This article synthesizes national and international research on professional competence in a master's degree in higher education. The review addressed three questions: how professional competence is defined in recent literature, which constituent components are most frequently posited, and which assessment approaches are employed at universities: methodology *and Methods.* A structured search covering 2015-2025 was conducted with three sources. Inclusion criteria are peer-reviewed research that explicitly state a definition of professional competence, describe its structural components, and report assessment methods or instruments. *Results.* Reported assessment practices typically combine practice-based tasks, mentor or supervisor observations, and employer feedback, often supported by rubrics or checklists. Research frequently links measured competence to academic achievement, practicum results, and early employment outcomes. A recurrent problem noted is misalignment between graduates' competencies and labor-market needs; many institutions report adopting strategies to reinforce competence development and graduate employability, with outcomes varying by the strength of internal innovation and collaboration. *Scientific Novelty.* The review consolidates a dispersed body of national and international sources into a coherent frame. The study also provides transparent eligibility criteria and flow for included literature, enabling reproducibility. *Practical Significance.* Across the included research, operational definitions of competence anchored in observable performance and explicit levels make goals and criteria clearer and testable. Aligning competence development with labor-market expectations through employer collaboration and supervised practicum links measured competence to concrete outcomes. Several research reports associations with course achievement, practicum ratings, and early employment. These effects recur in different institutional and disciplinary settings, underscoring the applied value of the documented approaches.

Keywords: professional competence, competency-based approach, global competence, higher education, competence assessment, assessment instruments.

Introduction. Over the past two decades, universities have increasingly designed instruction backwards, moving from stated learning outcomes to curriculum and assessment. Within this logic, professional competence serves as the target of the program. What matters is not only what is taught, but how a graduate acts in typical and atypical professional situations. At the same time, international and domestic research retains heterogeneous definitions, levels, and typologies of competence, complicating curriculum design and reducing comparability of results across institutions. Recent reviews note that competency-based education models vary across systems and cultural contexts and adopt different emphases; the primacy of performance-oriented outcomes and transparent assessment is consistently upheld as foundational (Tahirsilaj & Sundberg, 2025).

Formulating an operational definition of competency-based education remains a key methodological task. In the professional domain, the proposed operationalization underscores the need for explicit learning outcomes, evidence-based demonstration of mastery, and flexible time frames, thereby aligning program

requirements, instructional strategies, and assessment procedures without compromising academic depth (Gervais, 2016). In practice, this reliance on clearly articulated outcomes is enacted through constructive alignment of goals, teaching, and assessment at both program and course levels, including the involvement of external stakeholders and linkage to professional standards and qualifications frameworks (Serbati, 2015).

The most robust effects are observed where competence is treated as an integration of knowledge, skills, attitudes, and experiential performance, and where assessment is built around relevant tasks. Research shows that this form allows for seeing learning progress and managing the quality of the program, rather than just recording individual learning achievements. (Bergsmann et al., 2015). For universities, this entails a shift from formal checks of content recall to evaluating the ability to act in the context of professional tasks. An expanding evidence base links competency-oriented practices to graduate employability and the development of transferable skills, reinforcing the approach's pragmatic value for learners and employers (Abelha et al., 2020).

Nonetheless, important issues remain unresolved: fuzzy boundaries and overloaded competency lists that hinder planning and measurement, gaps between professional standards and course-level tasks, and insufficient scrutiny of the reliability and validity of assessment tools. Such challenges are reported both in work on European frameworks and in regional research, including implementation efforts across diverse education systems, where there is particular demand for clear alignment structures and concrete exemplars of appropriate tasks for master's degree programs and continuing professional development. Complementary cases from professional and non-formal learning show how competency logic helps align educational aims with real workplace practices and labor markets (Ramasamy & Pilz, 2019). Theoretical and review publications further stress that the effectiveness of competency-based approaches depends not only on content and methods but also on organizational support and the regular review of assessment criteria (Serbati, 2015).

The scientific and methodological literature converges on several points. First, working definitions and components of competence should be specified in terms of observable behaviors and level descriptors. Second, curricula should be designed through a structure that aligns outcomes, learning activities, and assessment instruments, with the engagement of employers and professional communities. Third, genuine performance-based assessment formats with explicit rubrics should be implemented, accompanied by routine checks of the reliability and validity of the tools employed. Together, these measures create a basis for comparability across programs and for a meaningful dialogue with the labor market. The present review systematizes these solutions, juxtaposing national and international sources that can be adapted to specific university contexts without loss of scholarly rigor or the academic identity of the program (Bergsmann et al., 2015; Gervais, 2016; Serbati, 2015; Tahirsilaj & Sundberg, 2025).

Methods and Materials. A systematic review was conducted for the period 2015-2025, focusing on the social sciences and humanities strand of higher education. The review was guided by three research questions:

– How do contemporary researchers define and operationalize professional competence in social sciences and humanities education?

– How are these definitions embedded in curriculum design and learning activities?

– Which assessment methods are employed, and how are their validity and reliability reported?

The methodological framework was aligned with the principles of the competency-based approach and with transparent reporting practices for systematic reviews in adjacent fields, as reflected in foundational publications on defining competency-based education and on constructive alignment of aims, instruction, and assessment (Gervais, 2016; Serbati, 2015; Abelha et al., 2020; Jiaxin et al., 2024; Tahirsilaj & Sundberg, 2025).

Searches were carried out in Scopus, ProQuest, and Google Scholar using the following keywords: professional competence, competency-based learning/education, profes-

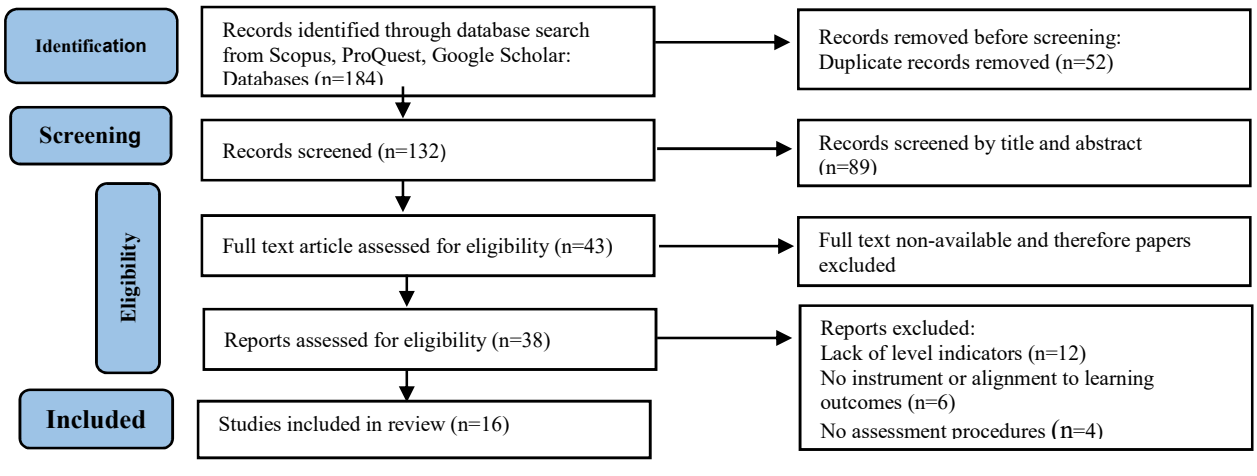
sional skills, higher education, master's degree, university, and assessment of learning outcomes.

Inclusion criteria were pre-specified. Eligible records were peer-reviewed articles, reviews, and conference papers published in 2015-2025 that: (1) pertained to higher education in the social sciences and humanities; (2) provided an explicit definition of student professional competence; and (3) described program-level solutions and assessment instruments with documented procedures for establishing validity and reliability. Exclusion criteria comprised research confined to school education without transferability to higher education, publications lacking methodological relevance, materials without a description of assessment approaches, and duplicates.

Screening proceeded in two stages: initial title/abstract screening followed by full-text eligibility assessment. Data were extracted using a standardized template with a second pass for internal self-verification. For each source, we recorded the study context, program level, operational definitions, and typologies of competence, the set of assessment instruments, and indicators of methodological quality, including types of validity evidence and reliability coefficients. Data extraction and reporting were informed by best practices for evaluating competency-based approaches in universities and by guidance on implementing assessment tools at program and course levels (Bergsmann et al., 2015; Gervais, 2016; Serbati, 2015).

Figure 1

Updated search strategy framework



Quality appraisal was conducted separately for qualitative, quantitative, and mixed-methods research using a common set of minimum criteria. For qualitative designs, we considered transparency of the study rationale and data-collection procedures, justification of the sampling frame and recruitment strategies, completeness of contextual description, and the logic and steps taken to enhance trustworthiness, including data cross-checks. For quantitative research, examined sample size justification, representativeness, and sampling method were examined, and the appropriateness of measurement procedures and their alignment with the stated constructs. For mixed-methods designs, we additionally analyzed the integration between qualitative and quantitative components and the consistency of the conclusions. Data extraction was conducted using a standardized template. For each source, we recorded bibliographic details, higher-education level, research design, and methods. Ethical approval was not required because the analysis relied on openly published materials without personal data.

Results. The 2015-2025 search was conducted in three sources: Scopus, ProQuest, and Google Scholar. 184 articles were identified. After removing 52 duplicates, 132 remained for screening. During title and abstract screening, 89 records were excluded as not aligned with the topic and the aim

of identifying operationalized professional competence, including publications offering only general descriptions of skills without assessment procedures, materials about other educational levels, and non-peer-reviewed items. 43 articles were retrieved for full-text review, and 5 were excluded due to lack of access to the full text. 38 publications were assessed for eligibility, and an additional 22 were excluded on transparent grounds: absence of operationalization and level indicators of professional competence (n=12), reliance solely on self-report without instrument description and without linkage to learning outcomes (n=6), absence of assessment procedures or focus on a different educational level (n=4). 16 articles were included in the final synthesis, providing sufficient coverage across regions and disciplines and allowing comparison of the assessment instruments employed. Of these, seven were empirical research with reporting on instrument quality, and nine were theoretical, review, or methodological publications that established conceptual and procedural guidelines for aligning learning outcomes, instructional activities, and assessment.

All methodological sources documented the use of alignment tables, «learning outcomes, learning activities, assessment, and the involvement of external stakeholders in program design. Replacing discipline-based pass or fail checks with relevant assessment practices is described as a key condition for making competence measurable at the program level (Serbati, 2015; Abelha et al., 2020). Research focused on aligning educational outcomes with professional requirements describes role-based and scenario tasks, along with the integration of project and case work.

In empirical publications, relevant assessment formats predominate projects and case analyses (Ramasamy & Pilz, 2019). Several studies demonstrate growth in graduate master's degree students' global and professional competence resulting from intercultural and interdisciplinary learning activities and online projects (Kang et al., 2018; Liu et al., 2020). In the social sciences and humanities strand, individual research emphasizes tying tasks to the functional responsibilities of future professional practice and employing comprehensive assessment criteria.

Most empirical research reports content validity through expert alignment and links to stated learning outcomes, construct validity through factor models and relationships with external indicators, and reliability via Cronbach's alpha coefficient (Bergsmann et al., 2015; Liu et al., 2020). Kazakhstani sources additionally report item difficulty and discrimination indices and item total correlations, indicating the implementation of a minimal psychometric standard at the program level (Minzhanov et al., 2024).

Table 1

Research on competence-based education

Source (year)	Design & context	RQ1: Definition and operationalization	RQ2: Integration into curricula and activities	RQ3: Assessment, validity, and reliability
Serbati (2015)	Analysis of university alignment practices	Competence = knowledge, skills, attitudes, with level descriptors	Program-level alignment maps, involvement of external stakeholders, and re-mapping courses to targeted outcomes	Rubrics, portfolios, project tasks, emphasis on coherence, and the formative function of assessment
Bergsmann et al., (2015)	Methodological study on assessing CBE in universities	Operationalization through observable outcomes and attainment indicators	Embedded assessment within course design, preparing faculty to use rubrics	Utility and feasibility of instruments, reporting on reliability and rater calibration as a quality condition
Gervais (2016)	Conceptual paper on competency-based education	Competence as measurable learning outcomes manifested in observable actions, with emphasis on clear level indicators	Constructive alignment of «outcomes – teaching –assessment» at program and course levels, recognition of prior learning	Relevant tasks and rubrics, requirement for transparent criteria and mastery thresholds, psychometrics noted as desirable, without detailed reporting

Kang et al., (2018)	Quasi-experiment: intercultural online projects	Operationalization via changes in global-competence indicators	Embedding online collaborations within a course	Use of self-report scales, internal consistency reported, and participation effects noted
Lozano et al. (2017)	Literature review and framework on competence-oriented higher education for sustainable development	Highlights systems thinking, anticipatory, and normative components	Cross-curricular embedding, problem-based learning, community, and stakeholder-engaged tasks	Limited validity and inter-rater reliability reporting
Ramasamy & Pilz (2019)	Competency-based curriculum development	Competence is described via professional functions and actions	Modular design from functions to tasks, close linkage with workplace practice	Assessment through work-integrated tasks, observation, and checklists, reliability supported by assessor training
Liu et al., (2020)	Development and validation of a graduate-level scale	Competence model with factors and operational indicators	Application of the scale in courses and programs for monitoring	Detailed psychometrics: factor analysis, Cronbach's alpha, relationships with external measures
Butum et al. (2020)	Comparison of competency requirements in social-economic sciences	Lists and prioritization of competencies based on employer demand	Recommendations for adjusting curricula and activities	Assessment is predominantly survey-based; the need for validated instruments is emphasized
Ortiz-Marcos et al. (2020)	Framework of global competence for universities	Competencies formulated as actions and outcomes	Project-oriented learning, tasks related to sustainable development	Achievement indicators proposed, validity left for subsequent research
Abelha et al., (2020)	Systematic review: competencies and employability	A broad framework of professional and «transversal» competencies, need for explicit levels	Practices linking learning outcomes with labor-market requirements, projects with external clients	Concludes that many research lack robust validity and reliability evidence
Kulik et al., (2020)	Theoretical review in the higher-education context	Typology of competencies: key, general, cultural, professional, need for operational indicators	Recommendations for aligning programs and courses with stated outcomes	Notes a shortage of validated Russian-language instruments, calls for development and testing
Brauer (2021)	Systematic literature review of competence-oriented processes in higher education across disciplines	Competence = integrated knowledge, skills, observable indicators, and explicit levels.	Curriculum-level constructive alignment, project and work-based learning, stakeholder co-design.	Authentic tasks with rubrics, gaps in validity and inter-rater reliability, need for standardized evidence.
Kjellgren & Richter (2021)	Conceptualizing global competence for sustainable development	Global competence is the capacity to act in complex social contexts	Strategies: cross-cutting sustainability themes, interdisciplinary assignments, micro-credentials for supplementary competencies	Program-level moni_ toring proposed, call to strengthen measurement reliability
Jiaxin et al., (2024)	Systematic review of global competence in higher education	Global competence is a set of knowledge, skills, and attitudes	International and intercultural online projects, «Internationalization at Home»,	Predominance of self-report surveys, reliability and factor structure reported, but criterion

		assessed in intercultural tasks	interdisciplinary assignments	validity needs strengthening
Minzhanov et al., (2024)	Applied study in a Master's in Social Work	Professional competence is described via functions and observable actions	Development of task sets and alignment tables «outcomes – activities –assessment» at the program level	Psychometrics for the task set: item difficulty and discrimination indices, revision of weak items
Tahirsylaj & Sundberg (2025)	Research review of the «five visions» of CBE	Multiple co-existing definitions, shared core is action and transfer to practice	Diverse pathways for curriculum-level implementation	Critique of a weak evidence base, call for more rigorous validation procedures

Comparison of results yields four stable conclusions: (1) competence should be specified through observable actions with level descriptors aligned to stated learning outcomes; (2) in master's degree programs within the social sciences and humanities, the most methodologically robust approaches are authentic tasks paired with rubrics and portfolios; (3) alignment practices that link «outcomes – activities – assessment» reduce the gap between program goals and actual assignments and improve the reproducibility of assessment; (4) reporting on the validity and reliability of instruments remains uneven, uniform requirements are needed for describing procedures and minimum psychometric indicators.

Discussion. A synthesis of the sixteen research converges on a shared view of graduate professional competence as an action-visible result articulated through levels of mastery, which makes it genuinely testable within the educational process (Gervais, 2016). Translating such descriptions into curriculum architecture requires a direct linkage among the statement of outcomes, the forms of learners' work, and the means of verification at both program and course levels (Serbati, 2015). Although the elements of competence are labeled differently, the literature agrees on action and transfer to practice as the common core of the approach (Tahirsylaj & Sundberg, 2025). In other reviews, additional emphasis the need for explicit operational indicators and a clear typology; without these, goals become diffuse, and assessment loses its meaning (Kulik et al., 2020).

A turn toward labor-market requirements heightens attention to end results and to embedding external projects in the curriculum, thereby narrowing the program-practice gap (Abelha et al., 2020). Comparisons between university and employer expectations help prioritize competencies and update assignments and courses based on actual demand (Butum et al., 2020). Sustainability frameworks provide ready-made contexts for project tasks in which competence can be demonstrated and measured in action (Ortiz-Marcos et al., 2020). Strategies for developing global competence propose cross-cutting themes and interdisciplinary assignments as routine practice rather than one-off events (Kjellgren & Richter, 2021). Reviews of global competence document the growth of intercultural formats while simultaneously calling for stronger evidence linking measurements to external criteria (Jiaxin et al., 2024).

In assessment, practice-based tasks consistently outperform alternatives. Projects, cases and portfolios paired with clear rubrics yield defensible evidence of level and actionable, program-level feedback for quality management (Bergsmann et al., 2015). Translating professional functions into learning tasks with explicit observation rules and checklists makes the full cycle from outcomes to verification visible and provides a workable template for teachers (Ramasamy & Pilz, 2019). Intercultural online projects produce measurable gains for participants and are therefore reasonable to embed in coursework as a standard element (Kang et al., 2018). Scales developed for master's students confirm the feasibility of reliable monitoring, provided that the factor structure, internal consistency, and relationships with external criteria are reported (Liu et al., 2020).

Domestic developments show how to bring a task set to the required standard by computing item difficulty and discrimination, checking item total correlations, and revising weak items before summative assessment (Minzhanov et al., 2024). Pilot reports complement this trajectory by describing assessor calibration and subsequent validation steps, thereby establishing a clear technological standard for programs. Overloaded competency lists without levels lead to formalistic control and poor transferability of results (Kulik et al., 2020). Heterogeneous reporting on validity and reliability impedes comparison and scaling, necessitating unified minimum requirements for publishing quality indicators and calibration procedures (Abelha et al., 2020). Conceptual reviews also note insufficient rigor in instrument validation and call for a stronger evidentiary base, especially at the stage of curriculum-level implementation (Tahirsylaj & Sundberg, 2025).

Program documentation should specify where and by which task each stated outcome is assessed, closing coverage gaps and making quality control transparent to teachers and students (Serbati, 2015). Assessment design should be mixed rapid screenings provide early signals, whereas level decisions are based on performance in relevant tasks with explicit criteria preserving validity while keeping workload reasonable (Bergsmann et al., 2015). For key instruments, a minimum set of quality indicators should be published and kept current, enabling well-grounded and transparent program decisions (Liu et al., 2020). Using sustainability and internationalization contexts furnishes a natural environment for demonstrating complex outcomes and helps embed them in ordinary courses rather than leaving them as one-off activities (Ortiz-Marcos et al., 2020). National cycles for developing and refining assessment tasks with calculation of psychometric indices and rater calibration ensure portability across modules and cohorts and increase confidence in the final assessment (Minzhanov et al., 2024).

Conclusion. A decade of research converges on the view that graduate master students' professional competence is defined through observable actions and graded levels of mastery, and is best examined via tasks approximating real practice. The included publications document the translation of such definitions into curriculum through explicit alignment of learning outcomes with student work and assessment procedures at both program and course levels. On the assessment side, practice-based formats projects, case analyses, and portfolios predominate, accompanied by transparent rubrics and articulated performance levels. Several research report indicators of instrument quality. Methodological reporting remains heterogeneous, and a subset of research relies primarily on self-reports without performance verification.

Empirical findings consistently link stated outcomes to labor-market demands and to contexts in which competence naturally manifests. In the social-sciences and humanities, research show that assessment tasks function as carriers of evidence of mastery and provide actionable, program-level feedback. Measurement instruments developed for master's degree programs demonstrate that reliable monitoring is feasible, provided key metrics are reported and scoring is regularly calibrated. National and international sources agree on the need for uniform minimum requirements for describing instruments and presenting evidence of their quality, to ensure comparability across programs and institutions. The review is constrained by the choice of databases and search languages, as well as the heterogeneity of study designs among the included works. Nevertheless, key findings were replicated across different samples and institutional settings. Future work should include longitudinal measurement over the full course of study, cross-country checks of instrument comparability, and the development of open task banks with performance exemplars and concise psychometric documentation.

References

Abelha, M., Fernandes, S., Mesquita, D., Seabra, F., & Ferreira-Oliveira, A. T. (2020). Graduate employability and competence development in higher education—A systematic literature review using PRISMA. *Sustainability*, *12*(15), 5900. https://www.mdpi.com/2071-1050/12/15/5900

Bergsmann, E., Schultes, M. T., Winter, P., Schober, B., & Spiel, C. (2015). Evaluation of competence-based teaching in higher education: From theory to practice. *Evaluation and Program Planning*, *52*, 1-9. https://www.sciencedirect.com/science/article/pii/S0149718915000270

Brauer, S. (2021). Towards competence-oriented higher education: a systematic literature review of the different perspectives on successful exit profiles. *Education+ Training*, *63*(9), 1376-1390. https://www.emerald.com/insight/content/doi/10.1108/ET-07-2020-0216/full/html

Butum, L. C., Nicolescu, L., Stan, S. O., & Găitănaru, A. (2020). Providing sustainable knowledge for the young graduates of economic and social sciences. Case study: comparative analysis of required global competences in two Romanian universities. *Sustainability*, *12*(13), 5364. https://www.mdpi.com/2071-1050/12/13/5364

Gervais, J. (2016). The operational definition of competency-based education. *The Journal of Competency-Based Education*, *1*(2), 98-106. https://onlinelibrary.wiley.com/doi/abs/10.1002/cbe2.1011

Jiaxin, G., Huijuan, Z., & Md Hasan, H. (2024). Global competence in higher education: A ten-year systematic literature review. In *Frontiers in Education 9*, 1404782. https://www.frontiersin.org/articles/10.3389/feduc.2024.1404782/full

Kang, J. H., Kim, S. Y., Jang, S., & Koh, A. R. (2018). Can college students' global competence be enhanced in the classroom? The impact of cross-and inter-cultural online projects. *Innovations in Education and Teaching International*, *55*(6), 683-693. https://www.tandfonline.com/doi/abs/10.1080/14703297.2017.1294987

Kjellgren, B., & Richter, T. (2021). Education for a sustainable future: Strategies for holistic global competence development at engineering institutions. *Sustainability*, *13*(20), 11184. https://www.mdpi.com/2071-1050/13/20/11184

Kulik, A. A., Lazareva, P. V., Ippolitova, N. V., Egorova, A. E., & Nedorezova, O. Y. (2020). Competency-based approach and competencies in higher education: a theoretical review. *Propósitos y Representaciones*, *8*(2), 38. https://dialnet.unirioja.es/servlet/articulo?codigo=8113535

Liu, Y., Yin, Y., & Wu, R. (2020). Measuring graduate students' global competence: Instrument development and an empirical study with a Chinese sample. *Studies in Educational Evaluation*, *67*, 100915. https://www.sciencedirect.com/science/article/pii/S0191491X20301632

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability*, *9*(10), 1889. https://www.mdpi.com/2071-1050/9/10/1889

Minzhanov, N.A., Minzhanova, G.N., Okashev, R.D., Isina, S.S., & Kossybaev, Zh.Zh. (2024). Training of future social workers based on a competence-based methodology. *Pedagogy Series*, 147(2), 121-132. https://doi.org/10.32523/2616-6895-2024-147-2-121-132

Ortiz-Marcos, I., Breuker, V., Rodríguez-Rivero, R., Kjellgren, B., Dorel, F., Toffolon, M., ... & Eccli, V. (2020). A framework of global competence for engineers: The need for a sustainable world. *Sustainability*, *12*(22), 9568. https://www.mdpi.com/2071-1050/12/22/9568

Ramasamy, M., & Pilz, M. (2019). Competency-based curriculum development in the informal sector: The case of sewing skills training in rural South India. *International Review of Education*, *65*(6), 905-928. https://link.springer.com/article/10.1007/s11159-019-09810-4

Serbati, A. (2015). Implementation of Competence-Based Learning Approach: stories of practices and the Tuning contribution to academic innovation. *Tuning Journal for Higher Education*, *3*, 19-56. https://www.research.unipd.it/handle/11577/3242465

Tahirsylaj, A., & Sundberg, D. (2025). Five visions of competence-based education and curricula as travelling policies: a systematic research review 1997–2022. *Journal of Curriculum Studies*, 1-26. https://www.tandfonline.com/doi/abs/10.1080/00220272.2025.2492605

Information about authors:

Kozhamberdiyeva Nurzada, PhD Doctoral Student, Al-Farabi Kazakh National University, ORCID ID: https://orcid.org/0009-0003-6261-1448, e-mail: nurzada_k8@mail.ru

Kudaibergenova Aliya, candidate of pedagogical sciences, Al-Farabi Kazakh National University, ORCID ID: https://orcid.org/0000-0002-9551-3073, e-mail: alia80.80@mail.ru

Original Article
IRSTI 14.35.07 10.51889/2960-1649.2025.65.4.010

SHALABAYEVA LAURA[1], UMIRBEKOVA AKERKE[2],*
BUTABAEVA LAURA[3], SOVETKANOVA DAMIRA[2]

[1]International University of Tourism and Hospitality (Turkistan, Kazakhstan)
[2]Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)
[3]National Scientific and Practical Center for the Development of Special and Inclusive Education (Almaty, Kazakhstan)

*Address of correspondence: Akerke Umirbekova, Postdoctoral Researcher, Abai Kazakh National Pedagogical University, Muratbayev Str., 14, Almaty, 050014, Republic of Kazakhstan, https://orcid.org/0000-0001-7964-7322, E-mail address: umirbekova.akerke@list.ru/ Tel.: +77054870515

Preparing Teachers to Work in an Inclusive Environment within the Framework of the Concept of "Laboratory of the Future in the Classroom"

Abstract

Introduction. The article addresses the issue of preparing future teachers for work in an inclusive educational environment based on the concept of the "Future Classroom Lab." The purpose of the study is to demonstrate the potential of training future teachers for an inclusive environment through the implementation of the Future Classroom Lab concept: methodology and Methods. During the research, a pedagogical experiment was conducted involving students majoring in education. As part of the experiment, a survey was administered to assess the participants' knowledge, understanding of inclusive education, and potential challenges in implementing inclusive practices in their future professional activities. Before the survey, students were provided with information on the principles of inclusive education and the essence of the Future Classroom Lab concept. *Results.* The results revealed that future teachers possess a general understanding of inclusive education. The vast majority recognize the importance of inclusive education principles and acknowledge that mastering them has a significant impact on their future professional practice. The Future Classroom Lab concept proved to be highly effective in fostering a high-quality, inclusive educational environment, as well as in developing key competencies such as critical thinking, empathy, tolerance, and quantitative competence among future teachers. The findings of the survey confirm that the Future Classroom Lab concept plays an important role in creating a quality, inclusive educational environment and has a direct influence on the formation of essential professional competencies in future teachers. *Scientific novelty.* The scientific novelty of the study lies in demonstrating that training future teachers within the framework of the Future Classroom Lab concept contributes to the creation of an accessible and high-quality educational environment and enhances the implementation of inclusive education principles. *Practical significance.* The practical significance of the study is that its results can be applied to improve the methodological preparation of future teachers in the process of professional training.

Keywords: inclusive education, classroom lab, educational ecosystem, future teachers, professional competence, inclusive environment.

Introduction. The creation of an educational environment that will enable each specialist to enhance their professional qualifications and develop the necessary abilities is currently the primary necessity of the global educational space. Inclusive education in our country is gradually developing, its foundation is the introduction of the concept of "inclusive education" into the Law "On Education of the Republic of Kazakhstan" (2011), the approval of comprehensive measures in the direction of inclusive education (Tashina & Semeno 2014), as well as the adoption of conceptual approaches to the development of inclusive education , the adoption of a law on inclusive education (Myronova et al., 2021), the beginning of the transition from the medical model to the socio-pedagogical model, and the implementation of continuous support for inclusive and special education (Rodríguez Herrero et al., 2023).

These significant changes, in turn, will lead to an intensive transition of the model of the specialist training system from the medical model to the social model. In this regard, we see a clear need for highly qualified specialists who can work in an inclusive environment and have mastered the necessary skills in each area of specialist training. Educational organizations must prioritize inclusive policy, culture, and practice. Additionally, the need for new methodological approaches in the training of future teachers makes our research work more significant. In addition to professional skills and practical skills that future teachers must develop in the process of professional education, it is important to have digital literacy, innovative thinking, and creative decision-making skills necessary for working in an inclusive educational environment. In order to adhere to all the principles of inclusive education, future teachers need special methodological skills. This increases the importance of mastering universal skills that take into account the needs of individuals with different educational backgrounds.

A wide range of professional disciplines is offered to help future teachers develop their theoretical knowledge and practical abilities. The content of these disciplines is designed to encompass preparation from a psychological, theoretical, social, and practical standpoint. Psychological preparation is aimed at ensuring the future teacher's continuous motivation to work in an inclusive environment, joint activities with children with special educational needs and their parents. Theoretical preparation provides the future teacher with knowledge of the characteristics of learners, which requires taking into account the educational needs, and social and practical preparation provides psychological, pedagogical, and methodological knowledge, skills necessary to ensure the necessary interactions for future professional activities (Gavrilova, 2022).

The authors stress the significance of training future teachers to acquire knowledge, master skills, possess the necessary principles, and be oriented to taking into account the needs of learners with special educational needs. If we examine the issue of preparing future teachers for an inclusive educational environment at the international level, future teachers play a great role in creating a favorable and accessible environment for learners (Rodríguez Herrero et al., 2023). In addition, the importance of considering the individual characteristics of learners, preventing possible obstacles in the process of providing support, and considering the possibilities of assessing possible negative impacts, based on which it is necessary to take a comprehensive approach to each educational process (Myronova et al., 2021). The importance of implementing and adapting curricula, developing them, and individualizing them, taking into account the characteristics of each learner, in order to create a quality educational environment in accordance with the future profession, is clearly seen from the following study (Hellmich et al., 2019).

In addition, the importance of studying the fundamental principles in creating an inclusive educational environment has been demonstrated (Polo Sánchez & Aparicio Puerta, 2023). In creating a favorable environment for learners, it is important to closely monitor the classroom situation, that is, to build positive relationships between learners, to build mutual trust and support, and to form a relationship of respect (Stăiculescu et al., 2022). Future teachers should master the methods and mechanisms for preventing obstacles that arise in the future professional environment, since emotional, social, and physical barriers may arise among students, which reduces the ability to create an inclusive education ecosystem on a normal basis (Wenham et al., 2020). In addition, there are cases where the principles of inclusiveness are not fully adhered to in the training of specialists in higher education institutions, and some programs do not include the skills necessary for future professional practice (Costa et al., 2020). In addition to theoretical knowledge, the process of training future teachers should focus on developing practical, i.e., effective use of flexible skills, and the ability to freely use the capabilities of various innovative technologies (Ioerger et al., 2019). In his research, he showed that future teachers should be focused on

mastering the skills necessary for their future profession and developing patience (Borosh et al., 2023).

"Future classroom lab", that is, future classrooms, provide a clear picture of the form that offers a style of reorganizing a traditionally built classroom. On its basis, there is a high opportunity to adapt learning spaces to teaching styles. The main concept of this approach is based on the work of a living laboratory, that is, a form of effective introduction of ICT technologies into an educational institution. The main principles and policies of this approach are combined with inclusive education. The educational environment created based on the "Future classroom lab" concept will arm the educational path with innovative methods and increase the capabilities of new technologies in transforming the learning and teaching processes. "Future classroom lab" consists of six main learning spaces. Each of its spaces opens up one aspect of learning, and also influences the reconsideration of other aspects of learning in a new direction. Among them, physical space, resources, rapid change of teacher and student roles, and the ability to adhere to different learning styles. "Future classroom lab" consists of six main directions: Investigate, Create, Present, Interact, Exchange, and Develop. These six aspects and directions of the future classroom concept serve as a single mechanism. The concept, as a universal approach, effectively serves in every field of specialist training, including future teachers. That is, by introducing the "Future classroom lab" concept into the professional process of training future teachers, that is, by creating an educational environment based on the concept, future specialists will have the opportunity to increase their level of readiness for the future inclusive educational environment. As we have noted, the principles of the "Future classroom lab" approach are most suitable for ensuring the needs of an inclusive educational environment and are most effective in creating a high-quality ecosystem of inclusive education (Göçen et al., 2020).

The purpose of the study: to demonstrate the possibilities of training future teachers in an inclusive environment through the concept of "Future Classroom Lab", based on which the following main tasks are implemented: to substantiate the relevance and importance of the concept of "Future Classroom Lab"; to analyze the experience of training future teachers; to identify the possibilities of training future teachers in an inclusive environment through the concept of "Future Classroom Lab"; to demonstrate the features of an inclusive environment.

Materials and Methods. During the research, the concept of "Future Classroom Lab" was considered, and six of its aspects were analyzed separately. A comparative analysis of the training features of future teachers was conducted, and the qualifications necessary for working in an inclusive education environment were analyzed. An analysis of domestic and foreign experiences and official documents on inclusive education was conducted, and priority areas were based on current practice. The best practices of the "Future Classroom Lab" concept in training future teachers were analyzed, and advanced opportunities were shown. A survey was conducted among future teachers. During the survey, the attitudes of students towards inclusive education were determined. The "Opportunities for Training Future Teachers in an Inclusive Environment" survey consists of the following content: in the first section, general information on the student (age, gender); in the second section, the concept of inclusive education (how they understand inclusive education, their understanding of inclusive education practice); The third section was to determine the views of students (the importance of inclusive education as a profession, the level of preparation for an inclusive environment, the inclusive educational environment, what difficulties may arise in working in an inclusive environment); the fourth section was to teach within the framework of the "Future Classroom Lab" concept (whether the "Future Classroom Lab" concept is familiar, and to assess the usefulness of approaches within the "Future Classroom Lab" concept for adapting to an inclusive educational environment); the fifth section was to ask students two open-ended

questions (what suggestions do you have for improving inclusive education practices in your field, and what is important for future teachers to form inclusive competencies). In addition, a survey method was used among the surveyed students, during which external monitoring of the professional skills of students and their level of adaptation to an inclusive environment was carried out in the educational process. The study was attended by 3rd-year students of the future specialty of primary education (25 students) and 3rd-year students of the specialty of pedagogy and psychology (30 students). The survey was conducted online using Google Forms. We also believe that the majority of 3rd-year students prefer to combine education and professional experience. A comparative analysis of the survey results, as well as taking into account the diversity of the content and meaning of the questions asked in the survey, was used to extract percentage and quantitative data for closed questions, compare frequencies and percentages, calculate the average value, show the average trend of responses, and use the χ^2 criterion. For open questions, qualitative analysis and diagrams were used. Also, all results were formalized and presented in diagrams and tables.

Results. The main focus of the conducted study was to examine the level of effective collaboration and partnership among future teachers (in physical education and sports, primary education and special pedagogy) their level of inclusive education, readiness for an inclusive educational environment, knowledge of the "Future Classroom Lab" concept and the ability to apply it in their own practice, as well as the potential to effectively implement inclusive education principles in their future professional activities.

General information about the researchers can be found in the following table 1-4.

Table 1

General information about the respondents

Age		Number	%
Category	19-20 y	38	69,1
	21-22 y	17	30,9
Gender			
		Number	%
Category	Female	49	89,1
	Male	6	10,9

The majority of respondents participating in the study were women (89.1%), which shows that the majority of young people who choose teaching specialties at a pedagogical university are women.

Table 2

General knowledge and attitudes of respondents about inclusive education

How do you understand inclusive education?			
		Number	%
Answer	An education system for all, regardless of their specificities	42	76,4
	Education of children with special educational needs in mainstream schools	11	20
	I am having trouble answering	2	3,6
Do you have experience interacting with an inclusive educational environment?			
		Number	%
Answer	Yes	21	38,2
	No	34	61,8

On this basis, 76.4% of students say that they have an understanding of inclusive education, what inclusive education is in general, and that it provides equal access to all. However, less than half of the students (38.2%) indicated that they have experience of interacting with an inclusive educational environment, which may be due to the duality of practical work at the university, and we can also see that students have a general understanding of inclusive education, but still lack practical skills.

Table 3
Respondents' attitude to inclusive education

How important is it for teachers to be prepared for an inclusive environment?			
		Number	%
Answer	Very important	44	80
	It may be important	8	14,5
	I am having trouble answering.	3	5,5
How would you rate your readiness for an inclusive educational environment?			
		Number	%
Answer	High	21	38,2
	Middle	34	61,8
	Low	34	61,8
What challenges might you face in an inclusive education environment?			
		Number	%
Answer	Insufficient methodological preparation	27	49,1
	Lack of experience	16	29,1
	Psychological barriers	12	21,8

Just 16.4% of respondents rate their preparedness for an inclusive educational environment as high, even though the vast majority of respondents (94.5%) emphasize the significance of professional preparation for future teachers. Students identify the primary challenges as having limited practical experience and a lack of methodological expertise.

Table 4
Respondents' level of familiarity with the concept of «Future Classroom Lab.

Are you familiar with the concept of «Future Classroom Lab»?			
		Number	%
Answer	Yes	15	27,3
	I have heard of it, but I am not familiar with it.	25	45,5
	No	15	27,3
Do you believe that the Future Classroom Lab concept is a necessary and useful tool for adapting to an inclusive educational environment?			
		Number	%
Answer	Yes	43	78,2
	Half	10	18,2
	No	2	3,6

As we can see from the table, the vast majority of students are not familiar with the concept of "Future Classroom Lab", while the number of those who say they are familiar with it (only 27.3%), the vast majority of students (78.2%) indicated its usefulness and indicated that it can be very important in creating a flexible, adaptable, and inclusive educational environment.

As for the following open-ended questions among respondents:

Question 1. What recommendations would you make to improve inclusive education in your field?

Key recommendations: familiarization with the practice of inclusive education in general education schools, strengthening practical experience in the future professional environment (46%); development of adapted educational materials (27%); increasing the level of teachers' knowledge of inclusive methods (18%); creation of inclusive education laboratories in higher education institutions (9%).

Question 2. What, in your opinion, is most important for the formation of inclusive competence of a future teacher?

Key recommendations: empathy and tolerance (39%); correctional - knowledge of pedagogical practices (33%); development of collective interaction skills (16%); psychological preparation (12%).

Figure 1

Open-ended questions results- question 1

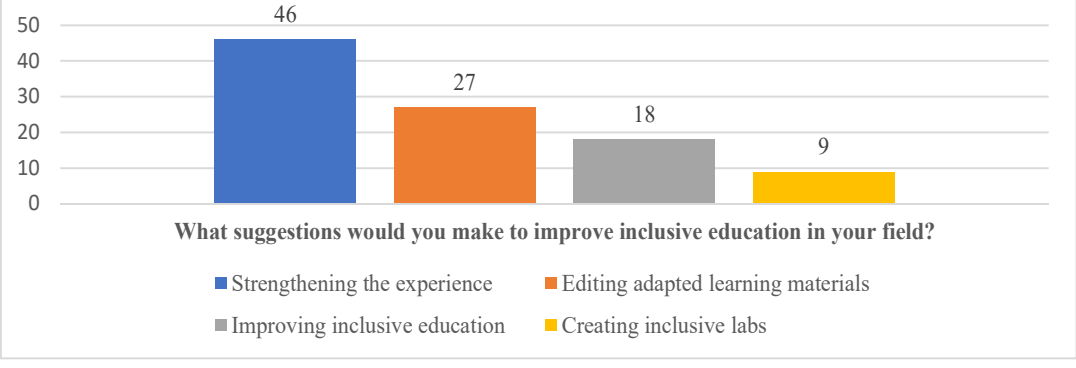
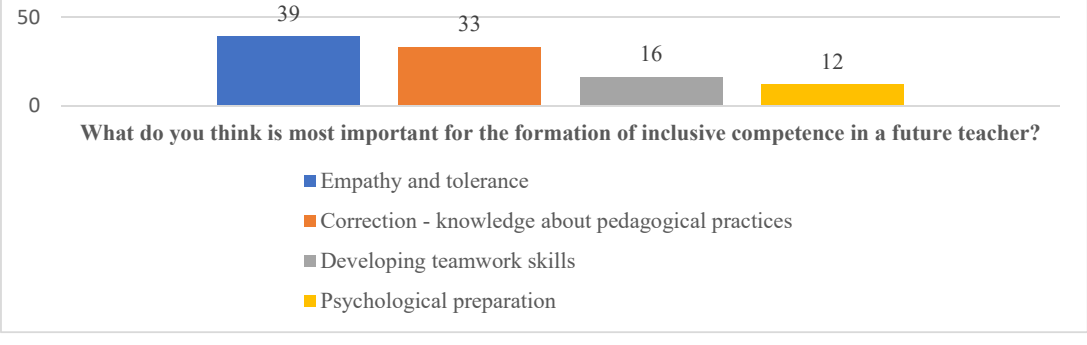


Figure 2

Open-ended questions results-question 2



Analyzing the questions, we were able to prove the following results of the survey: students who combined the educational process and pedagogical practice showed a high level of professionalism, activity, communication, and adaptability. The average level of professional training of these students was 18%, which was higher than that of students without experience (χ^2-criterion by $p<0.05$).

The following results were obtained from the study: Students have a general understanding of inclusive education, however, there is a lack of practical knowledge and methodological skills. The overwhelming majority of participants note the high importance of inclusive training, although the level of individual training of the participants still shows an average level. The concept of "Future Classroom Lab" is perceived by students as a necessary, innovative approach to inclusive education. According to students, the content and skills that require the development of inclusive competence of future

teachers are: empathy, practical orientation, and correct adaptation of innovative tools to the educational environment.

Discussion. Adaptation to the conditions of inclusive education is of particular importance in the process of training future teachers. Although in the current education system, including in the process of training future teachers, the educational process is mainly aimed at working with healthy students, in recent years, there has been an increase in the number of children with special educational needs in general education institutions. In accordance with the inclusion process, the participation of students with special educational needs in the educational process introduces significant changes in the basic principles and structure of the educational environment. This, in turn, increases the need for professionally prepared and adapted specialists who can work effectively in an inclusive environment. Future educators' development of inclusive competency depends heavily on the usage of specialized technologies. In this sense, it is critical to develop approaches that support the development of a top-notch learning environment and consider the needs of students with special educational needs; special didactic methods and approaches that adapt the teaching and upbringing process; interactive learning technologies based on team interaction, empathy, and tolerance are used. The content of training future teachers should include the theoretical and practical foundations of organizing inclusive education, and the professional competence of students is formed through the use of flexible pedagogical approaches that take into account the needs of different students and allow them to fully reveal their potential.

Researchers clearly emphasize the importance of inclusive competence, including the acquisition of the necessary knowledge, skills, and abilities for an inclusive educational environment. Among them, first of all, the future teacher should know the psychological and pedagogical characteristics of a child with special educational needs; secondly, the future teacher should master and develop special methods and approaches that will ensure equal opportunities in teaching, learning and mastering universal learning activities; thirdly, the readiness to quickly adapt to changes that arise during joint interaction with students with special needs and act in accordance with the situation; fourthly, the ability to master innovative methods, influence the formation of an inclusive culture, work together with other specialists, and build resilience in students (Tashina & Semeno, 2014).In the process of forming future teachers in the process of professional training, the inclusion of inclusive practice as an activity from an early age is a key training component. It allows not only to understand the basic principles of an inclusive educational environment and form a positive attitude towards it, but also to effectively apply the theoretical knowledge gained in practice. Students with special educational needs come into direct contact during the practice, understand the specifics of children, master the mechanisms of adapting educational knowledge, are ready to use adaptive pedagogical technologies, develop their own empathy, and have the opportunity for qualitative reflection on a professional basis. According to scientists, this foundational experience increases the confidence of future teachers in their own strength and knowledge, their readiness to organize the educational process in different situations, and their ability to create a quality educational environment and a positive atmosphere. Early experience of inclusiveness during the educational process directly affects the formation of inclusive competence and professional responsibility (Lucena-Rodríguez et al. 2025).

Teachers in today's inclusive practice frequently favor using an instructional model that has been modified especially for students with special education needs. If this methodology were based on each student's unique learning trajectory, it would be much more effective. To put it another way, improving the efficacy of inclusive practice necessitates developing universal competences in aspiring teachers, which will allow them to deliver teaching that is in line with the requirements of all students, rather than focusing just on the child with special educational needs. The

development of the required competencies in practice is directly impacted by the programs put into place within the suggested experimental framework, as well as by future teachers' direct interaction with students who have special educational needs - that is, their immersion in the educational environment. Since this directly affects their capacity to make wise pedagogical judgments and fosters the growth of emotional intelligence, it is critical to mold future educators' general attitudes toward the inclusive educational environment while they are still in the professional preparation stage.

Also, according to the results of the study, future teachers, including female teachers, have a positive attitude toward inclusive education, while male students advocate strict adherence to the principles of inclusive education. The formation of a positive attitude to inclusive education in future teachers is an important part of the training process of future teachers, which directly affects the correct perception of experience and pedagogical values.

Conclusion. We can make the following deductions after analyzing the study's findings: These days, inclusive education is one of the top priorities for social development and holds a substantial position in the educational system. To put it another way, inclusive education is a crucial tool for creating a society that is inclusive. Such a society is significantly shaped by the excellent training of aspiring educators. Our research showed that future experts in elementary education, special pedagogy, and physical education and sports must have a common set of universal competences. These include the ability to develop an inclusive culture, comprehend changes pertaining to the inclusive educational environment, and successfully use their knowledge in inclusive practice. There are cases when the perception of students with special educational needs, understanding, organization of the learning environment, and the formation of a quality and accessible educational environment, taking into account their individual characteristics, are perceived by the deficit education model, which directly affects the professional orientation of future teachers. In order to eliminate these obstacles, it is necessary to supplement the content of higher education programs with inclusive content, introduce practice-oriented teaching forms that ensure inclusive practice, and establish direct contact of future teachers with students with special educational needs based on professional experience.

As the study shows, the attitude of future teachers to inclusive education varies depending on the students' gender, age, academic specialty, and professional experience. On its basis, the development of social and emotional competencies is of great importance, including the ability to self-reflect, professional empathy, and the effective introduction of inclusion principles into pedagogical practice. The results of the study showed that the introduction of practice-based and innovative approaches to the training process of future teachers based on the concept of "Future Classroom Lab" has a significant impact on the development of an inclusive culture, increasing student motivation and improving the quality of creating an inclusive educational environment. This framework, in turn, serves as a key mechanism for implementing innovative transformations within the pedagogical education system, exerting a significant influence on the development of an inclusive society and the provision of accessible education for all learners.

Funding. This research has been funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan under the project AP27510667 Development of an Inclusive Education Ecosystem Based on the Future Classroom Lab Model.

References

Borosh, A. M., Newson, A., Mason, R. A., Richards, C. D., & Collins Crosley, H. (2023). Special education teacher-delivered training for paraeducators: A systematic and quality review. *Teacher Education and Special Education*, *46*(3), 223-242. https://journals.sagepub.com/doi/abs/10.1177/08884064231160575

Costa, P. L. S., Modica, N. D. S., & Santos, C. L. N. D. (2020). Teacher training and pedagogical practice in the inclusion process of young students with disabilities in higher education institutions. *Praxis Educacional Journal, 16*(42), 115-134. http://educa.fcc.org.br/scielo.php?pid=S2178-26792020000300105&script=sci_arttext

Gavrilova, E.A. (2022). Training of Future Teachers for Work in an Inclusive Educational Environment. *Society: Sociology, Psychology, Pedagogy, 8*(100), 235-239. https://cyberleninka.ru/article/n/podgotovka-buduschih-pedagogov-k-rabote-v-inklyuzivnoy-obrazovatelnoy-srede

Göçen, A., Eral, S. H., & Bücük, M. H. (2020). Teacher perceptions of a 21st century classroom. *International Journal of Contemporary Educational Research*, *7*(1), 85-98. https://dergipark.org.tr/en/pub/ijcer/issue/54696/638110

Hellmich, F., Löper, M. F., & Görel, G. (2019). The role of primary school teachers' attitudes and self-efficacy beliefs for everyday practices in inclusive classrooms–a study on the verification of the 'Theory of Planned Behaviour'. *Journal of Research in Special Educational Needs*, *19*, 36-48. https://nasenjournals.onlinelibrary.wiley.com/doi/abs/10.1111/1471-3802.12476

Ioerger, M., Machia, L. V., & Turk, M. A. (2019). Self-other overlap: A unique predictor of willingness to work with people with disability as part of one's career. *Plos One*, *14*(8), e0220722. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0220722

Lucena-Rodríguez, C., Invernón-Gómez, A. I., Ortiz-Marcos, J. M., & Sánchez-Mendías, J. (2025). Preparing future teachers for inclusive practices and disability: A systematic literature review. *International Journal of Instruction*, *18*(3), 59-78. https://e-iji.net/ats/index.php/pub/article/view/765

Myronova, S., Dokuchyna, T., Rudzevych, I., Smotrova, O., & Platash, L. (2021). Current problems of teachers' readiness of higher educational institutions for implementing inclusive education. *Revista Romaneasca Pentru Educatie Multidimensionala*, *13*(3), 151-165. https://lumenpublishing.com/journals/index.php/rrem/article/view/3473

Polo Sánchez, M. T., & Aparicio Puerta, M. (2023). Perceptions of university students with disabilities in Spain: ideas and beliefs about attitudes towards their inclusion. *Disability & Society*, *38*(8), 1435-1450. https://www.tandfonline.com/doi/abs/10.1080/09687599.2021.1997716

Rodríguez Herrero, P., García Sempere, P. J., & García, A. C. (2023). Inclusive co-teaching with teachers with intellectual disabilities in teacher education. *European Journal of Teacher Education*, 1-17. https://www.tandfonline.com/doi/abs/10.1080/02619768.2023.2288550

Stăiculescu, C., Dincă, V. M., & Gheba, A. (2022). Analysis of the factors influencing the favorable participation of students with special needs in public tertiary education in Romania. *Sustainability*, *14*(17), 10803. https://www.mdpi.com/2071-1050/14/17/10803

Tashina, T.M., & Semeno, A.A. (2014). Training specialists to work in inclusive education. *Modern Research of Social Problems, 2*(34). https://cyberleninka.ru/article/n/podgotovka-spetsialistov-k-rabote-v-inklyuzivnom-obrazovanii

Wenham, K. E., Valencia-Forrester, F., & Backhaus, B. (2020). Make or break: The role and support needs of academic advisors in work-integrated learning courses. *Higher Education Research & Development*, *39*(5), 1026-1039. https://www.tandfonline.com/doi/abs/10.1080/07294360.2019.1705254

Information about authors:

Shalabayeva Laura, PhD, Associate Professor, International University of Tourism and Hospitality, ORCID ID: 0000-0003-2231-7888, email: lolabany84@mail.ru

Umirbekova Akerke, PhD, associate professor, Postdoctoral researcher, Abai Kazakh National Pedagogical University, ORCID ID: 0000-0001-7964-7322, email: umirbekova.akerke@list.ru

Butabayeva Laura, PhD, Associate Professor, National Scientific and Practical Center for the Development of Special and Inclusive Education, ORCID ID: 0000-0002-3758-8624, email: lbutabayeva@gmail.com

Sovetkanova Damira, PhD, Postdoctoral researcher, Abai Kazakh National Pedagogical University, ORCID ID: 0000-0003-2737-4021, email: Dami_88@list.ru

Original Article
IRSTI 14.35.07 10.51889/2960-1649.2025.65.4.011

AITZHANOVA ELMIRA[1], KHASSANOVA INKAR[2],*
DARGUZHIEVA ASSIMA[2], NABIYEVA ZHANARGUL[2]

[1]Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)
[2]M. Utemisov West Kazakhstan University (Uralsk, Kazakhstan)

*Address of correspondence: Khassanova Inkar, Candidate of Pedagogical Sciences, West Kazakhstan University named aft. Makhambet Utemisov, Uralsk city, Nazarbayev st. 162, Republic of Kazakhstan, https://orcid.org/my-orcid?orcid=0000-0002-1317-9885, E-mail address: Khassanova.inkar@mail.ru

A Model for the Formation of a Digital Culture of Future Teachers of Preschool Education Based on Neurotechnologies

Abstract

Introduction. The article addresses the problem of qualitatively updating the methodological and technological substantiation of the system of preschool education, determined by the contemporary stage of global digital transformation. *The purpose* of the study is to identify the theoretical and methodological foundations and develop a structurally-functional model for the formation of the digital culture of future teachers of preschool education that ensures the development of neuropsychological indicators of cognitive activity: methodology *and Methods*. The methodological foundation of the study rests upon theoretical modelling, general didactic methods, and integrated interdisciplinary research. The work employs a four-component structural model of the formation of digital culture within the pedagogical process, integrating cognitive, structural, competency-theoretical, activity-theoretical, operational, and reflective-analytical modules. *Results.* The research has elaborated a structurally-functional model that integrates neuropsychological indicators into the process of professional training, thereby ensuring the development of psychological readiness for the commencement of pedagogical activity at a new level of professional competence development. *Scientific Novelty*. The key distinctive feature of the elaborated model resides in the integration of neuropsychological processes into the conditions of digital competence formation, ensuring the manifestation of professionally significant personal characteristics and the effectiveness of the professional training of future teachers of preschool education. *Practical Significance*. The proposed model enables the acquisition of contemporary professional pedagogical knowledge and facilitates the formation of digital culture, thereby contributing to the enhancement of professional pedagogical training and the preparation of future pedagogical professionals.

Keywords: digital culture, future pedagogues, preschool education, neuropsychology, neuropsychological development, professional training, model.

Introduction. Contemporary global digitalization (Hartong, 2019; Ronzhina, 2021) is forming a fundamentally new sociocultural environment where technologies permeate all spheres of human activity. The concept of digital culture (Giannini & Bowen, 2019) in this context extends beyond simple technical literacy, representing a complex system of values, practices, and competencies that define human interaction with the technological environment.

In the educational sphere, proficiency in digital culture (Ferreira, 2020; Mensan & Anagün, 2022) has become an integral component of a teacher's professional competence. A specialist lacking the relevant skills loses the ability to effectively use modern educational tools, keep curriculum content relevant, and adequately respond to the needs of the new, "digital" generation of children. The relevance of this study is driven by the profound transformation of the education system, which imposes qualitatively new demands on preschool teachers (Zhao & Li, 2015; El-Deeb, 2021; Bay & Hartman, 2025), altering the content and methodology of their work with young and preschool-aged children. Today, a preschool teacher tackles a wide range of interconnected tasks. These include: developing primary

technological skills in children, considering their age characteristics; applying interactive teaching methods; ensuring the safety of children in the digital space (Alvestad & Jernes, 2014; Ihmeideh & Alkhawaldeh, 2017); and building effective communication with parents through modern channels. Successfully addressing these tasks requires the teacher to possess a well-formed, holistic digital culture as a comprehensive personal quality that integrates knowledge, activity, and value-motivational components.

However, current practice in higher pedagogical education reveals a significant contradiction between the increasing demands for the digital culture of future teachers and the limited capacity of traditional approaches to its formation, which are not based on neurotechnology. The dominant training system often concentrates on the operational mastery of specific software products, insufficiently developing the fundamental cognitive abilities and meta-competencies that form the basis for the flexible application of digital technologies in professional practice.

Traditional methodologies do not fully account for the neurophysiological characteristics of perceiving and processing digital information, leading to fragmented knowledge acquisition, a low level of digital resilience, and an unpreparedness for creative professional self-realization in a dynamically evolving digital educational environment. Meanwhile, the potential of neurotechnologies in the educational process remains almost unstudied, despite their proven effectiveness in the field of cognitive development and forming stable skills in children. Thus, the research problem lies in the necessity to scientifically substantiate and create a model for developing digital culture in future preschool teachers based on neurotechnologies, a model capable of ensuring a qualitatively new level of professional training that is adequate to the challenges of the digital era.

Materials and Methods. The model for developing digital culture in future preschool teachers based on neurotechnologies represents a theoretical solution to a current scientific problem, defining the specifics of the study's methodological framework. The *research question* is: What are the structural-content components and pedagogical conditions for developing a digital culture in future preschool teachers that integrates neurotechnologies into the educational process? The methodological basis of the model consists of a set of theoretical research methods. Analysis allowed for the examination of the digital culture formation process as an integral pedagogical phenomenon, revealing its structure and external connections. Modeling served as a tool for constructing the model itself, defining the logic of interaction between its components and the neurotechnological element.

The evolutionary development of requirements for a teacher's professional competence, in the context of the progressive technologization of the educational space, has driven a transformation in the conceptual and terminological framework, reflecting the changing paradigm of professional training. The initial conceptualization of professional requirements focused on the operational and technical aspects of computer proficiency, reflected in the concept of "computer literacy" (Satharasinghe, 2006), which included knowledge of personal computer architecture, principles of operating systems, and proficiency in basic software.

The subsequent stage of conceptual development, driven by the exponential growth of information volume and the increasing complexity of information-analytical tasks, was marked by a transition to the more comprehensive concept of "information culture" (Nguyen & Nguyen, 2019). This concept emphasized cognitive-analytical competencies, including the ability to purposefully search for, critically analyze, synthesize, and rationally use information resources in professional activities.

In modern sociocultural conditions, characterized by the total integration of digital technologies into all spheres of human activity, the formation of new modes of communicative interaction, and the transformation of mechanisms for creating sociocultural values, the use of the concept "digital culture" (Artemieva

et al., 2020) becomes conceptually justified. The phenomenon under study represents a qualitatively new level of professional competence, transcending the boundaries of narrowly technical or information-search competencies. The digital culture of a preschool teacher is an integrative personal and professional attribute, characterizing their systemic readiness and ability for effective, critically conscious, and safe professional activities within the digital educational environment. The essential content of this process is the organic unity of cognitive, operational, and axiological components that ensure the conscious acceptance of the digital society's value orientations and the adequate fulfillment of professional functions in accordance with the ethical norms and standards of digital interaction (Bay, 2022).

However, fostering the *digital culture of a preschool teacher* as an integrative personal and professional attribute requires fundamentally new approaches to professional training. Traditional methods for developing technical skills and information competencies prove insufficient for building systemic readiness to operate in a digital environment, as they do not account for the neurophysiological mechanisms of acquiring and applying digital technologies. In this regard, the need for scientifically grounded technologies capable of providing objective diagnosis and targeted development of the cognitive, emotional, and regulatory components of digital culture, based on data about brain activity, becomes highly relevant.

In the context of modernizing teacher education, neurotechnologies (Privitera & Du, 2022; Alipoor & Pourrashidi, 2025) open up fundamentally new, instrumentally substantiated possibilities for optimizing the professional training of future teachers. Neurotechnologies are understood as an interdisciplinary field of knowledge and practice that combines methods and tools enabling the registration, analysis, and targeted influence on the activity of the central nervous system to solve practical tasks. Their integration into the educational process elevates teacher training to a qualitatively new, scientifically grounded level, based on objective data about the neurophysiological mechanisms of learning and development.

From a didactic perspective, the most relevant for teacher education are neurointerfaces (Brain-Computer Interfaces, BCI), particularly electroencephalography and functional near-infrared spectroscopy, which provide real-time information on the brain's bioelectrical activity and hemodynamics, allowing for the assessment of cognitive states, levels of concentration, mental fatigue, and emotional arousal. Biofeedback technologies, based on the feedback principle, enable the conscious regulation of brain activity parameters through the visualization of neurophysiological processes in a perceptually accessible form. Cognitive training programs, developed based on neuroscience data and implemented in an interactive game format, are designed for the targeted development of specific cognitive functions, including working memory, information processing speed, and cognitive flexibility (Nouri, 2025).

The didactic potential of neurotechnologies (Williamson et al., 2025) in training future preschool teachers is multifaceted and enables the targeted development of key professional competencies. The development of self-regulation through neurofeedback fosters the ability for conscious control of one's psychophysiological state, ensuring emotional stability and an optimal level of mental activity in stressful situations of pedagogical interaction. Enhancing concentration through the objective diagnosis and training of attention stability creates a neurophysiological basis for effectively conducting the educational process and responding promptly to the individual needs of students. The development of emotional intelligence, based on understanding one's own emotional states through neurophysiological indicators, contributes to the formation of empathy and the creation of an emotionally favorable climate in the educational environment. Building stress resilience through regular self-regulation training increases the adaptive capacity of the nervous system, ensuring maintained performance under conditions of high professional workload. Thus,

neurotechnologies serve as a didactic tool that enables a transition from general pedagogical recommendations to the personalized, scientifically-grounded development of fundamental, professionally important qualities in future preschool teachers, based on objective neurophysiological data.

Results and Discussion. The model for developing digital culture in future preschool teachers using neurotechnologies represents a systemic set of interconnected structural components that ensure the integrity and effectiveness of the process. This is achieved through the integration of neurotechnologies into the educational process of professional training. The model's constituent components are: the target component, the methodological component, the content component, the technological component, and the outcome component (Figure 1).

The target component of the model for developing digital culture in future preschool teachers using neurotechnologies serves a system-forming function. It defines the strategic direction of the entire educational process and ensures the conceptual unity of all the model's structural elements. The scientific rationale for this component is based on understanding the goal as an ideal image of the desired outcome, which determines the content, methods, and means of pedagogical influence. The goal of the model is to form the digital culture of future preschool teachers as an integrative personal and professional quality, ensuring their readiness for effective, critically conscious, and ethically responsible pedagogical activities within the digital educational environment.

The conceptual justification for this goal stems from the understanding of digital culture not as a mechanical set of technical skills, but as a systemic personal and professional attribute that integrates cognitive, activity-based, and value-motivational aspects of readiness for professional work in a digitized educational space. The integrative nature of digital culture is necessitated by the need to organically combine theoretical knowledge about digital technologies, practical skills in their use, and value-ethical guidelines for professional activity in the digital environment.

The specifics of preschool education as a unique educational stage, characterized by the distinct age-related features of the children, determine particular requirements for the teacher's digital culture. Working with preschool children necessitates the adaptation of digital technologies to the characteristics of children's perception, ensuring a balance between digital and traditional teaching methods, and creating a safe and developmental digital environment. This creates the need to foster a specific digital culture in future preschool teachers, one that considers the psychological and pedagogical patterns of development in young and preschool-aged children (Alvestad & Jernes, 2014).

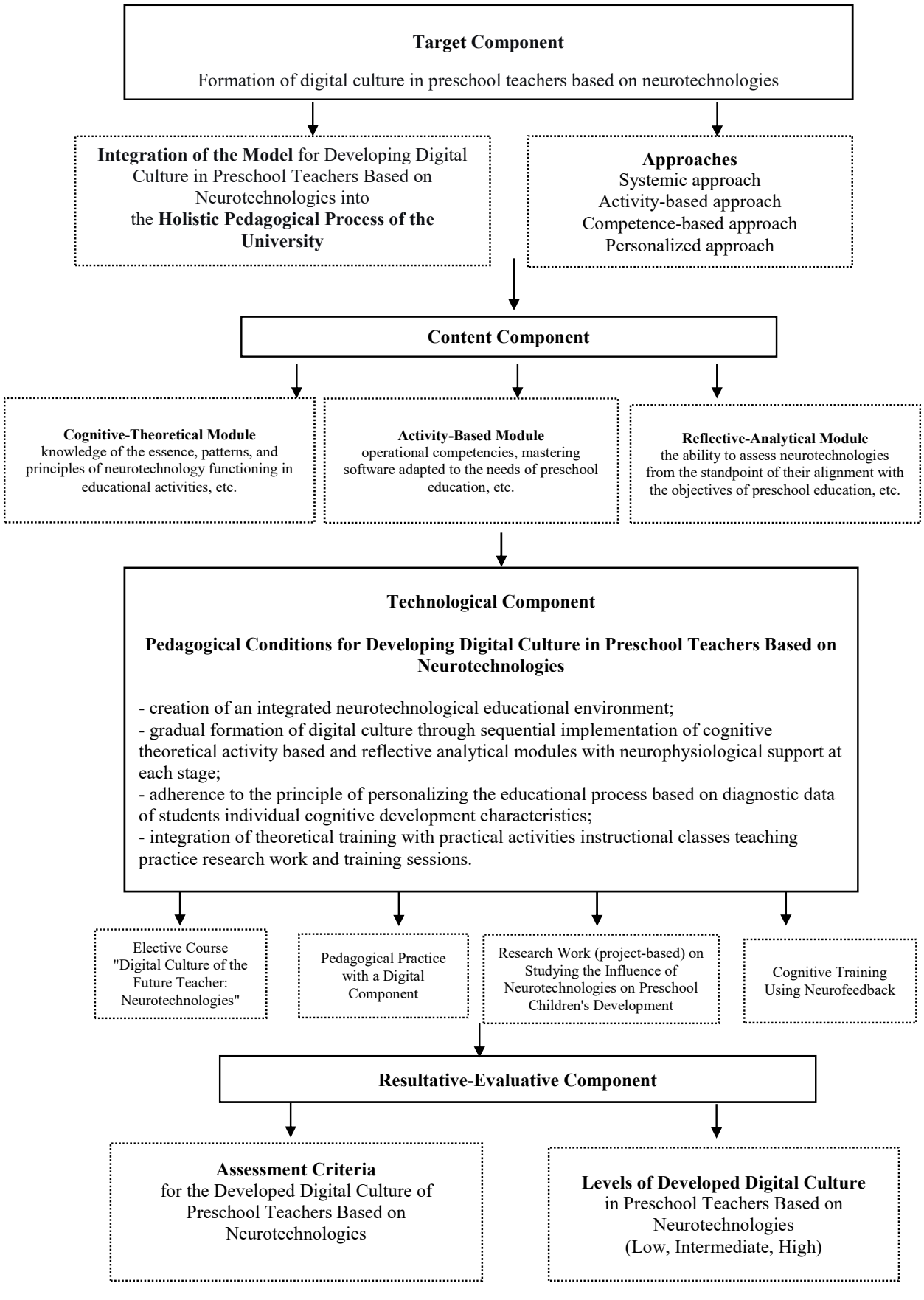
The innovative nature of the proposed model is defined by the integration of neurotechnologies into the process of forming digital culture, enabling a transition from intuitive approaches to scientifically grounded, personalized teacher training. The use of neurotechnologies allows for the objectification of the process of developing professionally significant qualities, accounts for the individual neurophysiological characteristics of students, and ensures optimal conditions for the formation of stable professional competencies**.**

The strategic significance of the set goal is determined by its alignment with modern trends in educational development, the requirements of professional standards, and the needs of preschool education practice in the context of digital transformation. Achieving this goal will ensure the preparation of teachers who are not only capable of adapting to changing professional conditions but also of acting as active agents of innovative development in preschool education in the digital era.

The predictive function of the target component lies in defining prospective directions for the development of professional training for preschool teachers and creating a foundation for the further improvement of educational technologies within the context of digitalization and the implementation of neuroscience achievements in pedagogical practice.

Figure 1

Model for developing digital culture in future preschool teachers based on neurotechnologies



The methodological component of the model for developing digital culture in future preschool teachers using neurotechnologies constitutes the theoretical foundation of the study, defining the conceptual bases, principles, and logic for constructing the educational process. The choice of an integrative methodological foundation, combining systemic, activity-based, competence-based, and personalized approaches, is necessitated by the complexity and multifaceted nature of the phenomenon under investigation - digital culture - as well as the innovative nature of the neurotechnologies employed.

The systemic approach serves as the general methodological foundation of the study, ensuring the consideration of digital culture as a holistic, multi-component phenomenon interconnected in all its structural elements. The necessity of applying the systemic approach is because digital culture represents a complex integrative attribute comprising cognitive, activity-based, and value-motivational aspects, which cannot be adequately understood or developed in isolation. The systemic approach enables the identification of internal connections between the components of digital culture, determines the hierarchy of their interaction, and ensures a synergistic effect from their joint development. In the context of using neurotechnologies, the systemic approach provides an understanding of neurophysiological processes as a system of interconnected brain functions (Williamson et al., 2025), allowing for a comprehensive impact on various aspects of students' cognitive development.

The activity-based approach determines the practice-oriented nature of digital culture formation through students' active learning and professional activities. The theoretical justification for the necessity of this approach is based on fundamental principles of psychological activity theory, according to which personality development occurs through the process of active interaction with the environment via various types of activities. In the context of forming digital culture, the activity-based approach ensures a transition from the passive assimilation of theoretical knowledge about neurotechnologies to their active mastery through solving professionally oriented tasks (Elkina, 2018).

The necessity of applying the competence-based approach (Mulder, 2012) is driven by modern trends in higher education, which require a focus on forming not abstract knowledge, but specific abilities for professional activity. In the context of digital culture, the competence-based approach allows for structuring educational content in accordance with the real needs of a preschool teacher's professional activity in a digital environment. The integration of neurotechnologies within the competence-based approach ensures an objective assessment of the formation of professional competencies by measuring corresponding neurophysiological indicators and creates opportunities for their targeted development.

The personalized approach (Ruotsalo et al., 2009), implemented through neurotechnologies, ensures the consideration of individual neurophysiological characteristics of students and creates a foundation for building individual educational trajectories. The scientific rationale for the necessity of applying a personalized approach is based on data from modern neuropedagogy, which indicates significant individual differences in the neurophysiological mechanisms of learning and development. The use of neurotechnologies allows for the objective diagnosis of individual characteristics of students' cognitive functioning, identifying their strengths and weaknesses, and determining optimal learning strategies. The personalized approach is particularly important in the context of forming digital culture, as the perception and processing of digital information are characterized by significant individual variability, determined by differences in information processing speed, working memory capacity, attention stability, and other cognitive functions.

Thus, the choice of a methodological foundation that integrates systemic, activity-based, competence-based, and personalized approaches is scientifically justified and ensures the adequacy of the methodological tools to the research objectives, the specifics

of the study object, and the innovative nature of the technologies used. Each of the selected approaches addresses a specific aspect of the overall problem: the systemic approach ensures the holistic consideration of the phenomenon; the activity-based approach defines the mechanisms of its formation; the competence-based approach focuses on practical results; and the personalized approach accounts for the individual characteristics of the subjects in the educational process.

The model for developing digital culture in future preschool teachers based on neurotechnologies structurally integrates content and technological components. The content component represents a systematically organized subject matter, the integrity of which is ensured by the cross-cutting integration of neurotechnologies through three interconnected modules.

The cognitive-theoretical module forms the conceptual foundation of digital culture, where neurotechnologies serve as a key element. Its content covers the fundamental principles of neurophysiology concerning cognitive processes and emotional-volitional regulation in preschool age, the functioning principles of non-invasive brain-computer interfaces, and neuro-monitoring methods. Studying the methodological foundations of neurodata analysis using machine learning algorithms creates a basis for the objective assessment of children's cognitive load and functional state. A structural element of this module is the mastery of the principles of neuroethics and safety in working with neurodata, including issues of confidentiality and informed consent.

The activity-based module is focused on developing operational competencies for applying neurotechnologies in professional practice. Its content is structured around mastering hardware-software systems adapted for preschool settings, involving the acquisition of skills for working with biofeedback equipment and gaming neurointerfaces aimed at developing self-regulation and cognitive control in children. Methodologies for integrating neurotechnologies into the educational process include principles for selecting neuro-enriched content and designing lessons using neuromonitoring data for their personalization.

The reflective-analytical module aims to develop critical thinking and the capacity for meta-analysis of neurotechnology applications. The module's content involves forming skills for a multifaceted assessment of neuropedagogical tools from the perspectives of their age-appropriateness, effectiveness, and ethical permissibility. Within this module, the ability to analyze the educational potential of specific neurotechnologies for addressing developmental tasks, as well as to forecast potential risks, is developed. An element of the module is the ability to conduct reflection on one's own pedagogical practice based on objective data about children's neurophysiological responses.

The technological component of the model defines the specific tools and pedagogical conditions for implementing the content. Its operationalization occurs through the creation of a specialized educational environment, the core of which is an instructional neuro-laboratory equipped with the necessary hardware-software complex. Organizational forms include project-based activities for developing and testing lesson segments with neurointerfaces, conducting neurotraining sessions and biofeedback sessions that provide personal self-regulation experience, and analyzing case studies based on real neuromonitoring data. The integration of neurotechnologies into the technological component allows for monitoring students' neurophysiological indicators during the learning process, creating a foundation for personalizing their educational trajectory and objectively assessing the level of competency formation.

The model for developing digital culture in future preschool teachers based on neurotechnologies is realized through a system of interconnected pedagogical conditions that create an optimal environment for professional development.

The creation of an integrated neurotechnological educational environment serves as a fundamental condition, ensuring the organic combination of traditional pedagogical approaches with the innovative capabilities of neurointerfaces and biofeedback systems. This

involves not only technically equipping the educational process with modern equipment but also developing corresponding software-methodological support and specialized training for the teaching staff.

The gradual formation of digital culture is carried out through the sequential implementation of the cognitive-theoretical, activity-based, and reflective-analytical modules with continuous neurophysiological support. This allows for structuring the educational process according to the logic of cognitive activity and the patterns of professional competency formation, ensuring control over the effectiveness of each learning stage and timely correction of the educational process.

The principle of personalizing the educational process based on neurophysiological diagnostic data creates opportunities for accounting for individual characteristics of students' cognitive development. The differentiation of instruction considers variations in information processing speed, working memory capacity, attention stability, and other cognitive functions, which is realized through the development of individual educational trajectories and the adaptation of teaching methods.

The integration of theoretical preparation with practical activity is achieved through a system of complementary forms of learning organization, instructional classes, teaching practice, scientific research work, and training programs unified by constant neurophysiological monitoring. This approach ensures the formation of a holistic digital culture as a unity of the knowledge, skills, abilities, and personal qualities necessary for professional activity in the digital educational environment.

The reflective nature of the educational process is supported by the systematic use of self-analysis and self-regulation technologies employing neurofeedback. This fosters the development of students' metacognitive abilities and the formation of self-control and self-regulation skills, which constitute the foundation for continuous professional development within a dynamically changing digital environment.

The elective course "Neurotechnologies in Shaping the Future Teacher's Digital Culture" serves as the core organizational form for implementing the model. Within this course, all components of digital culture are developed through: lecture sessions incorporating neurophysiological monitoring of attention; interactive seminars utilizing biofeedback; laboratory-practical classes focused on mastering specialized software; project-based activities; and reflective seminars incorporating neurofeedback.

Pedagogical practice with a digital component enables the testing of developed competencies in the real professional setting of a preschool organization. During this practice, students analyze the digital educational environment, apply neurotechnologies in their work with children, create interactive educational materials, and organize digital communication with parents, while simultaneously developing skills for the reflective analysis of their own pedagogical activities.

Student research work, conducted in the form of projects, integrates theoretical knowledge and practical skills by studying the influence of neurotechnologies on the development of preschool children, analyzing international experience in educational digitalization, and developing and experimentally testing digital educational resources. This research activity includes analyzing the effectiveness of digital educational technologies, investigating the risks associated with their application, and developing a system for assessing the quality of the digital educational environment.

Professional development training programs ensure the targeted formation of professionally significant qualities through cognitive training using neurofeedback, the practice of practical skills for working with digital devices, and the development of critical thinking. Individual educational trajectories are realized through personalized support based on neurophysiological diagnostics, including individual consultations, the development of personal theoretical training programs, and the selection of digital tools in accordance with the psychophysiological characteristics of the students.

The results component of the model defines the system of expected educational outcomes,

reflecting qualitative changes in professional training. Cognitive results are characterized by the development of digital thinking, information-analytical abilities, and a deep understanding of the principles underlying digital technologies. Activity-based results are manifested in the confident mastery of digital tools for professional activity and the ability to apply them creatively in the educational process. Personal results include the formation of a value-based attitude towards digital technologies and a readiness for continuous professional development in the context of educational digitalization. The integrative nature of the results component ensures the formation of a holistic digital culture in the future preschool teacher. The use of neurotechnologies creates a scientifically grounded system for assessing the effectiveness of the model's implementation.

Conclusion. The conducted theoretical study has achieved its goal and resolved the key scientific contradiction between the updated requirements for the digital culture of the future teacher and the limited potential of traditional pedagogical approaches. As a result, the essence of the digital culture of a preschool teacher has been clarified and scientifically substantiated as an integrative personal and professional attribute synthesizing cognitive, operational-activity, and axiological components. This conceptual position, in turn, confirmed the necessity of integrating neurotechnological tools into the university's educational process.

As a methodological response to this challenge, an innovative model was developed, representing an integrated system of target, content, technological, and results components. The implementation of the model is possible under a set of pedagogical conditions, such as creating an integrated neurotechnological educational environment, ensuring the gradual formation of digital culture with neurophysiological support, and personalizing learning based on neurodiagnostic data. The theoretical significance of the work lies in expanding scientific understanding of the structure of digital culture and substantiating the new possibilities of neurotechnologies in teacher education. The practical value resides in the model's potential for the qualitative renewal of the content and technologies for training future teachers. Prospects for further research are associated with testing the model in a real educational process, developing corresponding diagnostic tools, and creating methodological recommendations for its implementation into the system of teacher training.

References

Alipoor, J., & Pourrashidi, H. (2025). A critical study on the researches about the application of neurotechnology in education. *International Journal of Neuroscience*, *135*(4), 496-503. https://www.tandfonline.com/doi/abs/10.1080/00207454.2024.2311231

Alvestad, M., & Jernes, M. (2014). Preschool teachers on the implementation of digital technology in Norwegian Kindergartens. In *Forum on Public Policy: A Journal of the Oxford Round Table* (pp. NA-NA). Forum on Public Policy. https://go.gale.com/ps/i.do?id=GALE%7CA497796475&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=1556763X&p=AONE&sw=w

Artemieva, V. V., Voronina, L. V., & Utyumova, E. A. (2020). Development of information culture of future teachers in the conditions of digitalization of education. In *2nd International Scientific and Practical Conference "Modern Management Trends and the Digital Economy: From Regional Development to Global Economic Growth" (MTDE 2020)* (pp. 841-847). Atlantis Press.

Bay, D. N. (2022). The perspective of preschool teachers on the use of digital technology. *Southeast Asia Early Childhood Journal*, *11*(2), 87-111. https://www.academia.edu/download/95965992/the_perspective_of_preschool_teachers_on_the_use_of_digital_technology.pdf

Bay, D. N., & Hartman, D. K. (2025). Digital Technology in Kindergarten: Kindergarten Teachers' Practices and Their Effects on Children. *Journal of Research in Childhood Education*, 1-29. https://www.tandfonline.com/doi/abs/10.1080/02568543.2025.2514028

El-Deeb, R. M. (2021). The Digital Etiquette of the Kindergarten Teacher Pre-Service When Using Electronic Educational Platforms from the Point of View the Faculty Members. *International Journal of Instructional Technology and Educational Studies*, *2*(3), 28-33. https://journals.ekb.eg/article_204568.html

Elkina, E. E. (2018). Digital Culture as a Field of Interdisciplinary Research: Methodological Approaches and Tendencies of Development. *International Journal of Open Information Technologies*, *6*(12), 67-78. http://injoit.org/index.php/j1/article/view/649

Ferreira, J. D. L. (2020). Digital Culture and Teacher Education: an analysis from the perspective of undergraduate students in Pedagogy. *Educating in Review*, *36*, e75857. https://www.scielo.br/j/er/a/vDPPCznRr6dfVsYKqJS979L/?lang=en

Giannini, T., & Bowen, J. P. (2019). Digital culture. In *Museums and Digital Culture: New Perspectives and Research* (pp. 3-26). Cham: Springer International Publishing. https://link.springer.com/chapter/10.1007/978-3-319-97457-6_1

Hartong, S. (2019). The transformation of state monitoring systems in Germany and the US: Relating the datafication and digitalization of education to the global education industry. In *Researching the global education industry: Commodification, the market and business involvement* (pp. 157-180). Cham: Springer International Publishing. https://link.springer.com/chapter/10.1007/978-3-030-04236-3_8

Ihmeideh, F., & Alkhawaldeh, M. (2017). Teachers' and parents' perceptions of the role of technology and digital media in developing child culture in the early years. *Children and Youth Services Review*, *77*, 139-146. https://www.sciencedirect.com/science/article/pii/S0190740917301330

Mensan, N. Ö., & Anagün, S. S. (2022). Primary School Teachers' Perceptions of Digital Culture. *International Journal of Progressive Education*, *18*(1), 397-410. https://eric.ed.gov/?id=EJ1332723

Mulder, M. (2012). Competence-based education and training. *The Journal of Agricultural Education and Extension*, *18*(3), 305-314. https://www.tandfonline.com/doi/full/10.1080/1389224X.2012.670048

Nguyen, T. T. H., & Nguyen, T. M. (2019). Information technology and teaching culture: Application in the classroom. In *Smart Education and E-Learning 2019* (pp. 343-355). Singapore: Springer Singapore. https://link.springer.com/chapter/10.1007/978-981-13-8260-4_32

Nouri, A. (2025). A scoping review of educational neurotechnology: Methods, applications, opportunities, and challenges. *Review of Education*, *13*(2), e70070. https://bera-journals.onlinelibrary.wiley.com/doi/abs/10.1002/rev3.70070

Privitera, A. J., & Du, H. (2022). Educational neurotechnology: Where do we go from here?. *Trends in Neuroscience and Education*, *29*, 100195. https://www.sciencedirect.com/science/article/pii/S2211949322000230

Ronzhina, N., Kondyurina, I., Voronina, A., Igishev, K., & Loginova, N. (2021). Digitalization of modern education: problems and solutions. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(4), 122-135. https://www.learntechlib.org/P/220004/

Ruotsalo, T., Mäkelä, E., Kauppinen, T., Hyvönen, E., Haav, K., Rantala, V., ... & Matskin, M. (2009, September). Personalized Context-aware Access to Digital Cultural Heritage. In *Proceedings of the International Conferences on Digital Libraries and the Semantic Web, Trento, Italy* (pp. 8-11). http://seco.cs.aalto.fi/publications/2009/Ruotsalo-Smartmuseum-2009.pdf

Satharasinghe, A. (2006). Computer literacy of teachers. *Retrieved October*, *19*, 2015. http://www.statistics.gov.lk/Resource/en/ComputerLiteracy/Surveys/ComputerLiteracyTeachers2006.pdf

Williamson, B., Pykett, J., & Kotouza, D. (2025). Learning brains: educational neuroscience, neurotechnology, and neuropedagogy. *Pedagogy, Culture & Society*, 1-21. https://www.tandfonline.com/doi/abs/10.1080/14681366.2025.2521458

Zhao, P., & Li, X. (2015). Arts Teachers' Media and Digital Literacy in Kindergarten: A Case Study on Finnish and Chinese Children using a Shared Blog in Early Childhood Education. *International Journal of Digital Literacy and Digital Competence (IJDLDC)*, *6*(1), 1-17. https://www.igi-global.com/article/arts-teachers-media-and-digital-literacy-in-kindergarten/128286

Information about authors:

Aitzhanova Elmira, PhD Doctoral Student of Educational Program 8D01201 Preschool Education and Upbringing, Abai Kazakh National Pedagogical University, ORCID ID: 0000-0002-0604-5133, email: aytzhanova.1971@gmail.com

Khassanova Inkar, Candidate of Pedagogical Sciences, M. Utemisov West Kazakhstan University, ORCID ID: 0000-0002-1317-9885, email: Khassanova.inkar@mail.ru

Darguzhieva Assima, lecturer, M. Utemisov West Kazakhstan University, ORCID ID: 0009-0008-4655-1728, email: assimok_dar@mail.ru

Nabiyeva Zhanargul, master's degree of Pedagogical Sciences, senior lecturer, M. Utemisov West Kazakhstan University, ORCID ID: 0000-0003-2706-7857, email: nabi.zhanar@inbox.ru

Original Article
IRSTI 14.35.07 10.51889/2960-1649.2025.65.4.012

DAULETOVA AINUR, AITZHANOVA AKMARAL, KERIMBEKOVA AKBOPE

M. Auezov South Kazakhstan University (Shymkent, Kazakhstan)

*Address of correspondence: Aitzhanova Akmaral, Senior Lecturer, Department of General Pedagogy and Psychology, M. Auezov South Kazakhstan University, Shymkent City, Kazakhstan, Republic of Kazakhstan, https://orcid.org/0009-0009-7323-4258, E-mail address: akmaral1601@list.ru

Formation of Research Competencies of Future Educational Psychologists in the Digital Educational Environment of the University

Abstract

Introduction. The article addresses the problem of forming research competencies among future educational psychologists in the context of digital transformation of higher education. The authors substantiate the relevance of developing research competencies as a key component of professional preparation, which encompasses not only methodological knowledge but also practical skills, analytical abilities, and personal qualities necessary for reflective professional practice in contemporary educational environments: methodology and Methods. Empirical data were collected through a questionnaire survey using closed-type instruments. The questionnaire included 5 thematic blocks. The research sample was formed using purposive sampling and comprised 41 respondents. *Results.* The findings demonstrate that the digital educational environment, when appropriately utilized through grounded pedagogical methodology, creates unprecedented opportunities for developing research competencies. The research reveals that structured integration of research methodology content with digital tools and authentic psycho-pedagogical projects facilitates more effective competency formation. Analysis of the institutional conditions indicates that seven principal characteristics significantly influence the formation of research competencies. *Scientific Novelty.* The study presents empirical evidence that the distinctive features of digital educational environments, particularly networked collaboration, sophisticated analytical tools, and authentic project implementation, fundamentally transform the conditions for developing research competencies among future educational psychologists and contribute to overcoming problem areas in their professional preparation. *Practical Significance.* The comprehensive approach proposed in the article, integrating reconceptualization of professional preparation content with strategic utilization of digital tools and creation of supportive pedagogical conditions, provides practical guidelines for higher educational institutions implementing research competency development programs for educational psychology students.

Keywords: research competencies, educational psychologists, digital educational environment, higher education, professional preparation, research-based learning activities.

Introduction. The current stage of higher education development is characterized (Alenezi, 2023; Zhao & Zhou, 2024) by an increase in the volume of available scientific information and an expansion of the range of digital analytical tools. However, the expansion of information resources and technological capabilities is not always accompanied by a corresponding improvement in the quality of students' research training (Burke & Prieto, 2019). In the context of professional training of educational psychologists, this gap acquires particular significance, since the professional activities of specialists in this field require not only the application of existing diagnostic methods and standardized procedures, but also the ability to act as a reflective practitioner-researcher, prepared for independent identification, analysis, and resolution of complex problems arising in specific conditions of educational practice.

The digital educational environment of the modern university (Vasyliuk et al., 2021), by providing access to international scientific literature databases, specialized software for data processing, and platforms for organizing

collaborative activities, creates new opportunities for developing students' research capabilities. However, the availability of technological resources, even when properly organized, is in itself insufficient for the formation of genuine research competence. The technological potential of the digital environment requires pedagogical reflection and integration into the system of professional training.

There exists a methodological gap between traditional approaches to organizing students' scientific work and the opportunities provided by the digital environment. Most existing models either remain within the framework of classical forms of organizing educational-research activities, supplementing them with individual digital tools, or use technologies fragmentarily, failing to integrate them into a holistic system of professional training. At the same time, the question remains insufficiently studied concerning the degree to which students themselves, future educational psychologists, recognize the necessity of developing research skills and competencies as an integral component of their future professional activities.

The relevance of this research is determined by the need to identify the problem of forming research competencies of future educational psychologists within the framework of the university's digital educational environment. The research aims to reveal and describe the nature of this problem, as well as to examine the position of students themselves regarding the significance of research skills in their professional development. To this end, a survey of future educational psychologists is planned, which will make it possible to determine their perceptions of the necessity of forming research competencies, to identify difficulties in developing these skills, and to establish a connection between the use of digital tools and the quality of research training. The data obtained will contribute to a better understanding of the state of students' research training and the identification of directions for improving the system of professional education in the field of educational psychology.

Research competencies in the context of higher education are understood as a set of skills that university students should develop in order to create and disseminate scientific products in the process of their academic activities (George-Reyes et al., 2023). Competencies extend beyond simple mastery of technical research procedures and include the ability for critical analysis of information, systematic problem-solving, and the formation of original scientific knowledge. Research competencies represent an integrative formation that combines cognitive, activity-based, and personal aspects of specialist training, including not only knowledge of research methodology but also practical skills in applying various methods of data collection and analysis, the ability to formulate scientific problems, and the capacity to interpret research results.

Research competencies acquire particular significance in the system of professional training of future teachers. According to the research of Nagymzhanova et al. (2025), pedagogical research competency has recently become the most important component of educational outcomes in the training of future teachers, enabling specialists to carry out professional activities based on scientific knowledge and empirical data.

In the process of an empirical study conducted through a survey of students at a pedagogical university, the authors established the level of students' mastery of the skills that form the basis of research competency. The research showed that future teachers at the stage of their training need to acquire appropriate research experience. The practical significance of these findings lies in the development of methodological recommendations covering key theoretical information about the peculiarities of pedagogical-research competency and the means of its development in the context of training future primary school teachers (Nagymzhanova et al., 2025).

Koletvinova and Bichurina (2019) propose considering research competency as a multifunctional, theoretically substantiated, and practice-oriented construct. The authors emphasize that the complexity of professional training of a creative teacher, based on the mastery of professional research competency,

dictates the necessity of developing research abilities of future educators. Successful professional activity of a teacher presupposes a multifunctional research character of his or her work.

The psychological and pedagogical conditions for developing students' research qualities, according to Koletvinova and Bichurina (2019), are based on a system of pedagogical actions that have intellectual significance in relation to individual and personal characteristics. These actions are aimed at creating a scientific-creative educational space through the use of developed mechanisms of self-regulation, self-projection, self-determination, self-development, and self-education. The study employed both theoretical methods (analysis of pedagogical, psychological, and methodological literature) and empirical methods (analysis, comparison, synthesis, observation, survey), a pedagogical experiment with stages of identification, formation, and control, the method of expert evaluations, and statistical processing of research results. The authors developed a multifunctional, structurally informative paradigm for the development of professional research competency of future teachers.

Sandoval-Henríquez and Sáez-Delgado (2023) conducted a systematic review following PRISMA guidelines to assess research competencies of higher education students. Their study covered the Science and Scopus scientific databases, analyzing publications from 2013 to 2022. As a result of the systematic analysis, the authors selected 32 studies that met the established inclusion criteria. The results of the systematic review by Sandoval-Henríquez and Sáez-Delgado (2023) revealed a number of critical deficiencies in the current state of research on research competencies. First, the authors noted a limited number of studies conducted in South America, which indicates a geographical imbalance in attention to this issue. Second, existing research often uses non-representative sample sizes, which reflects methodological limitations in the existing knowledge base. Third, the authors identified a lack of theoretical models that allow for the systematization of competencies. Fourth, the research often employs unreliable and invalid measurement instruments, which raises questions about the validity of the obtained empirical data.

The results of the systematic review demonstrate that university students exhibit significant deficiencies in specific competency dimensions. The identified weaknesses include inadequate skills in conducting literature analysis, insufficient competency in applying methodological approaches, and limitations in effectively communicating research results. George-Reyes et al., (2023) propose an innovative approach to developing research competencies through the integration of complex thinking frameworks and Education 4.0 applications. The authors implemented an educational experience aimed at improving students' competency levels through deliberate integration with complex thinking and the use of modern digital technologies.

The technological tools used in the research by George-Reyes et al. (2023) included applications for remote teamwork, web-based virtual reality systems, and social robotics. The study was conducted using a sequential-quantitative and descriptive methodological design. The authors applied pre- and post-intervention surveys to assess the perceptions of 105 Mexican university students regarding their research competencies. Subsequently, a rubric was developed for the teacher to evaluate competency.

The results of the study by George-Reyes et al. (2023) show that students noted an improvement in their research skills following the intervention. However, the results revealed an important gap: the assessment based on teacher ratings showed statistically significant differences from students' self-assessment regarding the extent of improvement in research skills. The gap between students' subjective perception and objective teacher evaluation raises important questions about the reliability of self-reports on competency improvement. Despite the identified discrepancy between student perception and objective evaluation, George-Reyes et al. (2023) conclude that their approach can be scaled to other educational

scenarios. The authors argue that disruptive teaching strategies, particularly those that integrate complex thinking frameworks with Education 4.0 applications, can effectively support the development of research skills. The scalability potential of the approach indicates possibilities for wider implementation in diverse contexts of higher education.

Education 4.0 represents a paradigm that integrates advanced digital technologies into the educational process to develop competencies necessary in the context of the fourth industrial revolution. In the context of developing research competencies, Education 4.0 tools create new opportunities for organizing students' educational-research activities. The application of Education 4.0 technologies in the development of research competencies includes the use of remote applications for teamwork, enabling students to collaborate regardless of geographical location; web-based virtual reality systems, which can create immersive research environments; and social robotics, which can facilitate the development of interaction and communication skills in the context of research activities. Technological tools allow the integration of complex thinking into the development process, as they require students to analyze multifaceted problems, interact with non-linear systems, and employ adaptive problem-solving.

Complex thinking, as demonstrated in the research of George-Reyes et al., (2023), plays a critically important role in the development of research competencies. Complex thinking involves the ability to analyze multifaceted, non-linear, and dynamic systems, the capacity to synthesize information from various sources, the skill to identify patterns in complex data, and the ability to employ adaptive problem-solving. The integration of complex thinking with research competencies is particularly important in the context of professional activities in complex, dynamic environments, such as contemporary education. The development of complex thinking enables students not only to master the technical procedures of research but also to learn to see systemic connections, understand interdependencies between various factors, and analyze problems at multiple levels, which significantly enhances the quality of scientific work.

The analysis of literature conducted by Sandoval-Henríquez and Sáez-Delgado (2023) reveals a number of significant deficits in the development of research competencies among university students. The first critical deficit is associated with insufficient skills in conducting scientific literature analysis. Students experience difficulties in searching for relevant sources, assessing their quality, and applying information from various sources to form their own research position. The second significant deficit concerns methodological competencies. Students often demonstrate limited understanding of the principles of organizing empirical research, selecting appropriate research methods, and justifying methodological decisions. This deficit points to the necessity for more in-depth theoretical training in the field of methodology. The third deficit is related to skills in communicating research results. Students experience difficulties in formulating conclusions, interpreting results, and presenting findings in various formats and for different audiences. This indicates the need to develop scientific communication skills as an integral component of research competencies. The research revealed a gap between students' perception of their competencies and the objective evaluation of their competency levels by instructors. The observation by George-Reyes et al. (2023) points to the importance of using multi-method approaches to assessing research competencies and the necessity of developing students' critical self-analysis about their research abilities.

Results. The collection of empirical data was carried out through a survey method using a closed-ended questionnaire. The questionnaire included 5 thematic blocks aimed at identifying: 1) respondents' understanding of the essence of the concept "research competency"; 2) assessment of its level of formation in the context of the digital educational environment; 3) identification of problem areas in the structure of research competencies; 4) analysis of institutional conditions for their

development. The research sample was formed using purposive sampling and comprised 41 respondents. The inclusion criteria were: enrollment in the fourth year of the "Educational Psychologist" program, which is due to the final stage of professional competency formation and experience in participation in educational-research activities.

In accordance with the requirements of research ethics, all participants were previously informed about the research objectives, principles of anonymity, and confidentiality of data processing. The survey procedure was conducted voluntarily after obtaining informed consent from the respondents. For statistical processing of the obtained data, a matrix was created in SPSS format, where responses were coded using a nominal scale. The subsequent analysis involves the application of descriptive statistics methods (calculation of frequencies and percentage distributions) and procedures for analyzing relationships (chi-square test) to identify significant patterns in the data (Figures 1-5, Table 1).

Figure 1

Survey results for question 1 of the questionnaire "Which of the following definitions of research competency do you agree with most?"

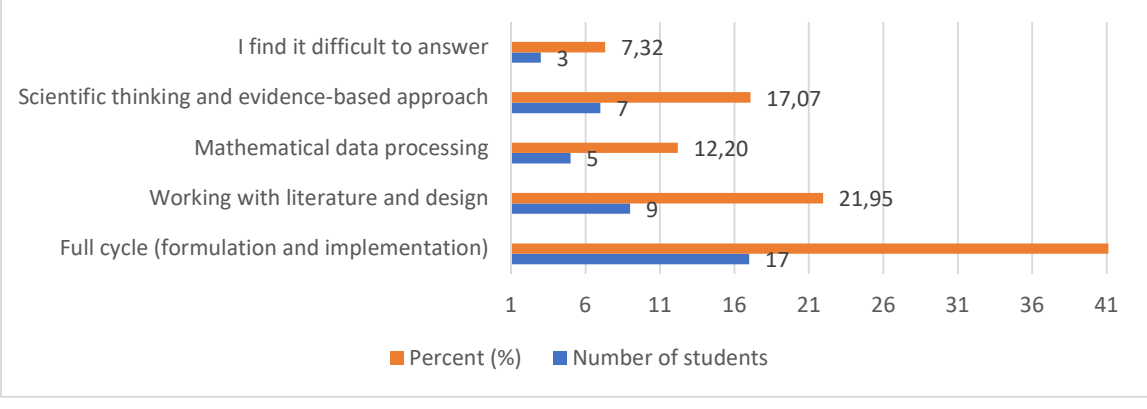


Figure 2

Survey results for question 2 of the questionnaire "To what extent, in your opinion, does your educational program develop research competency?"

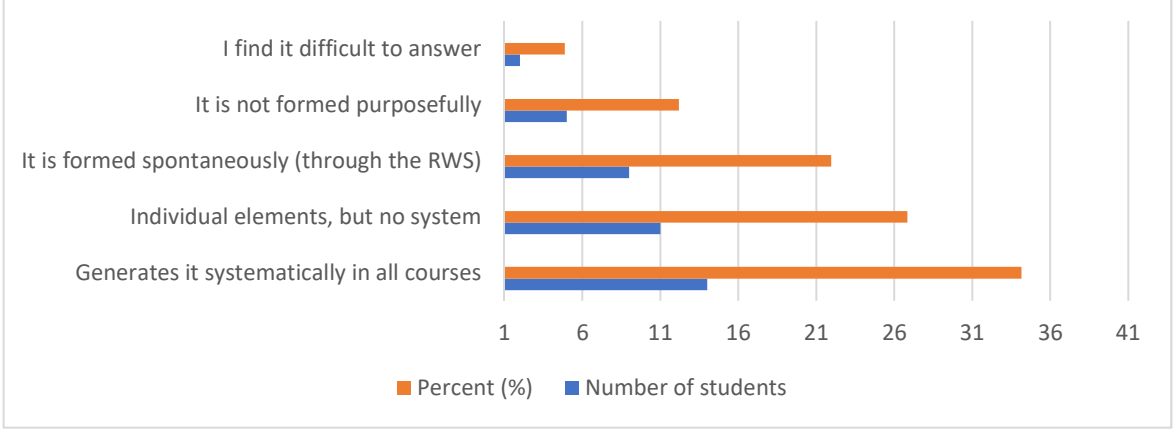


Figure 3

Survey results for question 3 of the questionnaire "To what extent does the digital environment of your university contribute to the development of research skills?"

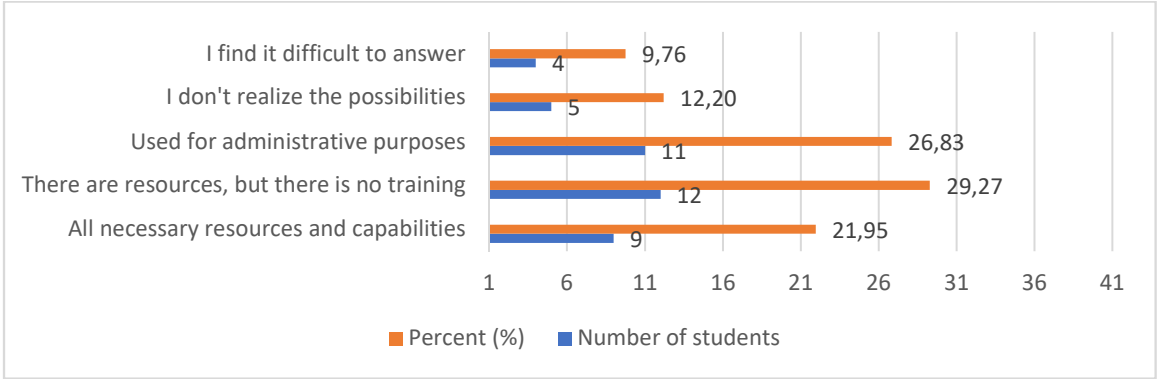


Figure 4

Survey results for question 4 of the questionnaire "Which components of research competency present the greatest difficulties for you?"

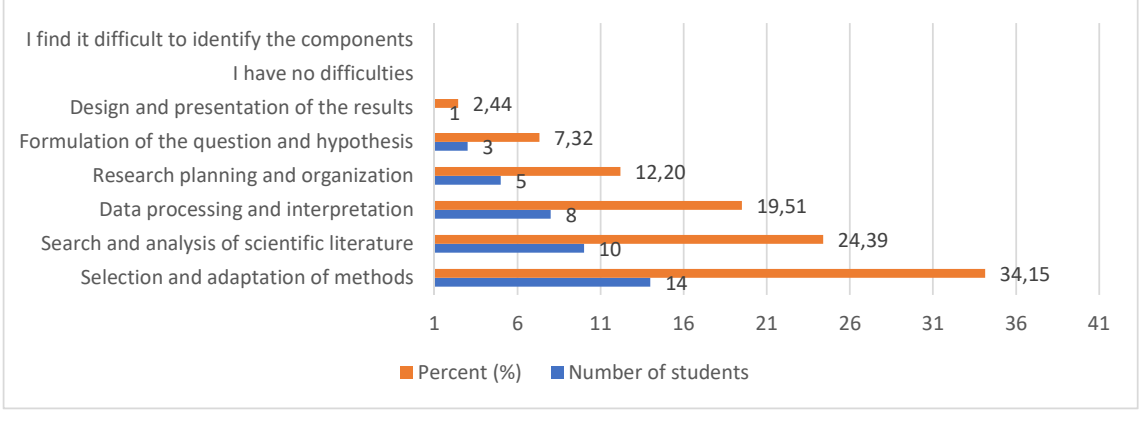


Figure 5

Survey results for question 5 of the questionnaire "How do you primarily acquire research skills and competencies?"

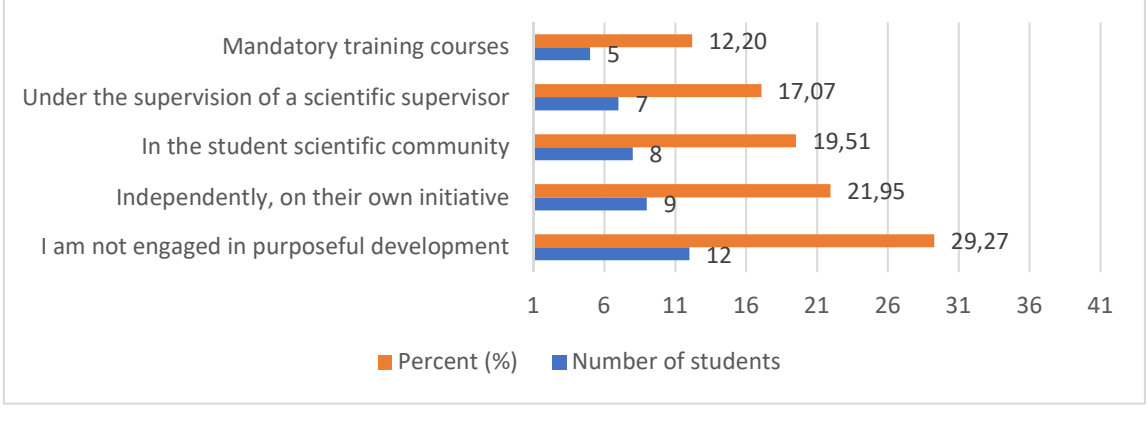


Table 1
Descriptive data statistics

	Which of the following definitions of research competency do you agree with most?	To what extent, in your opinion, does your educational program develop research competency?	To what extent does the digital environment of your university contribute to the development of research skills??	Which components of research competency present the greatest difficulties for you?»	How do you primarily acquire research skills and competencies?
Average	2,825	2,675	3,05	4,175	3,625
The standard error	0,22328406	0,22184396	0,26054676	0,31802173	0,26235497
The median	2,5	3	3	4	3,5
Mode	2	1	1	4	5
Standard deviation	1,41217236	1,40306441	1,64784241	2,01134602	1,6592785
Sample variance	1,99423077	1,96858974	2,71538462	4,04551282	2,75320513
Excess	-1,2576975	-1,0914277	-1,6326314	-1,0027171	-1,3141048
Asymmetry	0,26879641	0,32470798	-0,1561697	0,14579658	-0,1423503
Interval	4	4	4	7	5
Minimum	1	1	1	1	1
Maximum	5	5	5	8	6
The amount	113	107	122	167	145
Total	41	41	41	41	41

Analysis of the survey results makes it possible to identify several key patterns and contradictions in the system of forming research competency among future educational psychologists. First, students demonstrate an adequate, comprehensive understanding of research competency, viewing it as the ability to conduct a complete research cycle, demonstrating the presence of understanding of the essential characteristics and significance of the competency being formed, as well as correct conceptual foundations for further competency development. However, the identified discrepancy between the perceived systematicity of competency formation (the mode indicates a positive assessment, but the mean value is more critical) points to the necessity of reconsidering the organization of the educational program. It is necessary to ensure greater consistency, integration, and explicit purposefulness in the development of research competencies throughout the entire training program.

Most critical is the identified discrepancy between the availability of the digital environment and its practical use for research purposes. High standard deviation (1.65) and mean value of 3.05 with mode 1 indicate that, despite the availability of technological resources, their integration into the research process remains insufficient, pointing to the necessity for deliberate efforts to increase competency among both students and instructors in the use of digital tools for research purposes, as well as to develop structured methodological recommendations for the application of digital technologies in various components of research activities. The identified diversity of difficulties experienced by students (high standard deviation, distribution across the entire range) requires a differentiated approach aimed at addressing specific difficulties of various groups of students. The presence of a significant number of students not engaged in deliberate formation of research skills points to

the necessity of strengthening the motivational component and creating more structured and attractive opportunities for developing research competency. The obtained results demonstrate the necessity for a comprehensive revision of the system for forming research competency, including supplementing the educational program, integrating digital tools into the research process, developing differentiated approaches to overcoming difficulties, and increasing student motivation for active competency development.

Discussion. The formation of research competency among students who are future educational psychologists in the context of the university's digital educational environment is characterized by a set of fundamental features that qualitatively distinguish this process from traditional approaches to organizing scientific training. However, the question of whether the digitalization of the educational environment actually creates favorable conditions for the development of research competencies or, conversely, generates new challenges and contradictions, remains a subject of scientific debate.

On one hand, the unprecedented expansion of access to information resources and scientific sources through digitalization opens new horizons for students' professional development. The digital educational environment of the modern university (Peters, 2000; Samerkhanova et al., 2019) provides students with the opportunity for direct and immediate access to international scientific literature databases (PubMed, Web of Science, Scopus, ERIC, PsycINFO), electronic journal versions, dissertation research, and open scientific data. This accessibility allows students to familiarize themselves with the current state of scientific knowledge in the field of psychological and pedagogical research, track the dynamics of scientific idea development, and determine their place in the scientific field. However, it should be critically noted that expanded access to information per se does not guarantee quality mastery of research competencies. On the contrary, unlimited information abundance (Skivko, 2021) creates a paradoxical situation: students face information overload and experience difficulties in selecting relevant sources. There is a risk that students become lost in an ocean of information, failing to develop critical thinking and information literacy skills to a sufficient degree. Thus, an important question arises: is it sufficient to simply provide access to information resources, or is deliberate pedagogical work necessary to develop skills in critically evaluating sources and distinguishing authentic scientific information from pseudoscientific content?

A similar contradiction is observed with regard to the availability of professional digital tools (Mhlongo et al., 2023) for data processing and analysis. On one hand, the modern digital environment provides students with the opportunity to apply professional statistical analysis programs (SPSS, R, Jamovi, Statistica), specialized systems for qualitative analysis of textual data (NVivo, MAXQDA, Atlas.ti), and cloud platforms for creating electronic surveys. This significantly expands the range of methods available for students' scientific work and makes the data processing process more efficient and aligned with modern standards of scientific work. However, there is a danger of superficial, uncritical application of statistical methods without adequate understanding of their theoretical foundations and assumptions of use. Students lacking deep methodological knowledge may use powerful analytical tools mechanically, obtaining numerical results that appear scientifically justified but do not actually reflect reality. As researchers emphasize, there is a risk that the technological complexity of tools can conceal methodological errors and misinterpretation of data. Thus, the question of whether the availability of digital tools contributes to the genuine development of research competencies or creates an illusion of competency remains open.

The transformation of the character of organizing collaborative research activities in the digital environment also provokes contradictory assessments (Hussain et al., 2024). Cloud services, project management systems, and asynchronous communication tools indeed open new possibilities for organizing research groups and engaging experts from various universities.

The possibility of cross-institutional and international collaboration appears to be a significant achievement of modern education. However, the asynchronous nature of such interaction presents new demands on students and creates specific problems. The necessity of developing skills in self-organization, time management, and autonomous work while maintaining team coordination may prove excessively complex for students, especially at the early stages of training. The question arises of whether excessive mediation of interaction in the digital environment leads to a decrease in the quality of scientific mentoring and guidance, which was traditionally carried out through direct, synchronous interaction. There are concerns about the social alienation of students who work in asynchronous modes and lose immediate, face-to-face communication with the scientific community.

The transformation of the instructor's role (Ivanenko, 2015) in the process of forming research competency raises important pedagogical and philosophical questions. The shift from the model of direct mentor to the model of curator and facilitator undoubtedly contributes to the development of student autonomy and initiative (Tatto, 2021). However, one should critically consider whether the quality of personal mentoring, which plays a critically important role in developing not only skills but also value orientations and personal characteristics of a researcher, is lost in this process. The facilitator model assumes that student assumes greater responsibility for their own development, but the question arises: Are students sufficiently prepared for such responsibility? Does the lack of direct guidance lead to an increase in the number of students who feel lost in the digital environment and do not receive the necessary support?

The integration of synchronous and asynchronous forms of interaction, although providing greater flexibility, simultaneously complicates the organization of the educational process. An important question about balance arises: which types of activities are indeed more effective in synchronous mode, and which in asynchronous mode? There is a risk that with improper organization of the hybrid format, some students will gain advantages (for example, those who are better organized and can work effectively asynchronously), while others will be disadvantaged. Thus, the implementation of hybrid formats per se does not guarantee improved educational quality; careful pedagogical design and continuous evaluation of the effectiveness of various combinations of synchronous and asynchronous elements are necessary.

The increased authenticity of research projects due to the possibility of remote interaction with practical educational organizations is undoubtedly a positive aspect. However, questions arise about the quality of this interaction and the extent to which online diagnostics and remote collaboration can fully replace face-to-face interaction with the actual educational environment. There are concerns that many important contextual aspects of real practice are lost in the process of online interaction. Furthermore, schools and kindergartens may not be prepared for the active inclusion of student researchers in their work in the format of online collaboration, which may result in the superficial nature of such interaction.

The development of digital literacy and media competency (Park et al., 2021) as components of research competency is necessary in the modern context; however, it should be noted that this significantly expands the volume of content that students must master. The question arises of whether the spectrum of required competencies becomes excessively broad and complex for assimilation within the framework of a standard training program. Furthermore, the rapid pace of digital technology development means that educational content in this field may quickly become outdated, which creates additional challenges for educational programs.

It is important to note the discrepancy identified by researchers between students' perception of their competencies and instructors' objective evaluation. George-Reyes et al., (2023) note that students overestimate the improvement of their research skills as a result of educational intervention, while objective evaluation shows less significant changes. These

contradictions raise deep questions about what is actually being measured in the process of assessing research competencies. It is possible that students experience an increase in their confidence and motivation, which is a valuable outcome, but objective indicators of research skills do not improve proportionally. This discrepancy requires further critical analysis and may indicate the necessity of reconsidering both teaching methods and assessment approaches.

Thus, the digitalization of the university's educational environment undoubtedly creates new opportunities for developing students' research competencies. However, these opportunities are not realized automatically. On the contrary, each of the identified features of the digital environment carries potential risks and contradictions that require constant pedagogical attention and resolution. The question is not whether digital technologies should be implemented in the educational process (this becomes inevitable in the context of modern social development), but rather how to ensure that this digitalization actually contributes to the development of deep, sustainable research competencies, rather than creating an illusion of competency or leading to a degradation in the quality of scientific training. Solving this problem requires a reconceptualization of pedagogical approaches in the professional training of future educators, the development of more valid assessment instruments, and continuous analysis of the effectiveness of educational innovations.

Conclusion. The present study confirms that the digitalization of the educational environment contains significant potential for enhancing the preparation of future educational psychologists; however, this potential is insufficiently realized. The identified contradictions between students' theoretical understanding of research competency and its practical implementation, as well as between the availability of technological resources and their instrumental utilization, demonstrate the necessity for a fundamental reconceptualization of pedagogical strategies. Merely providing access to digital resources is insufficient for the formation of research competency; deliberate methodological work is required to integrate innovative technologies into the structure of professional preparation, taking into account the individual needs of various student groups.

The research findings justify the necessity for developing a comprehensive approach to overcoming the identified deficits, encompassing reconceptualization of educational content, creation of conditions for motivated student engagement in research activities, improvement of competency assessment methods, and continuous monitoring of the effectiveness of educational innovations. The proposed directions for enhancing the preparation system can serve as a foundation for developing practical recommendations for higher educational institutions seeking to ensure quality development of research competencies among future educational psychologists.

References

Alenezi, M., Wardat, S., & Akour, M. (2023). The need of integrating digital education in higher education: Challenges and opportunities. *Sustainability*, *15*(6), 4782. https://www.mdpi.com/2071-1050/15/6/4782

Burke, K. S., & Prieto, L. R. (2019). High-quality research training environments and undergraduate psychology students. *Scholarship of Teaching and Learning in Psychology*, *5*(3), 223. https://psycnet.apa.org/journals/stl/5/3/223/

George-Reyes, C. E., López-Caudana, E. O., & Ramírez-Montoya, M. S. (2023). Research Competencies in University Students: Intertwining Complex Thinking and Education 4.0. *Contemporary Educational Technology*, *15*(4). https://eric.ed.gov/?id=EJ1406901

Hussain, M., Qureshi, Z. M., & Malik, S. (2024). The impact of educational technologies on modern education: Navigating opportunities and challenges. *Global Educational Studies Review*, *9*(3), 21-30. https://www.gesrjournal.com/article/the-impact-of-educational-technologies-on-modern-education-navigating-opportunities-and-challenges

Ivanenko, N. A., Mustafina, G. M., Sagitova, V. R., Akhmetzyanov, I. G., Khazratova, F. V., Salakhova, I. T., & Mokeyeva, E. V. (2015). Basic Components of Developing Teachers' Research Competence as a

Condition to Improve Their Competitveness. *Rev. Eur. Stud.*, *7*, 221. https://heinonline.org/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/rveurost7&section=128

Koletvinova, N., & Bichurina, S. (2019). Development of research competence of future teachers in the process of their professional training. *ARPHA Proceedings*, *1*, 487-498. https://ap.pensoft.net/article/22055/download/pdf/

Mhlongo, S., Mbatha, K., Ramatsetse, B., & Dlamini, R. (2023). Challenges, opportunities, and prospects of adopting and using smart digital technologies in learning environments: An iterative review. *Heliyon*, *9*(6). https://www.cell.com/heliyon/fulltext/S2405-8440(23)03555-7

Nagymzhanova, K., Beisenbayeva, A., Feizuldayeva, S., Zhiyentaeyva, B., & Abilova, B. (2025). Formation of Research Competence of the Future Primary School Teacher. *Journal of Teaching and Learning*, *19*(2), 154-166. https://www.erudit.org/en/journals/jtl/2025-v19-n2-jtl010068/1118265ar/abstract/

Park, H., Kim, H. S., & Park, H. W. (2021). A scientometric study of digital literacy, ICT literacy, information literacy, and media literacy. *J. Data Inf. Sci.*, *6*(2), 116-138. https://sciendo.com/pdf/10.2478/jdis-2021-0001

Peters, O. (2000). Digital learning environments: New possibilities and opportunities. *International Review of Research in Open and Distributed Learning*, *1*(1), 1-19. https://www.erudit.org/en/journals/irrodl/2000-v1-n1-irrodl05643/1073270ar/abstract/

Samerkhanova, E. K., Bahtiyarova, L. N., Krupoderova, E. P., Krupoderova, K. R., & Ponachugin, A. V. (2019). Creation of a modern digital environment for managing the educational programs in university. In *Growth Poles of the Global Economy: Emergence, Changes and Future Perspectives* (pp. 1263-1273). Cham: Springer International Publishing. https://link.springer.com/chapter/10.1007/978-3-030-15160-7_129

Sandoval-Henríquez, F. J., & Sáez-Delgado, F. (2023). Systematic review on research competencies in higher education students. *Journal Paginas de Educacion,* 16(2), 186–211. https://doi.org/10.22235/pe.v16i2.3340.

Skivko, M. O. (2021). Challenges for modern higher education in the context of social, digital, technological, and sustainable trends. *Sociology of Science & Technology Journal*, *12*(2), 130-142. https://cyberleninka.ru/article/n/challenges-for-modern-higher-education-in-the-context-of-social-digital-technological-and-sustainable-trends

Tatto, M. T. (2021). Developing teachers' research capacity: The essential role of teacher education. *Teaching Education*, *32*(1), 27-46. https://www.tandfonline.com/doi/abs/10.1080/10476210.2020.1860000

Vasyliuk, T. G., Lysokon, I. O., & Shimko, I. M. (2021). Digital educational environment of a modern university: Theory, practice, and administration. In *Digital Humanities Workshop* (pp. 161-168). https://dl.acm.org/doi/abs/10.1145/3526242.3526260

Zhao, B., & Zhou, J. (2024). Research hotspots and trends in digitalization in higher education: A bibliometric analysis. *Heliyon*, *10*(21). https://www.cell.com/heliyon/fulltext/S2405-8440(24)15837-9

Information about the author

Dauletova Ainur, Doctoral student, Institute of Postgraduate Education, M. Auezov South Kazakhstan Research University, Shymkent City, Kazakhstan, Republic of Kazakhstan. ORCID: https://orcid.org/0009-0006-6642-1344. Email: dauletova-ainur@mail.ru. Phone: +7 707 5201201

Aitzhanova Akmaral, Department of General Pedagogy and Psychology, M. Auezov South Kazakhstan University, Shymkent, Republic of Kazakhstan, Email: akmaral1601@list.ru, ORCID ID: https://orcid.org/0009-0009-7323-4258

Kerimbekova Akbope, Candidate of Pedagogical Sciences, Shymkent University, ORCID ID: 0000-0001-7155-9301, Email: kerimbekova- 2026 @mail.ru

Original Article
IRSTI 14.25.05 10.51889/2960-1649.2025.65.4.013

KOSHERBAYEVA AIGERIM[1], ALPYSBAY LAILA[1], BEGIMBETOVA GULDANA[1,2], KOSHERBAEV RINAD[1], ALIPBEK ARDAK[3]*

[1]Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)
[2]Yogyakarta State University (Yogyakarta, Indonesia)
[3]Ozbekali Zhanibekov South Kazakhstan Pedagogical University (Shymkent, Kazakhstan)

*Address of correspondence: Guldana Begimbetova, Pedagogy and Psychology Department, Abai Kazakh National Pedagogical University, Dostyk ave., 13, Almaty, 050010, Republic of Kazakhstan, https://orcid.org/0000-0002-0435-1014, E-mail address: begimbetovaguldana227@gmail.com/Tel.: +77078073213

Developing Educational Competencies of Future Psychologist-Teachers with SACERS Scale

Abstract

Introduction. The research explores the potential of integrating the School-Age Care Environment Rating Scale (SACERS) into pre-service teacher education programmes to enhance future psychologist-teacher competencies in diagnostic evaluation, monitoring, instructional practice, and professional development: methodology and Methods. A mixed method approach was adopted, involving 110 undergraduate students assigned to either an experimental group (n=50) or a control group (n=60). Approximately four weeks later, the experimental group conducted guided assessments of authentic educational settings using the SACERS scale, while the control group followed traditional curricula without exposure to practical evaluation activities. *Results. SACERS*-based training significantly improved students' competencies in diagnosing and evaluating the school environment. *Scientific Novelty*. This research demonstrates that validated instruments like SACERS are effective tools in teacher education, supporting the development of professional competencies and encouraging reflective teaching practices. *Practical Significance.* The approach offers a measurable model for embedding environmental assessment in teacher training, fostering reflective and analytical skills aligned with national and international standards.

Keywords: pedagogical psychologists, school environment assessment, SACERS scale, competencies, education.

Introduction. Contemporary educational research underscores the critical role of the school environment in shaping academic outcomes, social conduct, emotional resilience, and holistic development. A well-structured, safe, and inclusive learning setting not only facilitates cognitive development but also supports students' moral, psychological, and physical growth (Lee et al., 2025). In alignment with these global insights, Kazakhstan's educational policy reforms increasingly prioritize cultivating environments that promote safety, inclusivity, and personal development as foundational conditions for effective teaching and learning.

In today's schools, pedagogical psychologists play a key role in creating healthy learning environments (Sasson et al., 2022). They assess the school's overall atmosphere, identify areas for improvement, and present strategies to build a more positive and inclusive space for students and administrative staff. Their knowledge is especially important for understanding how physical environments, social connections, and psychological aspects interact to influence the educational process (Smaoui et al., 2025). The need for professional psychologists capable of evaluating and improving school settings is growing as classrooms become increasingly multicultural (Fielding et al., 2025).

The state's strategic focus on fostering safe and supportive educational spaces is articulated through various national initiatives, notably the "Comfortable School" program (Gvozdikova & Bryantsev, 2024). This initiative aims to promote

the development of educational institutions that meet modern standards of safety, comfort, and inclusiveness. These programs reflect a growing recognition of the need to cultivate future psychologist teachers who possess not only technical expertise but also the evaluative and empathetic capacities required to conduct nuanced assessments of school environments, ensuring they can meaningfully contribute to the emotional, social, and developmental well-being of every student (Assylbekova et al., 2024).

Enhancing the quality of school environments requires specialized professional skills that address the complexities inherent in educational settings. As noted by Chen et al., (2022), the effective assessment and improvement of learning environments depend on practitioners' ability to integrate cognitive insights with practical application, allowing them to respond effectively to diverse school dynamics. Future psychology teachers must develop competencies that go beyond theoretical understanding, including practical skills in observation, measurement, and analysis. Sukenti & Tambak (2020) emphasize that intentional development of these competencies during pre-service training is essential for preparing educational professionals to critically engage with and adapt to the multifaceted and evolving demands of contemporary learning environments (Yasa, 2022).

Assessing the school environment SACERS scale requires psychologists to evaluate dimensions such as safety, interpersonal relationships, infrastructure, resources, and emotional support systems. This demands proficiency in applying standardized, evidence-based tools and in interpreting results to inform targeted interventions (Ivanova & Vinogradova, 2018). As the educational structure increasingly focuses on a comprehensive, student-centered approach, the emerging role of pedagogical psychologists requires a sophisticated understanding of fields such as environmental psychology, educational principles, and sociology. Their success is reliant not only on their broad knowledge across disciplines but also on their capacity to engage with teachers, administrators, students, and parents to include significant transformation in educational environments (Helmer et al., 2024). Developing these professional skills entails more than just learning technical methods. It involves nurturing ethical perceptiveness, analytical reasoning, and the ability to adapt evaluation approaches to different teaching situations. While (Sukirlan et al., 2020) highlights the importance of training initiatives that integrate real-world, practice-oriented assessment experiences. Such experiential learning ensures that emerging psychologist-teachers possess not only theoretical knowledge but also the essential practical skills to navigate and improve diverse school environments (Effendi & Sahertian, 2023).

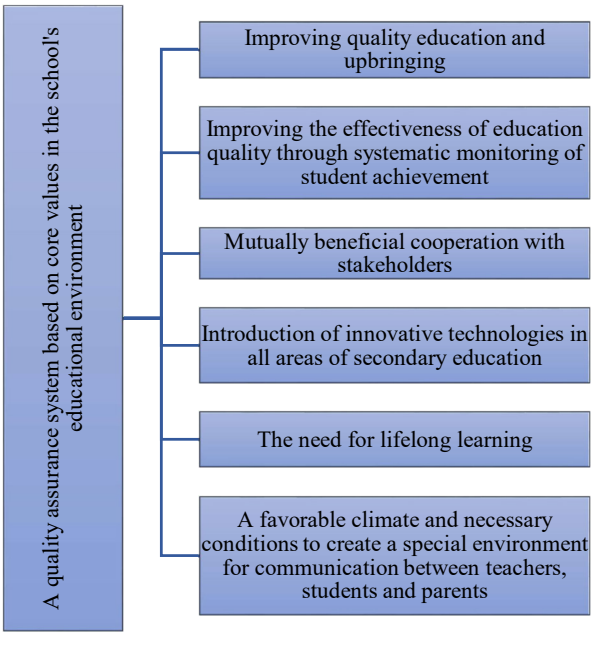
In the era of globalization, educational frameworks worldwide are undergoing significant changes, driven by advances in technology, cultural interactions, and the rising interdependence of communities (Suhardiman et al., 2024). These international phenomena impact teaching methods, curriculum development, and evaluation techniques, highlighting the need to equip learners for a complicated and interwined world. Modern educational models are placing greater emphasis on nurturing skills like critical analysis, innovative thinking, and understanding among future psychologists (Shen et al., 2024). Concepts such as holism, humanism, and planetary responsibility underpin new curricula aimed at fostering global citizens capable of navigating and contributing positively to an interconnected world (Buchan et al., 2024).

The development of global thinking has become essential in contemporary education. Global thinking encompasses intercultural awareness, adaptability, and ethical responsibility, attributes that are increasingly prioritized in education systems worldwide (Aidarov et al., 2020). To foster these competencies, schools are implementing interdisciplinary and integrative teaching models that encourage learners to connect knowledge across domains and engage with global challenges. Educational organizations employ progressive strategies, including interdisciplinary, meta-disciplinary, and synergistic approaches, as well as integrated

curriculum design. These methods enable students to make connections across subject areas, address global challenges critically, and contribute responsibly to both local communities and the broader global society (Bolukbasi et al., 2025).

Figure 1

A quality assurance system based on core values in the school's educational environment



Furthermore, the curriculum design now emphasizes the importance of interdisciplinary and integrative teaching methods. The concept of synergy involves integrating various fields to develop a unified understanding, which is key to this method. It motivates learners to examine intricate issues from diverse viewpoints, developing holistic thinking and the ability to address problems that are essential in the current interconnected world.

Providing educational psychologists with trustworthy tools is crucial for analysing academic settings. The SACERS scale provides an organized framework for assessing safety, facilities, connections, and the comfort atmosphere of schools, supporting evidence-based skills among future specialists (Taşcıoğlu, 2021). The SACERS scale serves as an important tool for generating reliable, data-driven insights that inform strategic improvements in educational processes. Its application in training programs equips future psychologist-teachers with essential skills in environmental diagnostics, including systematic observation, data collection, analytical reasoning, and interpretive synthesis (Jfa et al., 2018). Integrating the SACERS scale into training cultivates critical assessment skills and fosters collaboration with educators, enhancing the ability to generate practical, evidence-based recommendations. It also promotes a systematic understanding of how environmental and social factors shape educational outcomes. By supporting ongoing monitoring and adaptive planning, SACERS scales prepares future psychologist teachers to lead continuous improvements in school climate, aligned with evolving educational needs.

The concept of professional competences in pedagogical psychology has been extensively examined in the pedagogy and psychology literatures, with studies highlighting its significance for teacher education and professional practice (Mytnyk et al., 2023). Importantly, research highlights that competence development is not limited to theoretical knowledge but is strengthened through practical assessment and reflective practice, which foster deeper understanding and transferable skills. Competency-based education, as stated by

Shadan et al., (2025), is needed for integrating practical skills, such as data collection, analysis, and intervention, into curricula. This method aligns with the requirements of educational psychologists, whose success depends on applying theoretical understanding in practical settings.

The School Age Care Environment Rating Scale, developed by researchers (Mulyanti et al., 2024), provides a comprehensive model that encompasses aspects such as physical facilities, safety, social interactions, available resources, and the whole school environment. Programs that use SACERS for training have been found to enhance assessment precision, encourage critical thinking, and strengthen collaborative problem-solving skills among future professionals (Alafnan, 2025). These findings affirm the idea that training focused on practical assessments improves the skills needed for effective evaluation of the school environment.

Materials and Methods. This research adopts a mixed-method, quasi-experimental design, integrating quantitative evaluations of self–development and competency with qualitative data from student reflections and instructor observations. The experimental group has been trained using the SACERS scale, while the control group follows conventional methods. *The research focuses on the following question:* What is the impact of SACERS-based training on the competencies of future psychologists in evaluating and improving school environments? The sample included 110 undergraduate students enrolled in "Psychology of Education" and "Educational Diagnostics" courses. Participants were randomly assigned.

Table 1
Demography of participants

Group	N	Description
Experimental	50	Engaged in SACERS assessment activities in real schools
Control	60	Followed traditional coursework without a practical assessment

The Self-Development Test assesses how students perceive their own growth in motivation, cognition, and operational skills. Competency Assessment Scales: Measure the ability to observe, analyze data, interpret it, and design an appropriate intervention. The SACERS Evaluation Framework assesses school environments from multiple perspectives, including safety, relationships, infrastructure, resources, and school environments A, B, and C. Qualitative Data Collection: Reflective essays and instructor observation logs yield profound insights into students' learning methodologies and the development of future psychologist teachers' professional skills.

Results. The experimental group took the questionnaire before and after the training program, which used the SACERS scale and active assessment methods. Table 1 summarizes the answers, divided into three levels of competency: high, medium, and low.

Table 2
Building skills in assessing and measuring the school environment

№	Questionnaire Questions	High (ET)	Medium (BT)	Low (ET)	High (BT)	Medium (ET)	Low (BT)
1	How do you understand the concept of «school educational environment»? What does it include?	30.4%	47.8%	21.8%	23%	25%	52%
2	Is it necessary to evaluate the school environment? If yes, why?	32.3%	40.2%	27.5%	24%	30%	46%
3	Name and describe the course on evaluating the school environment.	37.9%	43.8%	18.3%	30%	30%	40%
4	What criteria can be used to evaluate relationships between the school staff and students?	38.2%	50.8%	11%	32%	42%	26%

5	How was your relationship with school teachers built? How did you measure it?	36.5%	40.8%	22.7%	27%	32%	41%
6	Was there any bullying among students in the school environment?	33.4%	45.9%	20.7%	22%	28%	50%

At first, a large number of students (47.8%) showed a medium level of understanding. After the training, there was a slight increase in the percentage of students with a high level of understanding, indicating they were improving in understanding the school environment.

The responses show a positive trend, with more students recognizing the importance of evaluating the educational environment after training. More students now regard evaluation as helpful, indicating that more people are becoming aware of its role in helping schools progress. The students' understanding of the curriculum content related to environmental assessment also increased, with a significant rise in the number who could succinctly define relevant courses. Evaluation of teacher-student interactions: The capacity to assess relationships was enhanced, with more students applying suitable criteria post-training. Bullying detection and intervention: Awareness and the capacity to identify bullying incidents have greatly improved, evidenced by a notable increase in replies reflecting proactive detection and intervention measures.

Instructing these subjects during the formative stage profoundly influences the evolution of students' general pedagogical and professional cognitive competencies. To enhance students' general pedagogical and professional cognitive competences, we have undertaken systematic efforts in the "Cognitive direction of developing the competencies of future pedagogical psychologists in measuring and evaluating the school educational environment."

The cognitive direction "Development of the competencies of future pedagogical psychologists in measuring and evaluating the educational environment of the school" aims to enhance the skills of prospective pedagogical psychologists in their 1st to 4th years through subject matter focused on assessing and measuring the school environment. The primary objective of the experiment in this domain was to assist prospective pedagogical psychologists in improving their proficiency in measuring and evaluating the educational environment. The cognitive direction is shown in Table 3.

Table 3

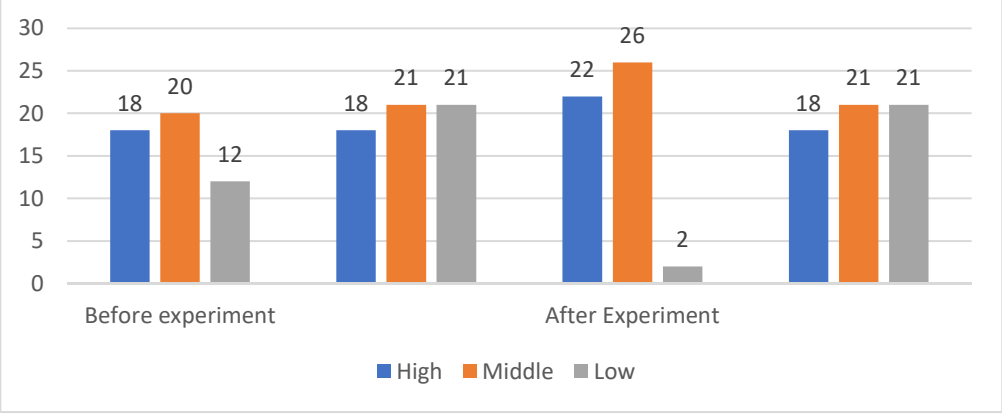
Outcomes of practical and experimental endeavors in the "cognitive" domain

Levels	Experimental group % (50 students)	Control group % (60 students)	Experimental group % (50 students)	Control group % (60 students)
	Before experiment		After experiment	
High	18 (37.2%)	18 (30.5%)	22 (44%)	18 (30.5%)
Middle	20 (41.2%)	21 (35.5%)	26 (52%)	21 (35.5%)
Low	12 (21.6%)	21 (34%)	2 (4%)	21 (34%)

Table 3 shows that the research conducted in the initial phase of the methodological program has produced favorable outcomes and validated the efficacy of the formation process. It is also clear that the dynamics of the production of research work in the first direction of the methodological program are rising, indicating that it is developing. Figure 2 shows.

Figure 2

Dynamics of competency development in the school environment evaluation



It is evident from the preceding figure that substantial progress has been achieved in developing competencies among future educational psychologists in measuring and evaluating the school's educational environment, compared with the exploratory experiment. These findings are supported by the diagnostic results used to determine the level of personal development. As a result of the survey, we note the development of knowledge regarding the competencies of future educational psychologists in measuring and evaluating the school's educational environment. According to the survey results, 36.7% of students gave correct answers.

Table 4

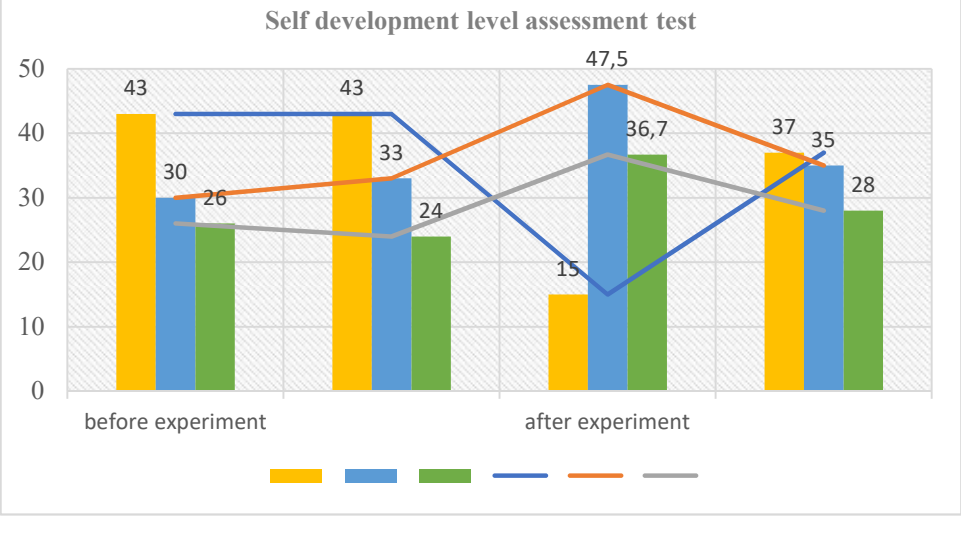
Outcomes of the assessment to ascertain the degree of personal growth

Self-development level assessment test		Experimental group before experiment	Control group	Experimental group after experiment	Control group
Level	low	43	43	15	37
	middle	30	33	47.5	35
	high	26	24	36.7	28

The dynamics of the self-development of future educational psychologists are depicted in a diagram (Figure 3).

Figure 3

The self-development dynamics of future educational psychologists



The formative experiment resulted in an increased percentage of positive indicators within the experimental group. This outcome suggests that intentional engagement in self-development and self-exploration enables future pedagogical psychologists to enhance their ability to assess and evaluate the school educational environment, thereby meeting societal expectations. Consequently, through this approach, we have identified the subsequent components of the competences required for future educational psychologists in assessing and evaluating the educational environment of the school.

Table 5

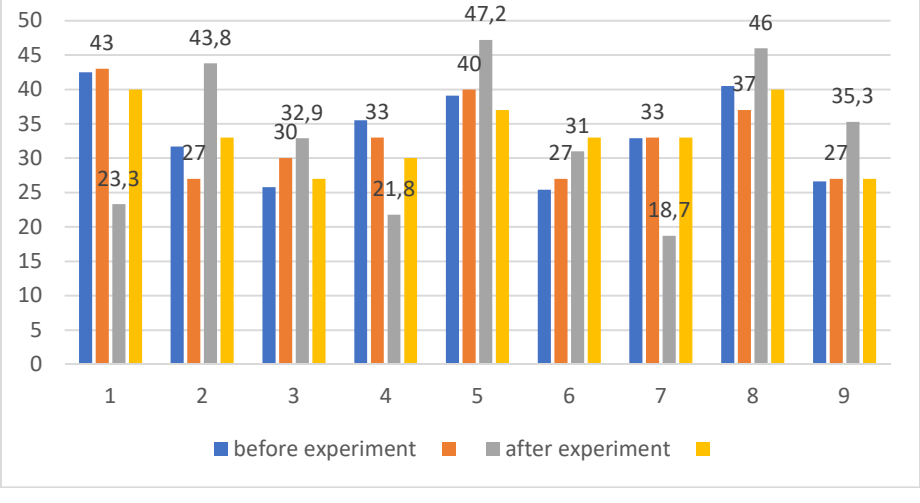
Results by components of future psychologists' competencies in evaluating the school environment

Indicators	Levels	Experimental group	Control group	Experimental group	Control group
		Before testing		After testing	
		42.5		43	
Motivational	low	31.7	27	23.3	40
	middle	25.8	30	43.8	33
	high	35.5	33	32.9	27
Cognitive	low	39.1	40	21.8	30
	middle	25.4	27	47.2	37
	high	32.9	33	31	33
Procedural	low	40.5	37	18.7	33
	middle	26.6	27	46	40
	high	26.6	26.6	27	35.3

Table 5 demonstrates that the experimental group exhibited greater growth at the middle and high levels in motivational, cognitive, and procedural competencies, while the proportion of students at the low level declined significantly. In contrast, the control group experienced only modest changes, indicating that the implemented technique was effective in enhancing the competencies required for future pedagogical psychologists to assess and evaluate the school educational environment.

Figure 4

Competency outcomes of future psychologists in school environment evaluation



The graphic shows that the experimental group's performance on the components went up following the formative experiment. The results of the work performed by students on self-assigned tasks in developing the competencies of future pedagogical psychologists in measuring and evaluating the school educational environment, psychological trainings on the SACERS scale "Relationship and Interaction" conducted on various topics, and systematic work on measuring and evaluating the school educational environment in all types of pedagogical practice have shown a change in the level of development of the competencies of future educational psychologists.

Comparing Schools on the SACERS' Seven Main Aspects: The evaluation was carried out in three schools, which future pedagogical psychologists observed and researched as part of their training. This provided an authentic context for applying SACERS and analyzing the quality of the educational environment.

Table 6

Means comparison of SACERS dimensions

ID	Space Furnish	Health Safety	Activities	Interactions	Program Structure	Staff Develop	Special Needs	Overall
Sch.A	5.111	6.75	5.000	5.444	5.000	6	5.571	5.553
Sch.B	4.000	6.00	5.250	6.111	6.000	6	3.429	5.255
Sch.C	5.444	6.50	5.375	6.778	6.667	7	5.429	6.170

Table 6 shows the mean scores for each of the three schools across the seven main aspects, scored on a scale of 1 to 7, with higher scores indicating better implementation of SACERS standards as follows:

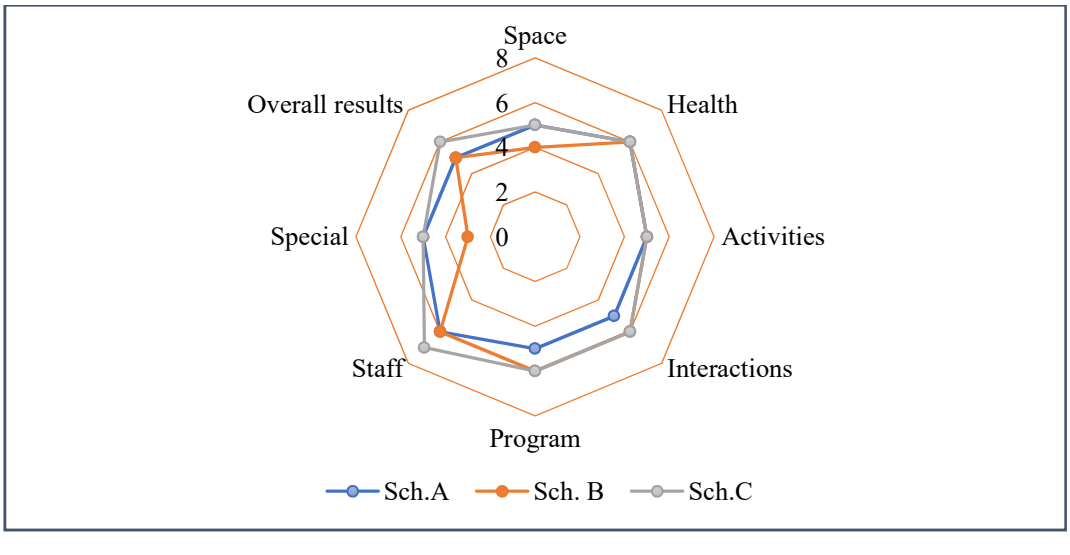
School A: demonstrates strong performance in *Health & Safety* (6.75, ranked first), and solid scores in *Furnish*, *Safety Development*, and *Special Needs*. Its weakest aspect is *Activities,* with a score of 5.000, indicating room for enhancement in activity planning and implementation.

School B: performs well in *Interactions* and *Program Structure* but lags notably in *Special Needs* with a score of 3.429, highlighting a potential gap in accommodating students with special needs.

School C: outperforms its peers across six aspects, notably scoring 7.000 in *Staff Development*, and has the highest overall score of 6.170, reflecting comprehensive implementation of SACERS standards.

Figure 5

Radar Chart of SACERS Dimension Scores Across Schools



Ranking Schools according to performance on each aspect: The best is Sch. C, ranking first for six aspects except for 'Health and Safety' (6.50 out of 7); it scored 6.170 out of 7. If we convert this score into percentages, with all seven aspects, the ideal score is 49, and the sum of the scores on each aspect is 43.193. The percentage becomes.

$$Score\ in\ \% = \frac{43.193x100}{49} = 88.148\%$$

Table 7

School results in percentages

School	%
Sch.A	79.33878
Sch. B	75.08163
Sch. C	88.14898

Sch. C has implemented the SACERS requirements at a rate of %, compared to Sch. A, whose implementation level is 79.33%, and Sch. B, with just 75.08%.

Figure 6

Comparative histogram of mean SACER scores across schools

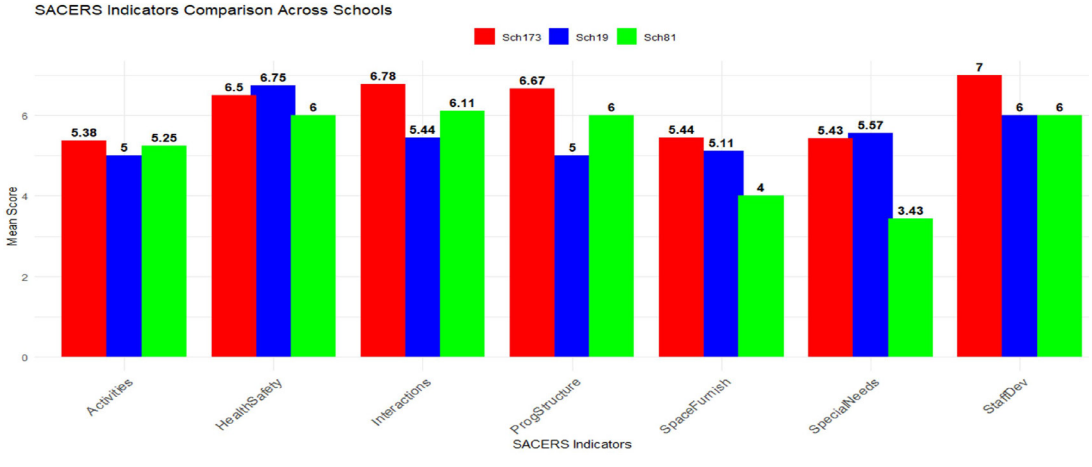


Figure 6 shows a histogram that highlights these disparities. School C is clearly in charge, as evidenced by no scores below 5, indicating that the implementation is consistently of excellent quality. On the other hand, School B has lower scores, especially in Special Needs, with some ratings in the ≤4 range. This implies that there is room for growth in some areas. The high ICC value indicates that the assessment ratings are consistent across evaluators, thereby making the conclusions more reliable. The quantitative comparison shows that School C has successfully incorporated SACERS standards at an implementation level of nearly 88%, which is better than both School A and School B.

These results suggest that the school with the highest implementation rate, School C, likely benefits from more comprehensive and effective interventions derived from the SACERS assessment results. This alignment of high implementation with better overall scores strongly supports the premise that thorough adherence to SACERS standards facilitates the development of a safe, supportive, and well-structured school environment. The discrepancies identified in School B, particularly regarding the Special Needs aspect, underscore critical areas for targeted intervention. Addressing these weaknesses can raise overall standards and promote more inclusive and supportive school environments. After the training, students exhibited enhanced assessment and critical thinking skills, increased practical competence, and improved self-reflection. These outcomes demonstrate the effectiveness of SACERS-based training in developing the core competencies of future pedagogical psychologists.

Discussion. The results of this thorough study show how important SACERS-based

training and assessment are for helping future pedagogical psychologists enhance their skills and make schools better places to be. This research aligns with (Zhundybayeva et al., 2024), as schools with high SACERS scores show excellent and outstanding distributions of 'Staff Development', 'Program Structure', 'Interaction', and 'Activities'. The incorporation of practical, real-world assessment activities has yielded beneficial outcomes on students' comprehension, abilities, and self-esteem, which are crucial for effective evaluation and intervention in educational settings. Quantitative results show that students' skills have clearly improved following SACERS-based training.

As stated by Parczewska (2020), SACERS scores are a useful instrument for evaluating the educational surroundings of Moscow schools, but on the contrary, comprehensive assessments revealed that Polish school common rooms fail to comply with SACERS standards regarding health and safety and instructional activities. The higher percentage of students achieving high proficiency levels, as evidenced by assessment and component-specific analyses, underscores the efficacy of experiential learning methodologies in cultivating critical observation, data analysis, and intervention planning competencies. The upward trend in self-development ratings suggests that direct contact with school environments improves students' motivation, self-awareness, and professional identity- elements essential for sustained engagement and eventual career success.

Competency-based education promotes the integration of practical skills, including data collection, analysis, and intervention, into the curriculum (Kosherbayeva et al., 2024). This approach aligns with the requirements of pedagogical psychologists; its efficacy depends on applying theoretical knowledge to practical scenarios. International research suggests that assessment methods like SACERS are necessary to improve schools. For instance, a comprehensive environmental assessment can enhance school safety and inclusivity (Imanian et al., 2019). It also suggests that trained psychologists who use standard techniques may identify problems more easily and advise the best ways to fix them. Psychologists who can apply thorough and trustworthy tools to assess complicated school settings.

However, these findings indicate that assessment-driven experiential training is crucial for enhancing the professional competencies of pedagogical psychologists in the future. The findings indicate that a comprehensive assessment using reliable instruments such as SACERS can yield insights into effective intervention techniques that lead to tangible enhancements in the educational environment. The outcomes of this research corroborate the existing literature, which underscores the significance of experiential and hands-on learning for professional advancement. They also stress that these strategies can improve the school atmosphere in a way that lasts.

Conclusion. The findings indicate that integrating structured assessment methods, such as SACERS, into the curriculum substantially enhances the essential competencies of prospective psychologist-educators. Qualitative data revealed improvements in confidence, critical thinking, and reflective capacity, while quantitative results demonstrated significant gains in diagnostic, supervisory, and training abilities. These outcomes suggest that assessment-driven experiential learning is vital for bridging gaps between theory and practice in teacher preparation programs. Assigning real evaluation tasks enables the development of reflective practitioners capable of assessing and improving educational environments.

This research contributes to the development of individual competencies and informs evidence-based reflective practices in curriculum design, policymaking, and broader educational objectives. The findings support the recommendation that teacher and psychologist training programs consistently incorporate validated assessment scales, promote experiential learning, and encourage reflective practice. These measures will better equip future professionals to address the complex needs of contemporary schools, ultimately fostering healthier school communities and improved student learning outcomes.

Acknowledgment. This research was conducted within the framework of the scientific project GF IRN AP19678780 "Theory and technology of complex psychological and pedagogical assessment of the developing potential of the educational environment of a school using the international SACERS scales (modified version)."

References

Aidarov, B. Z., Kamalov, Y. N., & Tangkish, N. P. (2020). Development Factors of the Lecturers' Professional Mobility in System of Higher Education in Kazakhstan. *European Journal of Contemporary Education*, *9*(3), 490-504. https://eric.ed.gov/?id=EJ1272617

Alafnan, M. A. (2025). Enhancing educational outcomes using AlAfnan taxonomy: integrating cognitive, affective, and psychomotor domains. *International Journal of Evaluation and Research in Education*, *14*(3), 2419-2437. https://www.researchgate.net/profile/Mohammad-Alafnan/publication/391602094_Enhancing_educational_outcomes_using_AlAfnan_taxonomy_integrating_cognitive_affective_and_psychomotor_domains/links/681ec027d1054b0207ed3844/Enhancing-educational-outcomes-using-AlAfnan-taxonomy-integrating-cognitive-affective-and-psychomotor-domains.pdf

Assylbekova, M., Saikhymuratova, I., Atmaca, T., Somzhurek, B., & Slambekova, T. S. (2024). Hidden wounds: unveiling the impact of social ostracism and bullying in university life (comparison of Kazakhstan and Türkiye). *Cogent Education*, *11*(1), 2434774. https://www.tandfonline.com/doi/abs/10.1080/2331186X.2024.2434774

Bolukbasi, S., Yilmaz, N. D., Aykar, F. S., & Sahin, S. (2025). Assessment of social workers' educational needs in geriatric competencies and attitudes towards older adults. *BMC Medical Education*, *25*(1), 432. https://link.springer.com/article/10.1186/s12909-025-06970-w

Buchan, M. C., Bhawra, J., & Katapally, T. R. (2024). Navigating the digital world: development of an evidence-based digital literacy program and assessment tool for youth. *Smart Learning Environments*, *11*(1), 8. https://link.springer.com/article/10.1186/s40561-024-00293-x

Chen, J., Li, D., & Xu, J. (2022). Sustainable development of EFL teachers' technological pedagogical content knowledge (TPACK) situated in multiple learning activity systems. *Sustainability*, *14*(14), 8934. https://www.mdpi.com/2071-1050/14/14/8934

Effendi, Y. R., & Sahertian, P. (2023). Principals' academic supervision based on humanistic spiritual values to increase student achievement motivation. *International Journal of Innovation and Learning*, *34*(1), 59-80. https://www.inderscienceonline.com/doi/abs/10.1504/IJIL.2023.132055

Fielding, A., Mundy, B., Tapley, A., Gani, S., Ali, R., Bentley, M., ... & Magin, P. (2025). Educational utility of observational workplace-based assessment modalities in Australian vocational general practice training: a cross-sectional study. *BMC Medical Education*, *25*(1), 762. https://link.springer.com/article/10.1186/s12909-025-07328-y

Gvozdikova, T. A., & Bryantsev, A. A. (2024). Modern Educational Space as a Result of the Reconstruction of School Buildings. *Bulletin of the Kazakh Leading Academy of Architecture and Civil Engineering*, *4*(94), 52-63. https://vestnik.mok.kz/index.php/vestnik/article/view/200

Helmer, J., Durrani, N., Mir, G., Polat, F., Karimova, N., & Qanay, G. (2024). Navigating homeschooling, parenting, and work during an educational emergency: Insights from Kazakhstan. *Sage Open*, *14*(4), 21582440241307440. https://journals.sagepub.com/doi/abs/10.1177/21582440241307440

Imanian, M., Tahmasebi, S., Biglaryan, A., Abdi, K., Teymouri, R., & Karimzadeh, M. (2019). Health and Safety Situation at Non-Public Primary Schools. *Malaysian Journal of Public Health Medicine*, *19*(2), 179-188. http://www.mjphm.org/index.php/mjphm/article/view/340

Ivanova, E. V., & Vinogradova, I. A. (2018). Scales SACERS: Results of the Study of the Educational Environment of Moscow Schools. *European Journal of Contemporary Education*, *7*(3), 498-510. https://eric.ed.gov/?id=EJ1192104

Jfa, M., Stigma, O. M., & Jfa, M. (2018). Spatial Stimulating as a Bio-Political Process: The Example of Hacihüsrev Egemen Yilgür. https://doi.org/10.4305/METU.JFA.2018.1.5

Kosherbayeva, A., Alipbek, A., Kosherbayev, R., Baimahova, A., & Niyazova, A. (2024). Effective Ways of Modernization and Internationalization of Education in Kazakhstan. *Bulgarian Comparative Education Society*. https://eric.ed.gov/?id=ED656192

Lee, Y., Sung, S., & Fan, X. (2025). Cultural competency education for healthcare professionals: an umbrella review. *BMC Medical Education*, *25*(1), 1445. https://link.springer.com/article/10.1186/s12909-025-08008-7

Mulyanti, R. Y., Wati, L. N., Tusminurdin, U., & Soma, A. M. (2024). Determinants of teacher digital competence: Empirical evidence of vocational schools in Indonesia. *International Journal of Data and Network Science*, *8*(3), 1517-1530. https://www.growingscience.com/ijds/Vol8/ijdns_2024_56.pdf

Mytnyk, A., Ivashkevych, E., Chanchykov, I., Predko, V., & Stakhova, O. (2023). Professional training of future psychologists in the information space in higher education institutions. *Amazonia Investiga*, *12*(61), 112-121. https://www.amazoniainvestiga.info/index.php/amazonia/article/view/2246

Parczewska, T. (2020). The quality of care for 5–9-year-old children in the school environment in Poland measured with the use of the SACERS scale. *Education 3-13*, *48*(5), 541-549. https://www.tandfonline.com/doi/abs/10.1080/03004279.2019.1629607

Sasson, I., Yehuda, I., Miedijensky, S., & Malkinson, N. (2022). Designing new learning environments: An innovative pedagogical perspective. *The Curriculum Journal*, *33*(1), 61-81. https://bera-journals.onlinelibrary.wiley.com/doi/abs/10.1002/curj.125

Shadan, M., Shalaby, R. H., Ziganshina, A., & Ahmed, S. (2025). Integrating portfolio and mentorship in competency-based medical education: a Middle East experience. *BMC Medical Education*, *25*(1), 36. https://link.springer.com/article/10.1186/s12909-024-06553-1

Shen, J., Qi, H., Liu, G., Li, X., & Fang, Y. (2024). The impact of a curriculum-based research training program on medical students' research productivity and future research interests: a longitudinal study. *BMC Medical Education*, *24*(1), 836. https://link.springer.com/article/10.1186/s12909-024-05841-0

Smaoui, S., Ganesan, S., & Williams, T. (2025). Dysphagia education in Addis Ababa, Ethiopia: student self-competency ratings during their dysphagia course. *BMC Medical Education*, *25*(1), 737. https://link.springer.com/article/10.1186/s12909-025-07365-7

Suhardiman, S., Putro, N. H. P. S., Hakiki, M., & Fadli, R. (2024). Using the Buana Online Course web-based mobile application to improve English for specific-purpose engineering courses. *International Journal of English Language and Literature Studies*, *13*(3), 449-463. https://ideas.repec.org/a/asi/ijells/v13y2024i3p449-463id5189.html

Sukenti, D., & Tambak, S. (2020). Developing Indonesian Language Learning Assessments: Strengthening the Personal Competence and Islamic Psychosocial of Teachers. *International Journal of Evaluation and Research in Education*, *9*(4), 1079-1087. https://eric.ed.gov/?id=EJ1274676

Sukirlan, M., Raja, P., Setiyadi, A. B., & Agustin, F. (2020). Developing Strategy Use and Language Performance through Implicit Strategy Training. *Humanities and Social Sciences Letters*, *8*(2), 191-201. http://repository.lppm.unila.ac.id/id/eprint/26607

Taşcıoğlu, E. (2021). States of exception: Legal governance of trans women in urban Turkey. *Social & Legal Studies*, *30*(3), 384-404. https://journals.sagepub.com/doi/abs/10.1177/0964663920924780

Yasa, I. N. (2022). Utilisation of university E-learning-assisted social media in learning contemporary Indonesian literature. *World Journal on Educational Technology: Current Issues*, *14*(5), 1259-1278. https://www.ceeol.com/search/article-detail?id=1074297

Zhundybayeva, T., Nametkulova, F., Sugirbekova, A., & Orakova, A. (2024). Comparison of Motivation and Job Satisfaction of Teachers Working in Schools with Low and High International SACERS Scale Scores. *Journal of Curriculum Studies Research*, *6*(2), 177-195. http://www.curriculumstudies.org/index.php/CS/article/view/391

Information about authors:

Kosherbayeva Aigerim, Doctor of Pedagogical Sciences, Professor, Abai Kazakh National Pedagogical University. ORCID ID: 0000-0002-3307-9814.Email: aigera63@mail.ru

Alpysbay Leila, Master of Pedagogical Science, Doctoral Candidate, Abai Kazakh National Pedagogical University. ORCID ID: 0009-0006-4881-8719 Email: alpysbai.laila78@mail.ru

Begimbetova Guldana, Master of Pedagogical Science, Doctoral Candidate, Abai Kazakh National Pedagogical University; Yogyakarta State University. ORCID ID: 0000-0002-0435-1014.Email: begimbetovaguldana227@gmail.com

Kosherbayev Rinad, PhD, Lecturer, Abai Kazakh National Pedagogical University. ORCID ID: 0000-0002-3851-2242 Email: rinad77@mail.ru

Alipbek Ardak, PhD, Associate Professor, Ozbekali Zhanibekov South Kazakhstan Pedagogical University. ORCID ID: 0000-0003-2633-9451.Email: alipbek_ardak@mail.ru

Original Article
IRSTI 14.29.27 10.51889/2960-1649.2025.65.4.014

ILYASSOVA LIRA[1], GUNDUZ SAMETTIN[2], SHOLPANKULOVA GULNAR[3]*

[1,3]L.N. Gumilyov Eurasian National University (Astana, Kazakhstan)
[2]Bolu Abant Izzet Baysal University (Bolu, Turkey)

*Address of correspondence: Lira Ilyassova, Department of Pedagogy, L.N. Gumilyov Eurasian National University, Yanushkevich Str., 6, Astana, 010000, Republic of Kazakhstan.
https://orcid.org/0009-0005-9149-5065, E-mail: lira.lira.8282@mail.ru/Tel: 87016210368

Developing Reflexive Skills in Future Social Educators for Enhancing Their Acmeological Competence

Abstract

Introduction. This paper examines the level of reflexive skills among prospective social educators as a foundation for developing acmeological competence. Acmeological competence is essential in the training of social educators, as it enhances their professional competitiveness and effectiveness. This study aimed to explore the significance of reflective skills in the development of acmeological competence among future social educators, as well as to assess the current level of their reflective skill formation. *Methodology and Methods.* To achieve this, the authors conducted a theoretical analysis of existing literature and utilized a survey method to gather data from prospective social educators. *Results.* The findings indicate that while the respondents demonstrate an awareness of their strengths and weaknesses, there remains a need for further development in areas such as critical thinking, value awareness, and other key reflective dimensions. *Scientific novelty.* The study highlights the necessity of designing and implementing specialized techniques or training programs to foster reflective abilities within the educational process for social educators. To achieve higher levels of professional accomplishment, social educators must be able to adjust their behavior, clearly understand their goals, and evaluate their outcomes. *Practical significance.* Without well-developed abilities in self-awareness and self-understanding, the growth of their professional identity and expertise becomes unattainable.

Keywords: reflexive skills, social educators, acmeological competence, training, professional competence, foundation.

Introduction. Modern society demands the highest professional training from social educators, whose activities are aimed at accompanying and supporting the individual in the process of their development and socialization. In the context of rapid socio-cultural changes, the development of acmeological competence as an integrated characteristic of a specialist, guaranteeing his or her professional and personal growth, the drive for self-improvement, and reaching professional heights, is especially important in the context of fast changes. The acmeological component in the context of training social instructors refers to an integral characteristic that encompasses professional knowledge, skills, personal qualities, and a commitment to continuous self-development. It involves not only mastering theoretical knowledge and methodologies but also the ability to apply them effectively in practice, adapt to changing conditions, solve professional tasks independently, and engage in long-term personal and professional growth.

The development of reflexive skills, which enables future social educators to acknowledge their own experiences, analyze their professional activities, pinpoint their strengths and weaknesses, and create plans for both professional and personal growth, is one of the most crucial prerequisites for the formation of acmeological competence. In addition to being a tool for self-awareness, prospective social educators' reflexive abilities are seen as the cornerstone of long-term professional growth that helps them accomplish academic goals.

Enhancing reflexive abilities is a crucial part of forming the academic component of future social educators. The ability to self-analyze and conceptualize an action is known as reflexive skills, and it enables aspiring social educators to evaluate their work critically, see issues, and come up with solutions. All of these abilities support the professional development and attainment of professional excellence of prospective social educators. The following factors determine the need to study this problem: first of all, contemporary society places high demands on social educators, expecting them to demonstrate exceptional professional competence, a capacity for self-analysis, critical reflection on their experiences, and a commitment to continuous professional growth. In this context, a specialist equipped with well-developed reflexive skills can evaluate the outcomes of their work, make necessary adjustments, and strive toward higher standards of professional excellence.

Secondly, the acmeological approach implies that professional excellence is the outcome of both personal and professional development, representing an individual's aspiration to reach their "acme"- the highest level of growth. However, it is impossible to construct a meaningful self-development plan without self-knowledge, self-evaluation, and self-regulation. Therefore, reflexive skills are considered a foundational component of acmeological competence in prospective social educators. The study of prospective social educators is contemporary, relevant, and in demand. It makes it possible to provide the pedagogical community with specialized instruments for raising the caliber of professional training in addition to expanding theoretical knowledge of a specialist's professional growth. The purpose of this article was to demonstrate the value of reflective skills in the process of developing future social educators' acmeological competence and to determine the degree of reflective skill formation to support future social educators' growth within the framework of acmeological competence.

The term acmeology originates from the Greek word "acme", meaning "peak" or "highest point", and the phrase "en akmy", which is translated as "at the height" or "in full bloom", referring to the highest stage of development. Acmeology is an interdisciplinary science that explores the optimal development of individuals or groups and the conditions that contribute to achieving their highest potential (Beysman, 1991). Kuzmina (2022) was among the first researchers to introduce the concept of acmeology within the framework of human studies and pedagogy, emphasizing its anthropological foundations in self-improvement and reflection. This gave rise to two interconnected directions of a single idea: the study of the human being and the dynamics of their development. From this concept emerged a tendency toward progress - a striving for personal growth through the enhancement of behavior, knowledge, abilities, and skills (Kuzmina, 2022).

Based on these foundations, scholars started investigating the possibility of systematizing and implementing this path toward both professional and personal greatness. As a result, the idea of acmeological competence, which represents a person's ability to reach their full potential to the greatest degree of both personal and professional functioning, was developed. The concept of acmeological competence was explored by Abdalina (2009), who argues that it encompasses the ability of educators to actualize their personal potential through self-realization, self-improvement, self-development, and self-determination. Dereka (2016) concludes that educators should gain acmeological competence in order to reach the heights of professional excellence and fulfillment in the professional activity. The educational process should be aimed at developing acmeological competence (its motivational, cognitive, activity, and personal components), development of professionalism, and their ability to self-improvement. Acmeological competence is the integrated personality activity quality that allows educators to set and effectively solve the different levels of complexity problems for the sake of self-improvement and self-realization in the professional field (Dereka, 2016).

Halima & Ulugbek (2022) devoted their research to the issues of effective realization

of acmeological component in education and considered the importance of acmeological approach in the development of education and in the training of students for professional activities on the basis of acmeological approach. Yessenamanova et al., (2022) studied the level of acmeological competence of social educators. Through their research, they found out that there is an average positive correlation between the level of motivation and the level of propensity to take risks. The results of this work indicate the need for further scientific research on the issue of acmeological competence, not only of social teachers, but also of other educators, to achieve heights in personal development and improve the learning process. Their research concluded that in the future, the types of motivation and methods (self-motivation, affirmation, visualization) should be researched. To our mind, this list should be added by reflexive skills as well (Yessenamanova et al., 2022).

In the context of acmeological competence, reflexive abilities play a crucial role. For social educators, these skills are fundamental to professional growth and effective across diverse educational environments. Reflexive skills involve the capacity to critically reflect on personal and professional experiences, adapt practices accordingly, and engage in ongoing self-evaluation. This continuous process not only fosters personal development but also enhances educators' interactions with students and the broader community (Pillay et al., 2023). Acmeological reflection is one of the key factors in the growth of self-awareness. She highlights that educators may reach a better degree of professional and personal development by thoroughly comprehending their own experience and analyzing their accomplishments. The development of a comprehensive self-perception, which serves as the foundation for long-term motivation and self-realization, is facilitated by acmeological contemplation (Ryiabisheva, 2012).

The process of reflection on teaching and learning emphasizes critical thinking, self-awareness, and the creation of fresh, insightful understandings. In order to prepare students for cooperation, professional identity development, and building links with the outside world, educators work to instill in them the abilities of reflection and reflexivity. When students work in groups and reflect on their own and other members' activities as well as the dynamics within the group, it is beneficial to design courses that integrate the use of reflection (Dutta et al., 2023). Indrasiene et al., (2023) consider critical reflection as the combination of new information and study material with personal experience, which results in a fresh perspective on oneself, one's education, one's research, and environmental phenomena. According to Usaki (2009), the abilities that students should acquire before the start of the school year, such as interacting, introducing themselves, and asking questions, are known as social skills. Teachers can acquire those abilities. For educators, reflective teaching is crucial. Throughout their lesson, teachers observe everything in the classroom. They consider the goals and aims to be achieved, conduct unbiased observations, and then vary the approaches in light of the classroom environment. One of the most often used strategies that has been researched recently is reflective teaching (Usaki, 2009).

Working on self-use with social education professionals from the very beginning of their training is frequently seen as an essential component of their professional and personal growth, according to Pallisera et al., (2013). Even yet, it is challenging to locate mentions of initiatives and experiences that have been carried out from this angle. Their study sought to improve students' professional identities and self-awareness by applying the reflective learning paradigm before their hands-on job experience. Their study pinpointed the advantages and disadvantages of students' reflective skills while contextualizing the experience of educating social educators in Spain (Pallisera et al., 2013). Christensen et al., (2020) consider reflexive skills as a component of social educators' reflective abilities, which allow them to better comprehend both themselves and others in certain social contexts. Transformative learning results from this process, which encourages critical evaluation of prior experiences and

raises understanding of how social settings affect behavior and cognition (Christensen et al., 2020).

Developing reflective abilities throughout professional training is essential since reflection is a critical teaching attribute that is required for successful professional activity. This idea was analysed in the scientific article written by Usheva et al., (2020). They suggest that developing these abilities through educational programs and by establishing the following pedagogical conditions: training in the analysis of pedagogical activities from various perspectives; educational activities within individual educational programs; educational dialogue during training; and subject-subject relations through educational interaction. These authors think that ability to evaluate and appropriately perceive oneself, to identify and analyze the reasons behind one's behavior, as well as its performance elements and mistakes, to comprehend one's own qualities in the present as compared to the past and to predict the prospects for further development, to comprehend the reasons behind another person's actions during interaction, to analyze experienced situations, and to take into account the actions of others within your behavioral strategies are all examples of reflexive skills, which are thought to be an essential and meaningful quality of a teacher (Usheva et al., 2020). The ideas put forward by earlier researchers were further supported by Kurniati and Nuraeningsih (2019), who emphasized that teachers should engage in reflective teaching. Reflective teaching involves critically analyzing classroom experiences and considering alternative strategies for achieving educational goals and objectives. According to their view, reflective teaching serves as an essential tool for continuous professional development (Kurniati and Nuraeningsih, 2019) As future social educators constantly engage with diverse groups of students and encounter a wide range of social, emotional, and ethical challenges, the ability to recognize their own attitudes, assess the effectiveness of their actions, and adapt their behavior to specific contexts becomes essential. Reflective practice not only fosters professional growth but also plays a crucial role in building trustful and respectful relationships with clients (Kurniati and Nuraeningsih, 2019).

Through reflection, social educators cultivate empathy, critical thinking, and self-regulation competencies required for effective and sustainable professional practice. The ability to step outside oneself and critically reassess one's perception of reality lies at the core of reflective processes. This capacity is especially crucial for future social workers, as they are constantly engaged with diverse individuals and must navigate a range of social, emotional, and ethical challenges. The ability to recognize one's own beliefs, evaluate the effectiveness of one's actions, and adapt behavior in response to situational demands fosters both personal and professional development. Through reflection, aspiring social workers cultivate empathy, critical thinking, and self-regulation - key competencies essential for effective and sustainable professional practice. Without the capacity for self-analysis, meaningful personal growth is fundamentally unattainable.

Materials and Methods. A quantitative method was employed in the research. The primary objective of our study was to highlight the significance of reflective skills in the development of acmeological competence among future social educators and to assess the extent to which these skills are formed. A review of the theoretical foundations of the concepts of acmeological competence and reflective skills, as well as the relationship between them, revealed a gap in this area of research. From our perspective, identifying the level of reflective skills in prospective social educators provides a comprehensive understanding of the issue and enables us to offer recommendations for further advancement in this field.

To achieve this goal, we conducted a survey aimed at assessing the level of reflective skills among future social educators. The purpose of the survey was to determine the degree of development of these skills to support their further enhancement within the framework of acmeological competence. The survey was structured into five blocks, each containing five statements, making a total of 25 items.

Responses were collected using a Likert scale, which included the following options: 1 – completely disagree; 2 – rather disagree; 3 – difficult to answer; 4 – rather agree; 5 – completely agree.

The participants of this study were prospective social educators (Bachelor's degree) from three universities across Kazakhstan. These are L.N.Gumilyov Eurasian National University, Abai Kazakh Pedagogical University named Abai, and Al. Farabi Kazakh National University. A total of 50 students responded to the survey. Since the number of students enrolled in the "Social Pedagogy" program is relatively small, respondents were selected from all academic years, from first to fourth year. The following table gives the information about the number of respondents from each university.

Table 1

The number of respondents from each university

L.N. Gumilyov Eurasian National University	Abai Kazakh National Pedagogical University	Al.Farabi Kazakh National University
23	17	10

Since the students were from different academic years, their ages also varied, ranging from 18 to 32. The following table gives the information about the age of respondents.

Table 2

The information about the age of respondents

18	19	20	21	22	24	32
5	16	14	12	1	1	1

Among the 50 respondents, only four were male, while the remaining 46 were female. This reflects the fact that the "Social Pedagogy" specialty is predominantly chosen by female students. The following table gives the information about the academic year of participants.

Table 3

The information about the year of the respondents

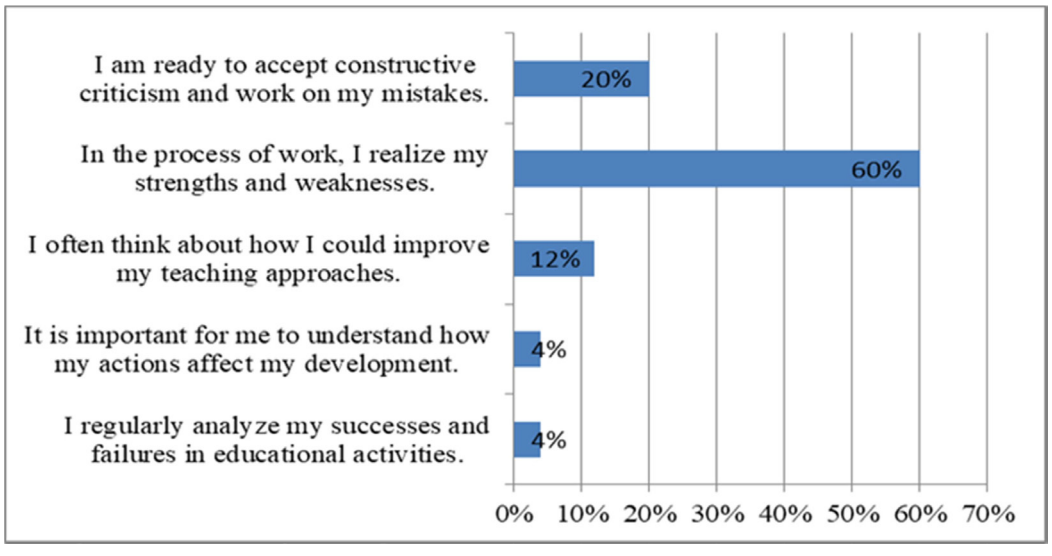
Year	1	2	3	4
	20	1	7	22

From this table, we can see that most respondents were the 1st and 4th year students. The survey was conducted within two months. The participation of students was voluntary, and they were informed about the anonymity and confidentiality. Collected data were processed through the use of descriptive statistical methods: frequency calculation, percentage distribution, and analysis of variation by age, course, and university. This allowed us to reveal the peculiarities of the formation of reflexive skills in future social educators.

Results. The first block of statements focused on the respondents' awareness of their own learning activity. The figure below presents the data obtained from the survey related to this block.

Figure 1

Respondents' evaluation of awareness of their learning activity

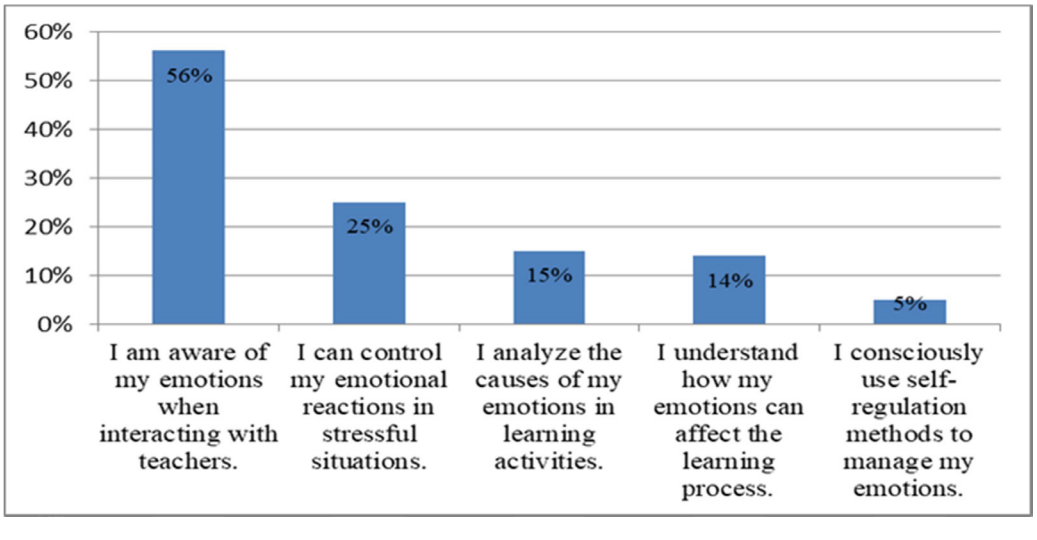


From the data, it is observed that most respondents (60%) understand their strong and weak sides. This means that a significant portion of respondents have developed a basic reflexive ability to understand their learning goals. This level of awareness of their personal characteristics allows students to more effectively plan their educational activities and build a self-development strategy. 20 % of respondents consider that they accept criticism and that they can work on their mistakes. We consider that this point should be improved in the future. 4% of respondents think that they can analyze their achievements in studying.

The next section of our survey focused on emotional and cognitive reflection. Respondents were evaluated based on specific criteria, and the survey revealed the following data.

Figure 2

Respondents' evaluation of emotional and cognitive reflection

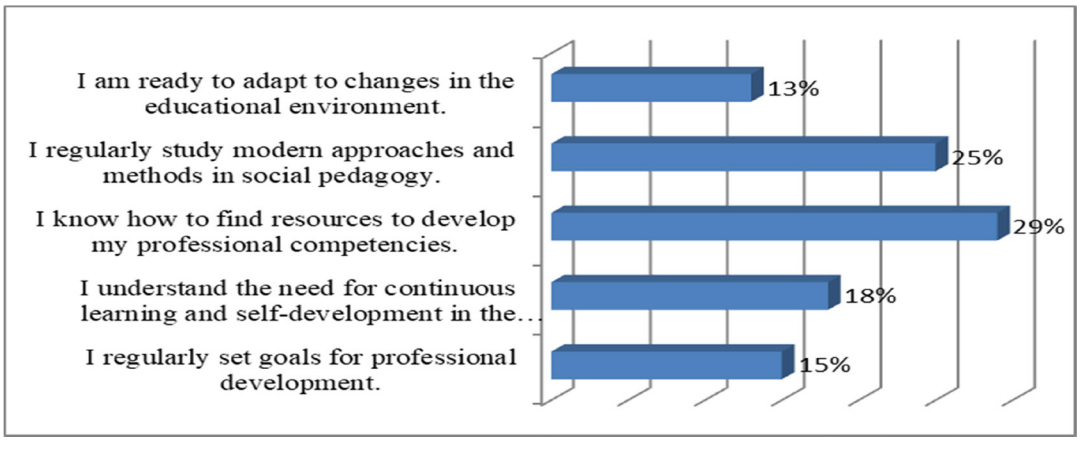


The figure shows that the majority of respondents (56%) are aware of their emotions when interacting with teachers. However, only 5% believe they use self-regulation techniques to manage these emotions. About a quarter of the participants consider that they are capable of controlling their emotions in challenging situations. A similar proportion of respondents

report that they analyze the causes of their emotions during learning activities, and they understand how emotions affect the learning process. The third block of our survey focused on respondents' ability to engage in self-improvement. Participants were asked to select the statement that best reflected their views. The results are presented in Figure 3.

Figure 3

Respondents' evaluation of their ability to self-improve

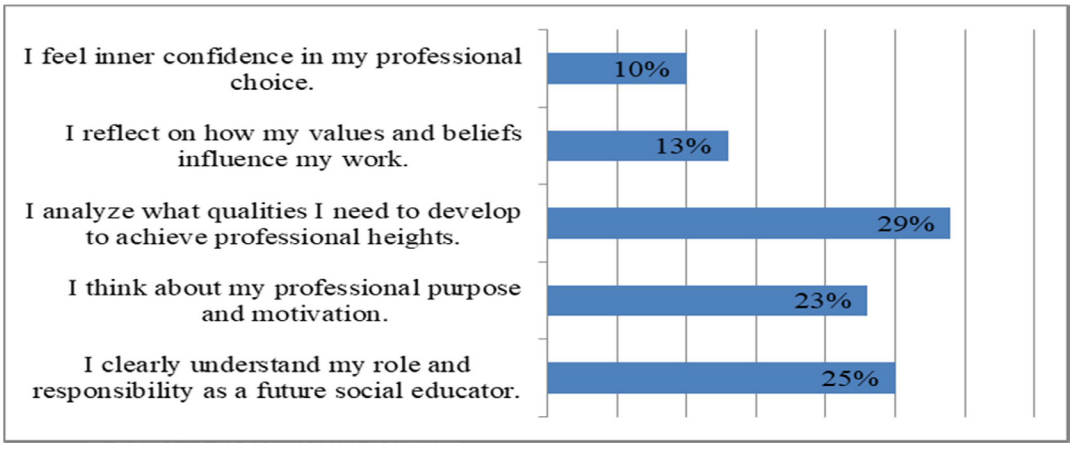


The majority of respondents (29%) reported being able to locate resources to advance their professional skills. Twenty-five percent of students routinely study contemporary social pedagogical techniques. 18% recognize the importance of ongoing education and personal growth in work-related endeavors. Just 13% of respondents said they were prepared to adjust to changes in the educational environment, and only 15% said they often established goals for professional growth. According to these findings, the majority of respondents recognize the value of self-improvement, but fewer participants have developed the practical skills necessary to create objectives and adjust to changes.

The fourth block of the survey provided insights into the respondents' development of professional self-awareness. The corresponding data are presented in Figure 4.

Figure 4

Respondents' evaluation of professional self-awareness

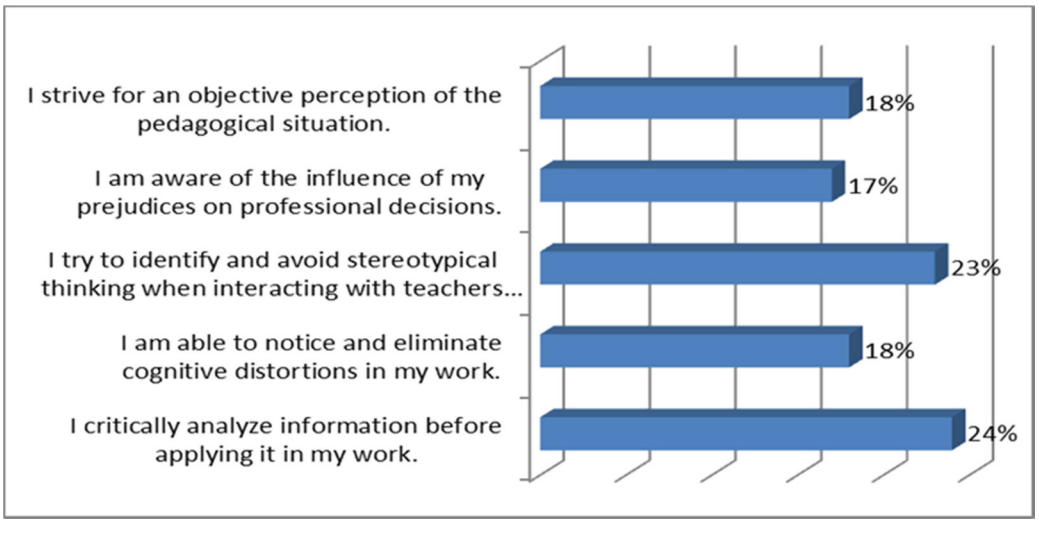


The figure demonstrates that the largest proportion of respondents (29%) said they examine the traits they must cultivate to succeed professionally. 23% consider their motivation and career ambitions, and 25% are well aware of their role and responsibilities as aspiring

social educators. Just 10% of respondents say they have inner confidence in their career decision, and only 13% say they consider how their values and beliefs affect their work. We may infer from these statistics that the majority of respondents prioritize professional development and role awareness, but there is less clarity in their expression of confidence and personal values. These data were obtained from the fifth block of statements, which focused on the respondents' ability for critical thinking and self-reflection.

Figure 5

Respondents' evaluation of their ability to think critically and self-reflection



The data illustrate how respondents evaluated their ability for critical thinking and introspection. Approximately 25% indicated that they make an effort to avoid conventional thinking when interacting with professors and carefully analyze information before applying it. A similar proportion of respondents (around 17–18%) reported that they strive to assess pedagogical situations objectively, recognize the influence of personal biases on professional decisions, and identify and eliminate cognitive distortions in their work. The results of the study showed that the majority of participants had just rudimentary reflexive abilities. They can recognize their strengths and shortcomings thanks to these abilities. This is the main stage of their professional and personal reflection, which serves as the foundation for organizing their own area of personal growth.

Respondents are seen to be emotionally attuned, particularly while interacting with teachers. However, there is a lack of development in the ability to control and manage emotions. This suggests that components for building emotional intelligence and resilience in work-related settings should be incorporated into the educational process. Particular consideration should be given to the professional identity component. Not all participants exhibit internal confidence in their professional decisions and a significant attitude toward their own values and beliefs that impact their professional actions, even when they are aware of their position and duties. This suggests that further research into the axiological component and the growth of introspection is necessary.

Some responders also exhibit the rudiments of critical thinking, the desire to evaluate educational circumstances objectively, and an understanding of professional behavior. These abilities need focused development, though, as they are not yet systematic. The development of reflexive skills, such as emotional self-regulation, awareness, critical thinking, and the capacity to link professional actions with personal values, requires comprehensive support, even though students possess the necessary elements for the formation of

acmeological competence. Individual reflexive competence is demonstrated by the responders, particularly in the areas of self-awareness, emotional intelligence, and goal-orientedness. In addition, there is a deficiency in the practical abilities of self-control, flexibility, self-assurance, and value contemplation. These elements need more focus in the classroom and can serve as the foundation for future experts' development of acmeological competency.

Discussion. According to our study's findings, future social educators possess fundamental reflexive abilities (such as the capacity to identify their own advantages and disadvantages), but they lack emotional control, goal-setting, flexibility, and critical thinking. A similar profile is in line with the findings of contemporary research, which indicate that student teachers' reflections typically start at the descriptive level and only progress toward self-regulation and transformation when unique educational circumstances are present. Such a profile is in line with the findings of recent research, which show that novice teachers' reflections typically start with self-writing and basic awareness before progressing toward self-regulation and transformation only in the presence of particular circumstances (such as structured diaries, portfolios, or "scaffolds"). Therefore, it is demonstrated in Shiraly Gizi's (2023) research that the application of structured procedures raises student teachers' reflective skill levels greatly, which is consistent with our suggestion that such practices should be incorporated into the teaching and learning process.

Similarly, the research conducted by Haipa (2024) confirmed that portfolio management assists future social educators in thinking more deeply and critically, moving their thinking from descriptive to an analytical level. This research emphasizes that the development of education students' critical thinking and creative skills was significantly impacted by the building of portfolios. Building educational materials and fulfilling academic criteria required a careful, analytical approach that called for critical thinking and problem-solving abilities. This suggests that organized mechanisms for reflection and teacher evaluation might be helpful (Haipa, 2024).

Particularly of relevance are weak measures of emotional self-regulation, such as the application of emotion management techniques. According to available data, students' emotional competence and stability are greatly increased by focused programs that teach emotional intelligence with practical awareness and direct instruction of regulation techniques. These programs are also linked to students' self-efficacy and involvement. This concept was considered in the study conducted by Putri et al. (2024), where they conclude that emotional intelligence is important in enhancing students' self-efficacy, making its development in an educational setting crucial. The implications of his research highlight the necessity of instructional approaches that can improve emotional intelligence in order to promote both students' academic achievement and personal growth (Putri et al., 2024).

The research findings demonstrate that future social educators have only acquired fundamental reflexive abilities, leaving them lacking in emotional self-control, goal-setting, adaptability, and critical thinking. Current research confirms that students' reflection is restricted to the descriptive level and does not extend into the realm of self-regulation and transformation in the absence of unique educational settings, such as maintaining a portfolio, utilizing structured diaries, or other activities. At the same time, it has been demonstrated that the use of such activities greatly raises the degree of reflective abilities, fosters the growth of critical and creative thinking, and fortifies students' emotional competence and self-efficacy. Therefore, a prerequisite for social teachers' professional and personal development is the incorporation of organized mechanisms of reflection and programs for the development of emotional intelligence into the training process.

Conclusion. This study made an attempt to substantiate the importance of reflective skills in the process of forming the acmeological competence of prospective social educators, as well as to identify the level of formation

of reflective skills in prospective social educators for their further development in the context of acmeological competence. The conducted survey made it possible to identify prospective social educators' level of reflexive skills as a foundation of the development of their acmeological competence. Respondents comprehend their weaknesses and strengths; however, their levels of critical thinking, understanding their own values, and many other points should be enhanced in the future. These aspects are the components of acmeological competence and should be the object of their attention in the educational environment. The limitations of the study are the fact that our survey covered respondents studying at three universities, which may restrict the representativeness and extrapolation of the obtained results to a broader student population. The creation and testing of unique techniques or training targeted at the formation and development of reflexive abilities, which would raise the degree of acmeological competence of students of educational specializations, might be future research suggestions on this problem.

References

Abdalina, L. V. (2009). Acmeological competence of a college teacher: structure and content. *Bulletin of TSU, 2*(70), 249-251. Retrieved from https://cyberleninka.ru/article/n/akmeologicheskaya-kompetentsiya-prepodavatelya-kolledzha-struktura-i-soderzhanie

Beysman, A. D. (1991). Greek-Russian Dictionary. Moscow. https://archive.org/details/Veysman

Christensen, J., Thönnessen, J., & Weber, B. (2020). Knowledge creation in reflective teaching and shared values in social education: A design for an international classroom. *Educatia 21*, (19), 12-23. https://www.ceeol.com/search/article-detail?id=1042820

Dereka, T. (2016). The building of personal component in the structure of physical education specialists' acmeological competence. *The Advanced Science Journal*, *2*, 59-62. https://scholar.archive.org/work/zwm6vl75fnfy7fdsnsgba3f6xm/access/wayback/http://advancedscience.org/2016/2/059-062.pdf

Dutta, S., He, M., & Tsang, D. C. (2023). Reflection and peer assessment to promote self-directed learning in higher education. *Journal of Educational Research and Reviews*, *11*(3), 35-46. https://www.researchgate.net/profile/Shanta-Dutta/publication/371536633_Reflection_and_peer_assessment_to_promote_self-directed_learning_in_higher_education/links/648928519bc5e436682e1817/Reflection-and-peer-assessment-to-promote-self-directed-learning-in-higher-education.pdf

Haipa A. S. (2024). Critical Reflection in Students' Critical Thinking Teaching and Learning Experiences. *Environment & Social Psychology, 9*(11) https://doi.org/10.59429/esp.v9i11.3199

Halima, A., & Ulugbek, A. (2022). Acmeological Approach as the Development of the Educational Process. *Universum: Technical Sciences*, (12-6 (105)), 58-60. https://cyberleninka.ru/article/n/acmeological-approach-as-the-development-of-educational-process

Indrašienė, V., Jegelevičienė, V., Merfeldaitė, O., Penkauskienė, D., Pivorienė, J., Railienė, A., & Sadauskas, J. (2023). Critical reflection in students' critical thinking teaching, and learning experiences. *Sustainability*, *15*(18), 13500. https://www.mdpi.com/2071-1050/15/18/13500

Kurniati, D., & Nuraeningsih, N. (2019). Reflective teaching as a means of teacher professional development. *Journal of English Teaching, Applied Linguistics and Literatures (JETALL)*, *2*(1), 8-15. https://ppjp.ulm.ac.id/journal/index.php/jetall/article/view/7370

Kuzmina, N. V. (2022). Definition of the subject of fundamental acmeology. Vestnik of Samara University. *History, Pedagogics, Philology*, *28*(4), 60-64. https://journals.ssau.ru/hpp/article/view/11001

Pallisera, M., Fullana, J., Palaudarias, J. M., & Badosa, M. (2013). Personal and professional development (or use of self) in social educator training. An experience based on reflective learning. *Social Work Education*, *32*(5), 576-589. https://www.tandfonline.com/doi/abs/10.1080/02615479.2012.701278

Pillay, R., Khunou, G., Muphosho, M. (2023). Reflection Skills in Social Work. Transforming Teaching and Learning Experiences for Helping Professions in Higher Education. *Global Prospectives.* 227-243 https://doi.org/10.1163/9789004540811_014

Putri, G. M., Kawuryan, S. P., Saptono, B., & Fianto, Z. A. (2024). The role of emotional intelligence in improving student Self-Efficacy. *Jurnal Ilmiah Sekolah Dasar*, *8*(2), 370-378. https://ejournal.undiksha.ac.id/index.php/JISD/article/view/68257

Riyabisheva, E.N. (2012). Acmeological aspects of reflection as a factor in the growth of self-awareness of an individual. *Territory of Science*, (3), 127-134. https://cyberleninka.ru/article/n/akmeologicheskie-aspekty-refleksii-kak-faktora-rosta-samosoznaniya-lichnosti

Shiraly Gizi, T. S. (2023). Pedagogical bases of using acmeological approach in future teacher's professional training. *Revista Universidad y Sociedad*, *15*, 179-184. http://scielo.sld.cu/scielo.php?pid=S2218-36202023000600179&script=sci_arttext

Usakli, H. (2009). Reflective Teaching in Teaching Social Skills: Utopia or Necessity?. *Online Submission*. https://eric.ed.gov/?id=ED517584

Usheva, T. F., Zhdanko, T. A., & Schumovskaya, A. G. (2020). Development Of Reflexive Skills In Students-Future Teachers. *European Proceedings of Social and Behavioural Sciences*. https://www.europeanproceedings.com/article/10.15405/epsbs.2020.10.05.151

Yessenamanova, K., Arinova, B., Zhambylkyzy, M., Rakhimbayeva, R., & Zhunussova, D. (2022). Development of acmeological competence in rising social teachers. In *Frontiers in Education, 7,* 901050. https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2022.901050/full

Information about authors:

Ilyassova Lira, Department of Pedagogy, L.N. Gumilyov Eurasian National University, ORCID ID: 0009-0005-9149-5065, e-mail: lira.lira.8282@mail.ru

Samettin Gunduz, Faculty of Communication, Bolu Abant Izzet Baysal University, ORCID ID: 0000-0002-6837-5971, e-mail: samettin60@gmail.com

Sholpankulova Gulnar, Department of Pedagogy, L.N. Gumilyov Eurasian National University, ORCID ID: 0000-0002-4481-8635, e-mail: sh.gul@mail.ru

Original Article
IRSTI 14.35.07 10.51889/2960-1649.2025.65.4.015

MAMADALIYEV SANZHAR[1], AUTAYEVA AKBOTA[1], KULESZA EWA MARIA[2]*

[1]Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)
[2]Institute of Special Education, Poland (Warsaw)

*Address of correspondence: Sanzhar Mamadaliev, Doctoral Student in the Educational Program 8D01901 Training of Special Education Specialists, Abai Kazakh National Pedagogical University, Dostyk Ave. 13, Almaty 050010, Republic of Kazakhstan. ORCID: https://orcid.org/0000-0001-9722-9175, E-mail: sanzhar_sherlock@mail.ru, Tel: +7 701 634827

The Content and Pedagogical Potential of Project-Based Learning in the Training of Special Education Teachers

Abstract

Introduction. The study aims to analyze the content and pedagogical potential of project-based learning in the training of specialists in the field of special education. Project-based learning is recognized as an effective method that fosters the development of professional competencies in future teachers: Methodology and Methods**.** The research employed both qualitative and quantitative methods, including analysis of scientific publications, surveys among students and teachers, and observation of the educational process. The study was conducted at South Kazakhstan State Pedagogical University. *Results.* The findings revealed that project-based learning enhances students' deep understanding of the material, promotes critical thinking, and strengthens teamwork skills. It also positively influences learning motivation and readiness for professional practice, allowing for the integration of theoretical knowledge and practical skills. *Scientific novelty.* The research substantiates the role of project-based learning as an innovative teaching method with significant potential in special education teacher training, emphasizing its contribution to professional competency formation. *Practical significance.* The results can be applied in developing new curricula and teaching strategies aimed at improving the quality of teacher training for working with children with special educational needs.

Keywords: project-based learning, special pedagogy, professional competence, inclusive education, practical skills.

Introduction. In the current educational process, special attention is being paid to the preparation of specialists capable of working effectively with children with special educational needs. Special pedagogy, as a field of knowledge and practice, requires future professionals to possess not only deep theoretical knowledge but also practical skills. These skills can be developed through innovative teaching methods. One such method is project-based learning, which is increasingly being implemented in teacher training systems. Since this approach is based on students' active involvement in the project creation process, it fosters the development of critical thinking, creativity, and collaboration skills - qualities that are especially important for working in the field of special education (Petrovsky et al., 2018).

Project-based learning is a method in which students work on real-life problems and tasks, based on which they develop their own projects. This approach contributes to a deeper understanding of the subject, as students not only acquire theoretical knowledge but also apply it in practice. In the context of training special education teachers, project-based learning opens up new opportunities for future professionals to develop the skills necessary to work with children with special educational needs (Granado-Alcón et al., 2020). Moreover, recent longitudinal research with 143 preservice science teachers in Thailand showed that an 18-week project-based learning intervention led to statistically significant gains in all four dimensions of metacognitive skills (planning, monitoring, control, and reflection). Regression

analysis further indicated that exposure to project-based learning was a strong predictor of metacognitive development, even after controlling for academic level (Payoungkiattikun et al., 2025). Moreover, recent expert-based research in the field of inclusive digital education identifies project - and problem-based learning, as well as cooperative and service learning, as key pedagogical approaches that foster active participation, self-regulation, and collaboration among learners with special educational needs. The authors emphasize that integrating real-world projects with digital tools helps reduce barriers to participation and enables the effective implementation of differentiated instruction (D'Elia et al., 2025). A recent conceptual framework developed by international researchers emphasizes that the effectiveness of project-based learning depends on the intentional design of real-world tasks, continuous feedback, and structured collaboration, which together help optimize learning outcomes in diverse educational settings (Sánchez-García & Reyes-de-Cózar, 2025). A systematic review of 2015–2022 studies concludes that project-based learning consistently enhances students' problem-solving, creativity, and collaborative skills across different educational levels, confirming its relevance for modern teacher preparation programs (Yusri et al., 2024).

Likewise, research on initial teacher education across three universities in Portugal showed that the systematic use of project-based learning helped student teachers develop higher-order professional competences, including gathering and analysing data, making pedagogical decisions, working collaboratively, and demonstrating initiative and creativity. The authors conclude that project-based learning should not be treated as an isolated assignment but as a continuous element of teacher preparation (Tempera & Tinoca, 2023).

Current studies show that project-based learning significantly increases students' motivation and interest in the learning process. Unlike traditional methods, this approach prioritizes the development of student activity and independent thinking over memorization and reproduction of information (Brown & Thomas, 2019). This is particularly relevant for preparing future teachers to respond effectively to various situations in their professional practice. Furthermore, PBL is increasingly regarded as a universal pedagogical approach that supports both neuropsychological development and students' social-emotional growth. Recent empirical work in project-based settings also demonstrates how learners co-construct and regulate metacognitive processes at the group level, highlighting the crucial role of socially shared metacognition in such environments (Lobczowski et al., 2021).

During project-based learning, students can work both individually and in groups, which helps them develop teamwork and communication skills. These skills are essential for successful work in the field of special education, where collaboration with colleagues, parents, and other professionals plays a crucial role. Furthermore, project-based learning supports the development of students' research and analytical abilities, which are necessary for designing effective educational programs and strategies for children with special needs. One of the key aspects of project-based learning is its focus on results. Students do not merely learn theory but create tangible products that can be applied in practice. These may include developing educational materials, designing rehabilitation programs, or organizing social projects aimed at supporting children with special educational needs and their families. This approach not only increases student motivation but also allows them to see the practical value of the knowledge and skills they acquire (Johnson & Johnson, 2018). Project-based learning is an important tool in the training of special education teachers. Its application contributes not only to improving the quality of education but also to preparing professionals who are adapted to the demands of modern society. This method requires further exploration and development, taking into account students' needs and the current demands of the educational process. It creates opportunities for the development of more effective and adaptive educational programs that promote the successful inclusion

of children with special educational needs into society.

One of the key statements on the importance of project-based learning in professional education is the following: "As a systematically organized activity, the project method plays a crucial role in the formation and development of future professionals' competencies. This method is not only cognitive but also involves research and creative activities" (Kobernyk et al., 2022). This statement highlights the methodological significance of project-based learning. In the training of special education teachers, project activities not only enhance students' cognitive engagement but also foster their scientific and research-oriented thinking. By designing programs or methods tailored to specific learners, future educators improve their professional capacities. One of the most important features of project-based learning is its adaptability to students' individual needs. As noted in the works of Petrovsky et al., (2018), this method can be tailored to varying levels of student preparedness and interests, making it a universal tool in the educational process. Despite its many advantages, the implementation of project-based learning in the training of special education professionals faces several challenges. A major issue is the shortage of qualified instructors who can effectively apply project methods (Hmelo-Silver, 2004).

Additionally, the lack of material and technical resources necessary for organizing full-scale project-based learning remains a significant concern. As Thomas (2000) points out, many educational institutions are not sufficiently equipped with the resources required to support students in implementing their project ideas. Given these challenges, future research on project-based learning in the field of special education should focus on developing effective methodologies and technologies. Comparative studies evaluating the effectiveness of project-based learning versus traditional teaching methods are also needed (Lu, 2021). Moreover, attention should be given to training educators capable of integrating project methods into the learning process. This includes not only improving the qualifications of current instructors but also preparing a new generation of professionals able to meet the demands of the modern educational landscape (Turcotte et al., 2022). Project-based learning remains a powerful tool for developing the professional competencies required in the field of special education. However, for successful implementation, it is necessary to address challenges such as the lack of qualified personnel and insufficient technical resources. Future research in this area can contribute to improving the quality of teacher training and, ultimately, enhance the educational support provided to children with special needs.

Materials and Methods. This section presents the methodology of a study aimed at exploring the content and pedagogical potential of project-based learning in the training of special education professionals. The research is based on a comprehensive approach that includes both theoretical and practical aspects to provide a deeper understanding of how project-based learning can be integrated into the professional training process. To achieve the research objectives, a qualitative method was chosen, as it allows for a deeper understanding of participants' experiences and perceptions. In addition, both qualitative and quantitative approaches were combined. The study involved 150 students and 30 instructors specializing in the field of special education. Participants were selected from various higher education institutions. The research focused on the integration of project-based learning into the educational process, the challenges faced by participants, and the pedagogical potential of project-based learning. Observations were conducted during lessons where project-based learning elements were implemented. The observation was carried out based on the following indicators:

1) The level of student engagement in project work.

2) Teaching methods and techniques used by instructors;

3) Student interaction and collaboration.

This methodological section provides a comprehensive framework for exploring

the process of training special education professionals through project-based learning. The use of multiple data collection methods enables the formulation of scientifically grounded conclusions and recommendations. The study is planned to be further expanded and deepened in the future.

Results. The study identified several key challenges encountered by both students and instructors in implementing project-based learning (PBL) in the training of special education professionals. According to the survey results (Table 1), lack of time was the most frequently reported difficulty, indicated by 34% of students and 45% of instructors. This demonstrates that time constraints remain a significant obstacle within the academic schedule.

Table 1

Main challenges of project-based learning implementation

Type of Difficulty	Students (%)	Instructors (%)
Lack of time	34	45
Difficulties in group work	28	22
Lack of planning/management skills	21	18
Assessment-related difficulties	17	15

Difficulties in group work were identified by 28% of students and 22% of instructors**,** suggesting that collaborative skills may need to be further developed through structured team-based tasks. Another notable challenge was the lack of planning and management skills, as indicated by 21% of students and 18% of instructors**.** Additionally, assessment-related difficulties were reported by 17% of students and 15% of instructors**,** highlighting the need for clear and consistent evaluation criteria in project-based tasks. Before presenting the results, it is important to note how frequently different elements of project-based learning were applied during the observed lessons. The observation results are summarized in Table 2, which shows that group work was the most frequently implemented element, followed by student presentations and creative tasks.

Table 2

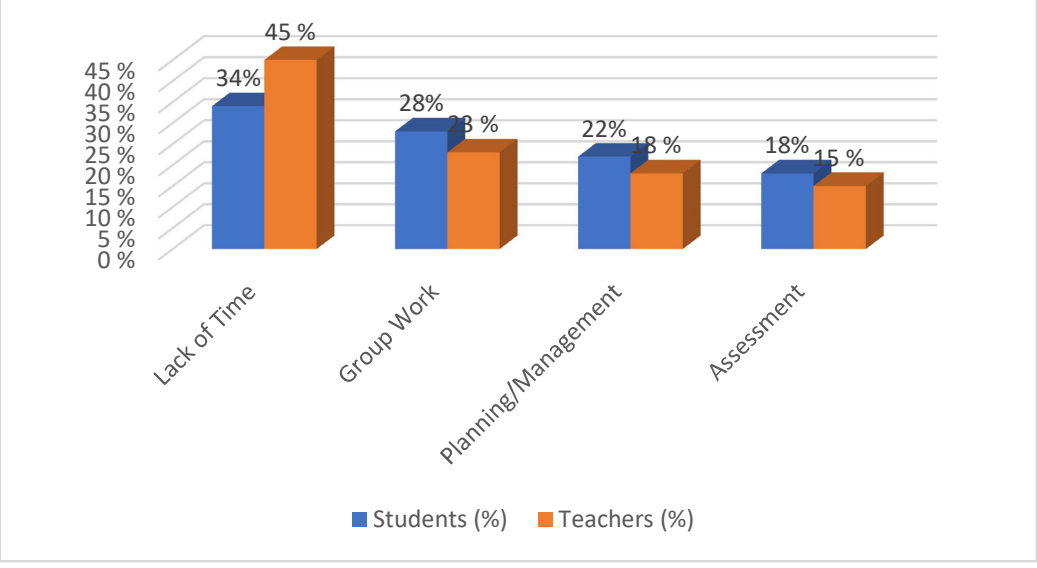
Frequency of project-based learning element use (based on classroom observation)

Project-Based Learning Element	Frequency of Use (%)
Group work	80
Presentations	72
Creative tasks	65

As shown in the table, group work was the most frequently applied element (80%), indicating a strong emphasis on collaborative learning. Presentations (72%) and creative tasks (65%) were also widely used, confirming the interactive and engaging nature of project-based learning practices. Figure 1 provides a comparative illustration of the challenges identified by students and instructors. The most significant obstacle reported was a lack of time, with 34% of students and 45% of teachers highlighting this issue. Difficulties in group work were noted by 28% of students and 23% of teachers, while lack of planning and management skills was reported by 22% of students and 18% of teachers. Assessment-related difficulties were the least reported, cited by 18% of students and 15% of teachers.

Figure 1

Challenges faced by students and teachers during project-based learning implementation



These findings clearly indicate that time constraints remain the most critical barrier to effective project-based learning implementation. Additionally, the results highlight the importance of strengthening collaborative and management skills to enhance the overall effectiveness of the approach. The frequency of project-based learning elements used during lessons was examined. The results are presented below (Table 3).

Table 3

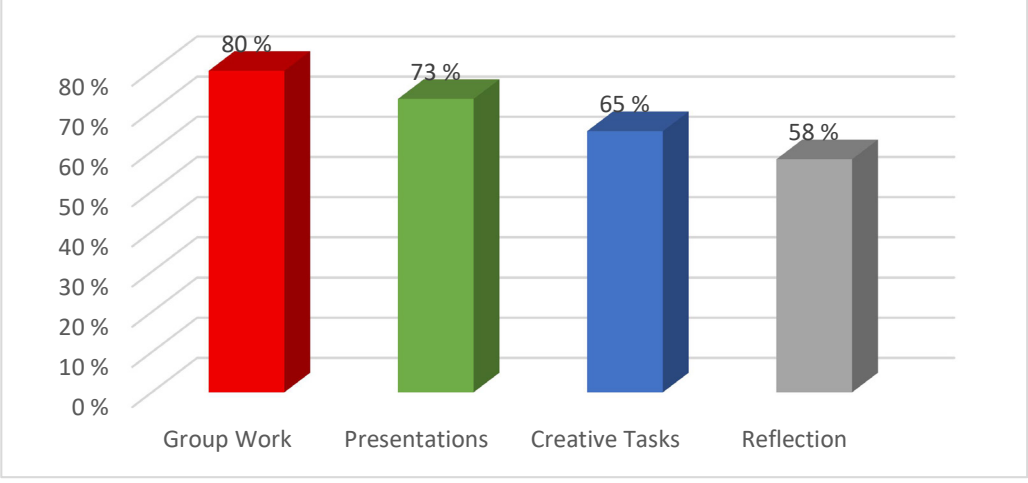
Frequency of Project-Based Learning Elements Used During Lessons

Project-Based Learning Element	Frequency of Use (%)
Group Work	80%
Presentations	73%
Creative Tasks	65%
Reflection	58%

As shown in the table, group work (80%) was the most frequently applied element. This was followed by presentations (73%) and creative tasks (65%). Reflection was observed in 58% of cases, indicating that although collaborative and creative elements are well integrated, reflective practices still require further emphasis. As illustrated in Figure 2, group work was the most frequently implemented project-based learning element, appearing in 80% of the observed classes. Presentations were the second most common (73%), followed by creative tasks (65%). Reflection, while less frequent (58%), was still present in more than half of the lessons, suggesting that reflective practices are integrated but could be further emphasized in future training.

Figure 2

Frequency of project-based learning elements observed during lessons



As shown in Figure 2, group work was the most frequently applied PBL element (80%), followed by presentations (73%), creative tasks (65%), and reflection (58%). These findings provide a clear picture of the core components of project-based learning implemented in special education training. Overall, the results demonstrate that project-based learning is actively integrated into the training process of special education professionals, though certain challenges, such as time constraints and limited reflective practices, remain. These findings form the basis for further discussion regarding the pedagogical implications and potential improvements of PBL in teacher education.

Discussion. The results of the study highlight both the opportunities and the challenges of implementing project-based learning (PBL) in the training of special education professionals. The frequent use of group work (80%) and presentations (73%) demonstrates instructors' efforts to create collaborative and engaging learning environments. Such practices are consistent with the core principles of PBL, which emphasize active student participation, teamwork, and communication. These findings align with previous studies suggesting that group-based activities contribute to the development of social and professional competencies among teacher trainees (Thomas, 2000). However, the results also reveal several challenges that may limit the effectiveness of PBL in special education training. The most significant obstacle identified was the lack of time, reported by 34% of students and 45% of instructors. This finding supports earlier research that emphasizes time management as a critical barrier to the successful implementation of PBL in higher education (Bell, 2010). Since project work often requires extended planning, coordination, and execution, academic schedules need to be adapted to provide sufficient opportunities for students to complete tasks effectively.

Another challenge concerns group dynamics. Difficulties in group work were noted by 28% of students and 22% of instructors, indicating that collaboration is not always equally successful. This reflects the need for structured approaches to teamwork, such as clearly defined roles, continuous monitoring, and the integration of conflict resolution strategies. Developing these collaborative skills is particularly important for special education professionals, who will frequently work in multidisciplinary teams involving teachers, psychologists, and parents.

Additionally, a lack of planning and management skills was highlighted by both students (21%) and instructors (18%). This suggests that PBL not only serves as a pedagogical tool but also as an opportunity to foster organizational and leadership abilities among students. Integrating explicit training in project management techniques could

therefore strengthen the effectiveness of PBL and prepare students for future professional responsibilities. Another noteworthy aspect concerns the relatively lower frequency of reflective practices (58%) compared to other PBL elements. Reflection is a crucial component of professional development, enabling future teachers to critically analyze their learning experiences and identify areas for improvement. Its limited use suggests that teacher educators should place greater emphasis on structured reflective activities, such as learning journals, peer feedback, and guided self-assessment.

Despite these challenges, the overall findings confirm the pedagogical value of PBL in the training of special education specialists. By integrating theoretical knowledge with practical tasks, PBL fosters deep learning, critical thinking, and professional identity formation. Moreover, it enhances motivation and prepares students for the complex realities of working with children with special educational needs. In summary, while time constraints, collaboration issues, and limited reflection remain significant obstacles, project-based learning demonstrates strong potential as an innovative teaching method in special education training. To maximize its effectiveness, educators should focus on creating flexible schedules, strengthening teamwork skills, incorporating project management training, and fostering reflective practices. These improvements will contribute to developing highly qualified and motivated professionals who are prepared to meet the diverse needs of learners in inclusive educational settings.

Conclusion. The study confirmed the effectiveness of project-based learning (PBL) as a pedagogical approach in the training of special education professionals. The results demonstrated that PBL promotes the integration of theoretical knowledge with practical skills, fosters critical thinking, and enhances teamwork and communication abilities. At the same time, several challenges were identified, including time constraints, limited planning and management skills, and difficulties in collaborative work.

Despite these barriers, the active use of group projects, presentations, and creative tasks shows that instructors are committed to implementing PBL elements in their teaching practice. Importantly, PBL was found to contribute to students' motivation, professional readiness, and the formation of their professional identity. Overall, the study highlights the significant pedagogical potential of project-based learning for improving the quality of teacher education in special education. Addressing the identified challenges - particularly by strengthening time management, collaboration strategies, and reflective practices - can further enhance its effectiveness. The findings provide a solid basis for the development of curricula and teaching strategies aimed at preparing competent and motivated professionals to work with children with special educational needs.

References

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*, *83*(2), 39-43. https://www.tandfonline.com/doi/abs/10.1080/00098650903505415

Brown, J. L., & Thomas, H. S. (2019). Project-based learning in technical education: Global trends and case studies. *International Journal of Engineering Pedagogy, 9*(3), 44–52. https://doi.org/10.3991/ijep.v9i3.10520

D'Elia, P., Stalmach, A., Di Sano, S., & Casale, G. (2025). Strategies for inclusive digital education: problem/project-based learning, cooperative learning, and service learning for students with special educational needs. In *Frontiers in Education, 9*, 1447489. https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2024.1447489/full

Granado-Alcón, M. D. C., Gómez-Baya, D., Herrera-Gutiérrez, E., Vélez-Toral, M., Alonso-Martín, P., & Martínez-Frutos, M. T. (2020). Project-based learning and the acquisition of competencies and knowledge transfer in higher education. *Sustainability*, *12*(23), 10062. https://www.mdpi.com/2071-1050/12/23/10062

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn?. *Educational Psychology Review*, *16*(3), 235-266. https://link.springer.com/article/10.1023/B:EDPR.0000034022.16470.f3

Johnson, D. W., & Johnson, R. T. (2018). Cooperative learning and project-based instruction: Enhancing student engagement and motivation. *Educational Psychology Review, 30*(4), 647–662. https://doi.org/10.1007/s10648-018-9457-3

Kobernyk, O., Kolomiiets, N., Komar, O., Roienko, L., & Baidiuk, L. (2022). Project Method Efficiency for the Teachers' Professional Activities. *Journal of Curriculum and Teaching*, *11*(1), 73-86. https://eric.ed.gov/?id=EJ1340926

Lobczowski, N. G., Lyons, K., Greene, J. A., & McLaughlin, J. E. (2021). Socially shared metacognition in a project-based learning environment: A comparative case study. *Learning, Culture and Social Interaction*, *30*, 100543. https://www.sciencedirect.com/science/article/pii/S2210656121000544

Lu, Q. (2021). A New Project-Based Learning in English Writing. *International Journal of Emerging Technologies in Learning*, *15*(5). https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=18630383&AN=149346011&h=c8PmPyP6sqmZtMmG%2BRcpz5ohoeniIrZWVdCqYrHy%2FgWvtjnCCSTwGMb2z1PA7HjPwBF8hOQN0zSludhfYCvcxQ%3D%3D&crl=c

Payoungkiattikun, P., Chooksamran, S., & Tanak, A. (2025). Project-based learning and metacognitive skill development in preservice science teachers: A longitudinal study. *Journal of Education and Learning Sciences, 4*(1), 55–72.

Petrovsky, A. M., Smirnova, Zh. V., & Kutepov, M. M. (2018). Formation of students' professional competencies in the context of project activities. *Karelian Scientific Journal, 7*(1), 22–28. https://cyberleninka.ru/article/n/formirovanie-professionalnyh-kompetentsiy-studentov-v-usloviyah-proektnoy-deyatelnosti

Sánchez-García, R., & Reyes-de-Cózar, S. (2025). Enhancing Project-Based Learning: A Framework for Optimizing Structural Design and Implementation—A Systematic Review with a Sustainable Focus. *Sustainability (2071-1050)*, *17*(11). https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=20711050&AN=185871115&h=s0tmHFN4w5pT%2F78ccN7uHgJ1%2Behxu9te4CljYp6hxw6sNaOWZnglLJiGYmJtHGqbIa5XW358ZK%2F0atFR84s%2BCw%3D%3D&crl=c

Tempera, T., & Tinoca, L. (2023). Project-based learning in initial teacher education: The practice of three higher education institutions in Portugal. *CEPS Journal*, *13*(2), 57-77. https://www.pedocs.de/frontdoor.php?source_opus=26893

Thomas, J. W. (2000). A review of research on project-based learning. https://tecfa.unige.ch/proj/eteach-net/Thomas_researchreview_PBL.pdf

Turcotte, N., Rodriguez-Meehan, M., & Stork, M. G. (2022). This school is made for students: Students' perspectives on PBL. *Journal of Formative Design in Learning*, *6*(1), 53-62. https://link.springer.com/article/10.1007/s41686-022-00066-0

Yusri, N. A., Yusof, N., & Sharina, S. (2024). Project-based learning: A systematic review (2015–2022). *Humanities & Social Sciences Reviews, 12*(1), 88–102. https://www.researchgate.net/publication/384509470_A_systematic_literature_review_of_project-based_learning_research_trends_methods_elements_and_frameworks

Information about authors:

Mamadaliyev Sanzhar, Doctoral student of the educational program 8D01901 Training of special education specialists, Abai Kazakh National Pedagogical University, ORCID ID: 0000-0001-9722-9175, Email: sanzhar_sherlock@mail.ru

Autayeva Akbota, Candidate of Psychological Sciences, Associate Professor, Abai Kazakh National Pedagogical University, Almaty, Kazakhstan. ORCID ID: 0000-0003-2270-3148, Email: Akbota-n@mail.ru

Kulesza Ewa Maria, Doctor of Philosophy, Professor at APS (MGU), Director of the Maria Grzegorzewska Poland ,Warsaw ORCID ID: https://orcid.org/0000-0002-2915-878X, Email: ekulesza@aps.edu.pl

Pedagogy and Psychology

Vol 65, №4 (December 2025)

Publishing editor: *Huseyin Uzunboylu*
Layout: *Sharban Aitmukusheva*
Design: *Akerke Yskak*

Signed for printing: December, 2025
Format 60x84$^{1}/_{8}$. Syktyvkar paper.
Printed sheets 18,75. Order no №559.

Abai Kazakh National Pedagogical University
050010, Almaty, Dostyk ave., 13. Phone no.: +7(727)2911865

Printed at the publishing house “Ulagat”
Abai Kazakh National Pedagogical University