

ISSN: 1991-3494 (Print)  
ISSN: 2518-1467 (Online)

**SCIENTIFIC JOURNAL OF  
PEDAGOGY AND ECONOMICS**

**№1  
2026**



ISSN 2518-1467 (Online),  
ISSN 1991-3494 (Print)



CENTRAL ASIAN ACADEMIC  
RESEARCH CENTER



# SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS

PUBLISHED SINCE 1944

# 1 (419)

*January – February 2026*

---

ALMATY, 2026

---

**EDITOR-IN-CHIEF:**

**ABYLKASSIMOVA Alma Yesimbekovna**, Doctor of Pedagogical Sciences, Professor, Academician of Central Asian Academic Research Center, Director of the Center for the Development of Pedagogical Education, Head of the Department of Methods of Teaching Mathematics, Physics and Computer Science at Abai KazNPU (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=57191275199>, <https://www.webofscience.com/wos/author/record/2076124>.

**DEPUTY EDITOR-IN-CHIEF:**

**SEMBIEVA Lyazzat Myktybekovna**, Doctor of Economics, Professor of the Eurasian National University (Astana, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=57194226348>, <https://www.webofscience.com/wos/author/record/38875302>.

**EDITORIAL BOARD:**

**RICHELLE Marynowski**, PhD in Education, Professor, Faculty of Education, University of Lethbridge, (Alberta, Canada), <https://www.scopus.com/authid/detail.uri?authorId=57070452800>, <https://www.webofscience.com/wos/author/record/16130920>.

**SHISHOV Sergey Evgenievich**, Doctor of Pedagogical Sciences, Professor, Head of the Department of Pedagogy and Psychology of Professional Education, Moscow State University of Technology and Management named after K. Razumovsky (Moscow, Russia), <https://www.scopus.com/authid/detail.uri?authorId=57191518233>, <https://www.webofscience.com/wos/author/record/2443966>.

**ABILDINA Saltanat Kuatovna**, Doctor of Pedagogical Sciences, Professor, Head of the Department of Pedagogy, Karaganda University named after E.A. Buketov (Karaganda, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=56128026400>, <https://www.webofscience.com/wos/author/record/4131549>.

**RYZHAKOV Mikhail Viktorovich**, Doctor of Pedagogical Sciences, Professor, Academician of the Russian Academy of Education, Editor-in-Chief of the journal "Standards and Monitoring in Education" (Moscow, Russia), <https://www.scopus.com/authid/detail.uri?authorId=6602245542>, <https://www.webofscience.com/wos/author/record/13675462>.

**BULATBAEVA Kulzhanat Nurymzhanovna**, Doctor of Pedagogical Sciences, Professor, Chief Researcher of the National Academy of Education named after Y. Altynsarin (Astana, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=57202195074>, <https://www.webofscience.com/wos/author/record/40173122>.

**PETR Hájek**, PhD, Unicorn University, Associate Professor, Department of Finance, (Prague, Czech Republic), <https://www.scopus.com/authid/detail.uri?authorId=35726855800>, <https://www.webofscience.com/wos/author/record/672404>.

**JUMAN Jappar**, Doctor of Economics, Professor, Honorary Academician of Central Asian Academic Research Center, Honored Worker of Kazakhstan, Director of the Center for International Applied Research Al-Farabi Kazakh National University (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=59238481900>; <https://www.scopus.com/authid/detail.uri?authorId=56658765400>, <https://www.webofscience.com/wos/author/record/60977874>.

**LUKYANENKO Irina Grigorievna**, Doctor of Economics, Professor, Head of Department of the National University of Kyiv-Mohyla Academy (Kyiv, Ukraine), <https://www.scopus.com/authid/detail.uri?authorId=57189348551>, <https://www.webofscience.com/wos/author/record/939510>.

**YESIMZHANOVA Saira Rafihevna**, Doctor of Economics, Professor of the University of International Business (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=56499485500>, <https://www.webofscience.com/wos/author/record/45951098>.

---

**Scientific Journal of Pedagogy and Economics**

**ISSN 2518-1467 (Online),**

**ISSN 1991-3494 (Print).**

**Owner:** «Central Asian Academic Research Center» LLP (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Communications of the Republic of Kazakhstan

**№ KZ50VPY00121155**, issued on 05.06.2025

Thematic focus: «*publication of the results of new achievements in the field of fundamental sciences*»

**Periodicity:** 6 times a year.

<http://www.bulletin-science.kz/index.php/en/>

© «Central Asian Academic Research CenterB» LLP, 2026



**БАС РЕДАКТОР:**

**ӘБІЛҚАСЫМОВА Алма Есімбекқызы**, педагогика ғылымдарының докторы, профессор, ҚР ҰҒА академигі, Педагогикалық білім беруді дамыту орталығының директоры, Абай атындағы ҚазҰПУ математика, физика және информатиканы оқыту әдістемесі кафедрасының меңгерушісі (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=57191275199>, <https://www.webofscience.com/wos/author/record/2076124>.

**БАС РЕДАКТОРДЫҢ ОРЫНБАСАРЫ:**

**СЕМБИЕВА Ләззат Мықтыбекқызы**, экономика ғылымдарының докторы, Л.Н. Гумилев атындағы Еуразия ұлттық университетінің профессоры (Астана, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=57194226348>, <https://www.webofscience.com/wos/author/record/38875302>.

**РЕДАКЦИЯ АЛҚАСЫ:**

**РИШЕЛЬ Мариновски**, білім беру саласындағы PhD, Летбридж университеті педагогика факультетінің профессоры, (Альберта, Канада), <https://www.scopus.com/authid/detail.uri?authorId=57070452800>, <https://www.webofscience.com/wos/author/record/16130920>.

**ШИШОВ Сергей Евгеньевич**, педагогика ғылымдарының докторы, профессор, К. Разумовский атындағы Мәскеу мемлекеттік технологиялар және басқару университетінің кәсіби білім беру педагогикасы және психологиясы кафедрасының меңгерушісі (Мәскеу, Ресей), <https://www.scopus.com/authid/detail.uri?authorId=57191518233>, <https://www.webofscience.com/wos/author/record/2443966>.

**ӘБІЛДИНА Салтанат Қуатқызы**, педагогика ғылымдарының докторы, профессор, Е.А. Бөкетов атындағы Қарағанды университетінің педагогика кафедрасының меңгерушісі (Қарағанды, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=56128026400>, <https://www.webofscience.com/wos/author/record/4131549>.

**РЫЖАКОВ Михаил Викторович**, педагогика ғылымдарының докторы, профессор, Ресей білім академиясының академигі, «Білім берудегі стандарттар мен мониторинг» журналының бас редакторы (Мәскеу, Ресей), <https://www.scopus.com/authid/detail.uri?authorId=6602245542>, <https://www.webofscience.com/wos/author/record/13675462>.

**БОЛАТБАЕВА Күлжанат Нұрымжанқызы**, педагогика ғылымдарының докторы, профессор, Ы.Алтынсарин атындағы Ұлттық білім академиясының бас ғылыми қызметкері (Астана, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=57202195074>, <https://www.webofscience.com/wos/author/record/40173122>.

**ПЕТР Хайек**, PhD, Юникорн университеті, Қаржы департаментінің қауымдастырылған профессоры (Прага, Чехия), <https://www.scopus.com/authid/detail.uri?authorId=35726855800>, <https://www.webofscience.com/wos/author/record/672404>.

**ЖҰМАН Жаппар**, экономика ғылымдарының докторы, профессор, Қазақстанның Еңбек сіңірген қайраткері, ҚР ҰҒА құрметті академигі, әл-Фараби атындағы Қазақ ұлттық университетінің Халықаралық қолданбалы зерттеулер орталығының директоры (Алматы, Қазақстан). <https://www.scopus.com/authid/detail.uri?authorId=59238481900>; <https://www.scopus.com/authid/detail.uri?authorId=56658765400>, <https://www.webofscience.com/wos/author/record/60977874>.

**ЛУКЪЯНЕНКО Ирина Григорьевна**, экономика ғылымдарының докторы, профессор, «Киево-Могилянская академия» ұлттық университеті кафедрасының меңгерушісі (Киев, Украина), <https://www.scopus.com/authid/detail.uri?authorId=57189348551>, <https://www.webofscience.com/wos/author/record/939510>.

**ЕСІМЖАНОВА Сайра Рафиққызы**, экономика ғылымдарының докторы, Халықаралық бизнес университетінің профессоры (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=56499485500>, <https://www.webofscience.com/wos/author/record/45951098>.

Scientific Journal of Pedagogy and Economics

ISSN 2518-1467 (Online),

ISSN 1991-3494 (Print).

Меншіктенуші: «Орталық Азия академиялық ғылыми орталығы» ЖШС (Алматы қ.).

Қазақстан Республикасының Ақпарат және коммуникациялар министрлігінің Ақпарат комитетінде 05.06.2025 ж. берілген № KZ50VPY00121155 мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *«іргелі ғылым салалары бойынша жаңа жетістіктердің нәтижелерін жариялау»*

Мерзімділігі: жылына 6 рет.

<http://www.bulletin-science.kz/index.php/en/>

© «Орталық Азия академиялық ғылыми орталығы» ЖШС, 2026

**ГЛАВНЫЙ РЕДАКТОР:**

**АБЫЛКАСЫМОВА Алма Есимбековна**, доктор педагогических наук, профессор, академик НАН РК, директор Центра развития педагогического образования, заведующая кафедрой методики преподавания математики, физики и информатики КазНПУ им. Абая (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=57191275199>, <https://www.webofscience.com/wos/author/record/2076124>.

**ЗАМЕСТИТЕЛЬ ГЛАВНОГО РЕДАКТОРА:**

**СЕМБИЕВА Лязат Мыктыбековна**, доктор экономических наук, профессор Евразийского национального университета им. Л.Н. Гумилева (Астана, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=57194226348>, <https://www.webofscience.com/wos/author/record/38875302>.

**РЕДАКЦИОННАЯ КОЛЛЕГИЯ:**

**РИШЕЛЬ Мариновски**, PhD в области образования, профессор факультета педагогики Летбриджского университета, (Альберта, Канада), <https://www.scopus.com/authid/detail.uri?authorId=57070452800>, <https://www.webofscience.com/wos/author/record/16130920>.

**ШИШОВ Сергей Евгеньевич**, доктор педагогических наук, профессор, заведующий кафедрой педагогики и психологии профессионального образования Московского государственного университета технологий и управления имени К. Разумовского (Москва, Россия), <https://www.scopus.com/authid/detail.uri?authorId=57191518233>, <https://www.webofscience.com/wos/author/record/2443966>.

**АБИЛЬДИНА Салтанат Куатовна**, доктор педагогических наук, профессор, заведующая кафедрой педагогики Карагандинского университета имени Е.А. Букетова (Караганда, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=56128026400>, <https://www.webofscience.com/wos/author/record/4131549>.

**РЫЖАКОВ Михаил Викторович**, доктор педагогических наук, профессор, академик Российской академии образования, главный редактор журнала «Стандарты и мониторинг в образовании» (Москва, Россия), <https://www.scopus.com/authid/detail.uri?authorId=6602245542>, <https://www.webofscience.com/wos/author/record/13675462>.

**БУЛАТБАЕВА Кулжанат Нурымжановна**, доктор педагогических наук, профессор, главный научный сотрудник Национальной академии образования имени Ы. Алтынсарина (Астана, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=57202195074>, <https://www.webofscience.com/wos/author/record/40173122>.

**ПЕТР Хайек**, PhD, университет Юникорн, ассоциированный профессор Департамента финансов, (Прага, Чехия), <https://www.scopus.com/authid/detail.uri?authorId=35726855800>, <https://www.webofscience.com/wos/author/record/672404>.

**ЖУМАН Жаппар**, доктор экономических наук, профессор, заслуженный деятель Казахстана, почетный академик НАН РК, директор Центра Международных прикладных исследований Казахского национального университета им. аль-Фараби (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=59238481900>; <https://www.scopus.com/authid/detail.uri?authorId=56658765400>, <https://www.webofscience.com/wos/author/record/60977874>.

**ЛУКЪЯНЕНКО Ирина Григорьевна**, доктор экономических наук, профессор, заведующая кафедрой Национального университета «Киево-Могилянская академия» (Киев, Украина), <https://www.scopus.com/authid/detail.uri?authorId=57189348551>, <https://www.webofscience.com/wos/author/record/939510>.

**ЕСИМЖАНОВА Сайра Рафихевна**, доктор экономических наук, профессор Университета международного бизнеса (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=56499485500>, <https://www.webofscience.com/wos/author/record/45951098>.

Scientific Journal of Pedagogy and Economics

ISSN 2518-1467 (Online),

ISSN 1991-3494 (Print).

Собственник: ТОО «Центрально-азиатский академический научный центр» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и коммуникаций и Республики Казахстан

№ KZ50VPY00121155 выданное 05.06.2025 г.

Тематическая направленность: «публикация результатов новых достижений области фундаментальных наук».

Периодичность: 6 раз в год.

<http://www.bulletin-science.kz/index.php/en/>

© ТОО «Центрально-азиатский академический научный центр», 2026



## CONTENTS

## PEDAGOGY

<b>Abuova B.P., Abisheva S.D., Adibayeva Sh.T.</b> The methodological potential of Kazakhstan’s children’s literature in the educational process on the example of “Kazakhstan fairy tales” by Yuri Serebryansky.....	19
<b>Azybayev M., Zhaidakbayeva L.K.</b> Pedagogical and technological aspects of blended synchronous learning Implementation.....	38
<b>Bazarbayeva A.N., Mubarakov A.M., Ibadulla S.N.</b> Model of didactic principles for using the system of collaborative open learning in the training of future computer science teachers.....	55
<b>Yerbolatov N. N.*, Toktaganova G.B., Nazarova G.A.</b> Diagnostics of learning results of master’s students based on the integration of education, science and production and prospects for improvement.....	69
<b>Zhaiynbayeva S.K., Maimataeva A.D., Kossauova A.K.</b> Formation of professional competence of future biology teachers based on the “flipped classroom” technology.....	87
<b>Zhambylkyzy M., Baibossynova T., Aleixo M.</b> Using action research as a method for professional development of efl teachers.....	102
<b>Zharylgapova D.M., Karabala T.M., Pirmaganbet A.E.</b> Increasing students’ interest and intellectual abilities in learning physics through mobile applications.....	116
<b>Imangaliyeva B., Yermakhanov M., Aldiyarova A.</b> Methods of teaching chemistry to students with special educational needs: kazakh secondary school practice.....	133
<b>Kazhenova Zh.S., Rakhmatullina Z. T.</b> Organizing the educational process with kits for educational robotics.....	151
<b>Kazbay P.A., Kudaibergenova K.T.</b> Teaching the image of "hero-girl" in kazakh epics through critical thinking technology in universities.....	174
<b>Kaisarova A.S., Zhensikbaeva N.Zh., Sabyrbaeva B.T.</b> Local studies as a means of student personality socialization.....	187
<b>Medeubaeva K.T., Khassanova I.U., Seitenova S.S.</b> Artificial intelligence potential in personalizing teacher training trajectories: Kazakhstan’s experience.....	204

**Nabi N.B., Rakhmetova R.S.**

The importance of the 4c model in the formation of communicative skills  
and its conceptual basis.....222

**Nurzhanova A.R., Zhussupova R.F., Jaleniauskiene E.**

Artificial intelligence in education: evaluating ai-powered educational platforms.....238

**Nurizina M.M., Baimukhanbetov B.M., Issayev M.S.**

Developing learners' soft skills: exploring the impact of theoretical approaches.....259

**Nurlan M., Bakirci N., Aden Zh.**

The relevance of teaching the genre of zhyr using new technologies.....275

**Orynbasar T.O., Amirbekova A.B.**

The writer's thesaurus and methodology of teaching literary style: a systematic review  
using the PRISMA method.....295

**Pernebayeva F., Bakesh Z., Kalymbetova A.**

Ways to form innovative competence in biology teaching.....319

**Seitbekova G.O., Kokzhayeva A.B., Suleimenkulova G.T**

Development and assessment of students' mathematical functional literacy through  
solving textual problems with financial content.....338

**Semenikhina S.F., Semenikhin V.V.**

Review of the implementation of the alliance "school – university – science – industry"  
in the holistic pedagogical process.....362

**Smatova K.B., Alimbayeva S.K., Ospanbayeva M.P.**

A study of the transformation of school readiness diagnostics into a digital format.....378

**Toktagulova U.S., Karmenova N.N., Sadykova D.A.**

Formation of students' conceptions in determining the role and effectiveness of  
training-field practice in the development of theoretical knowledge.....396

**Ualikhanova A., Abuov A.E., Bolysbaev D.S.**

Methodological approaches to studying yard clubs' role in forming children's  
spiritual values.....417

**Usmanova K., Stycheva O.**

The use of the official-business style in the educational process as a means  
of professional training of future Russian language teachers.....433

**Khassenova M.T., Smagulov M.Z.**

chemistry without barriers: strategies inclusive learning in class.....455

## ECONOMY

<b>Abdullaev A.M., Kadyrova M.B., Kuralbaev A.A.</b> Human resources management in the local government system: training and development of professional competencies.....	477
<b>Amanbai A., Rakhimberdinova M.U., Massanova L.E.</b> Analysis of the development of the housing construction market in the Republic of Kazakhstan.....	505
<b>Amangozhayeva A.B., Akpanov A.K., Kassymbekova G.R.</b> Determinants of banking sector vulnerability in Kazakhstan: a multi-method analysis of market, credit, and liquidity risks.....	523
<b>Beisenbayeva A., Yernazarova U., Turdaliyeva U.</b> Assessing the effectiveness of internal control with ESG risks: a model for the banking sector of Kazakhstan.....	539
<b>Domalatrov Ye.B., Abylaikhanova T.A.</b> Neural networks as a tool for improving the efficiency of human capital management: empirical analysis and predictive modeling.....	554
<b>Yeltay B.B., Azatbek T.A.</b> Assessment of the impact of changes in global prices for non-ferrous metals on the export dynamics of Kazakhstan's non-ferrous metallurgy.....	569
<b>Elshibekova K.Zh., Eralina E.M.</b> Competitive advantages of domestic robotic systems in the industry of kazakhstan.....	592
<b>Yendybayev S.T., Zhussipova E.Ye., Duisenbekuly A.-K.D.</b> Adaptation of startup valuation methodologies in Kazakhstan under conditions of limited financial information.....	613
<b>Yerimpasheva A., Tarakbaeva R., Lyu Zh.</b> Investment interaction between Kazakhstan and China as a factor in the formation of transcontinental transport corridors.....	631
<b>Zhumaldinova D., Yeshenkulova G., Wronka-Pośpiech M.</b> Emerging methodologies and technologies in creative startups: a configurational review.....	647
<b>Kadyrbekova D.S., Klimova T.B., Duiskenova R.Zh.</b> International tourism in Kazakhstan: factors attracting foreign tourists and opportunities to strengthen the country's brand.....	664
<b>Kadyrova K., Davletova M., Amirgaliyeva A.</b> Marketing strategies of small and medium-sized enterprises in Kazakhstan under digital transformation.....	681

**Kalbayeva N.T., Satenov B.I., Khassenova L.A.**

The impact of financial determinants on the export development of meat production in Turkestan region: a scenario-based approach.....699

**Karimova B., Kassenova G., Supugaliyeva G.**

Volatility of financial instruments on the Kazakhstan stock market: measurement and forecasting.....722

**Kozhakhmetova A.K., Yesmurzayeva A.B., Anarkhan A.K.**

Integrated ESG assessment of the efficiency of green energy projects: economic, social, and environmental aspects.....741

**Kuralbayeva A.Sh., Issayeva G.K., Makhatova A.B.**

Fintech tools as a mechanism for stimulating investment in the sustainable development of rural regions of Kazakhstan.....767

**Meldebekova A., Kanabekova M., Azbergenova R.**

Innovation management in Kazakhstan's higher education: indicators and governance models.....783

**Moldazhanov M.B., Takhtaeva R.Sh., Dyusembinova Zh.S.,**

The impact of economic activity in the Semipalatinsk nuclear safety zone and the city of Kurchatov on the development of STS nuclear tourism.....807

**Nurbatsin A., Kireyeva A.A.**

Digital technologies as a tool for improving the quality of higher education.....829

**Nurbekova Sh. K., Yessimzhanova S. R., Alimzhanova L.M.**

Improving the efficiency of transport and logistics services management in special economic zones based on digitalization.....851

**Nurmukhanova G.Zh., Abzhatova A.K., Kurmangaliyeva A.K.**

The relationship between the labor market and higher education in Kazakhstan: trends and development directions.....875

**Polezhayeva I.S., Suyundikov A.S., Statsenko O.A.**

The impact of digitalization on improving the economic efficiency of the energy sector of the Republic of Kazakhstan.....892

**Razakova D.I., Alshanov R.A., Kazybayeva M.N.,**

Digital transformation of Kazakhstan's industry: an empirical analysis of enterprise readiness and implementation barriers.....916

**Sagindykova G.M., Tussibayeva G.S., Balginova K.M.**

Innovative strategies for the formation of social responsibility and motivation of participants the pension system of the Republic of Kazakhstan in the context of digitalization.....935

**Sadykov E., Zhamkeyeva M., Konyrbekov M.**

The structure of markups in Kazakhstan's economy and its impact on inflationary trends.....955

## МАЗМҰНЫ

### ПЕДАГОГИКА

<b>Абуова Б.П., Абишева С.Д., Адибаева Ш.Т.</b> Қазақстан балалар әдебиетінің білім беру үрдісіндегі әдістемелік әлеуеті Юрий Серебрянскийдің «Қазақстан ертегілері» мысалында.....	19
<b>Азыбаев М., Жайдакбаева Л.К.</b> Аралас синхронды оқытуды жүзеге асырудың педагогикалық және технологиялық аспектілері.....	38
<b>Базарбаева А.Н., Мубаракوف А.М., Ибадулла С.Н.</b> Болашақ информатика пәнінің оқытушыларын даярдауда біреккен ашық оқыту жүйесін пайдаланудың дидактикалық принциптер моделі.....	55
<b>Ерболатов Н.Н.* , Тоқтағанова Г.Б., Назарова Г.А.</b> Магистранттарды білім, ғылым және өндіріс интеграциясы негізінде даярлау нәтижелерін диагностикалау және перспективті жетілдіру.....	69
<b>Жайынбаева С.К., Майматаева А.Д., Қосауова А.К.</b> «Төңкерілген сынып» технологиясы негізінде болашақ биология мұғалімінің кәсіби құзыреттілігін қалыптастыру.....	87
<b>Жамбылқызы М., Байбосынова Т., Алейшо М.</b> Action research әдісін ағылшын тілі мұғалімдерінің кәсіби дамуына қолдану.....	102
<b>Жарылғапова Д.М., Қарабала Т.М., Пірмағанбет А.Е.</b> Мобильді қосымшалар арқылы физиканы оқытуда оқушылардың пәнге қызығушылығын және интеллектуалды қабілеттерін арттыру.....	116
<b>Иманғалиева Б., Ермаханов М., Алдиярова А.</b> Ерекше білім беруге қажеттіліктері бар оқушыларға химияны оқыту әдістемесі: қазақ орта мектебінің практикасы.....	133
<b>Каженова Ж.С., Рахматуллина З.Т.</b> Білім беру робототехникасына арналған жинақтарды қолдану арқылы оқу үрдісін ұйымдастыру.....	151
<b>Қазбай П.А., Құдайбергенова К.Т.</b> Қазақ эпостарындағы «қаһарман-қыздар» бейнесін жоғары оқу орнында сыни ойлау технологиясы арқылы оқыту.....	174
<b>Кайсарова А.С., Женсикбаева Н.Ж., Сабырбаева Б.Т.</b> Өлкетану – оқушы тұлғасын әлеуметтендіру құралы ретінде.....	187

<b>Медеубаева К.Т., Хасанова И.У., Сейтенова С.С.</b> Жасанды интеллекттің болашақ мұғалімдерді дайындаудың білім беру траекторияларын дербестендірудегі әлеуеті: Қазақстан тәжірибесі.....	204
<b>Нәби Н.Б., Рахметова Р.С.</b> 4К моделінің қатысымдық дағдыны қалыптастырудағы маңызы және оның концептуалдық негізі.....	222
<b>Нуржанова А.Р., Жусупова Р.Ф., Яленяускене Э.</b> Білім берудегі жасанды интеллект: жасанды интеллект негізіндегі білім беру платформаларын бағалау.....	238
<b>Нуризинова М.М., Баймуханбетов Б.М., Исаев М.С.</b> Білім алушылардың икемді дағдыларын (soft skills) дамыту: теориялық тәсілдердің әсерін зерттеу.....	259
<b>Нұрлан М.Н., Бакырджы Н., Әден Ж.Ш.</b> Жыр жанрын жаңа технологиялар көмегімен оқытудың маңызы.....	275
<b>Орынбасар Т.О., Амирбекова А.Б.</b> Жазушы тезаурусы және көркем әдебиет стилін оқыту әдістемесі: PRISMA әдісімен жасалған систематикалық шолу.....	295
<b>Пернебаева Ф.С., Бакеш З.О., Калымбетова А.А.</b> Биологияны оқытуда инновациялық құзыреттілікті қалыптастыру жолдары.....	319
<b>Сейтбекова Г.О., Кокажаева А.Б., Сүлейменқұлова Г.Т.</b> Оқушылардың математикалық функционалдық сауаттылығын қаржылық мазмұндағы мәтіндік есептерді шешу арқылы дамыту және бағалау.....	338
<b>Семенихина С.Ф., Семенихин В.В.</b> Тұтас педагогикалық үдерісте "мектеп – жоғары оқу орны – ғылым-өндіріс" альянсын енгізуді зерттеу бойынша шолу.....	362
<b>Сматова К.Б., Алимбаева С.К., Оспанбаева М.П.</b> Мектепке даярлық диагностикасын сандық форматқа ауыстыру үрдісін.....	378
<b>Токтагулова У.С., Карменова Н.Н., Садыкова Д.А.</b> Оқу-далалық практиканың теориялық білімді дамытудағы рөлі мен тиімділігін анықтауда білім алушылардың түсініктерін қалыптастыру.....	396
<b>Уалиханова А., Абуов А.Е., Болысбаев Д.С.</b> Балалардың рухани құндылықтарын қалыптастыруда аула клубтарының рөлін зерттеуге әдіснамалық тұғырлар.....	417

**Усманова Х., Стычева О.**

Ресми бизнес стилін болашақ орыс тілі мұғалімдерін кәсіби дайындау құралы ретінде оқу үрдісінде пайдалану.....433

**Хасенова М.Т., Смагулов М.З.**

Кедергісіз химия: сыныпта инклюзивті оқытудың стратегиялары.....455

**ЭКОНОМИКА****Абдуллаев А.М., Қадырова М.Б., Құралбаев А.А.**

Жергілікті өзін-өзі басқару жүйесіндегі кадрларды басқару: кәсіби құзыреттерді дайындау және дамыту.....477

**Аманбай А., Рахимбердинова М.У., Массанова Л.Е.**

Қазақстан Республикасындағы тұрғын үй құрылысы нарығының дамуын талдау.....505

**Аманғожаева А.Б., Ақпанов А.К., Қасымбекова Г.Р.**

Қазақстанның банк секторының осалдық детерминанттары: нарықтық, кредиттік және өтімділік тәуекелдерін көпәдісті талдау.....523

**Бейсенбаева А., Ерназарова У., Турдалиева У**

ESG тәуекелдерін ескере отырып ішкі бақылаудың тиімділігін бағалау: Қазақстан банк секторы үшін модель.....539

**Домалатов Е.Б., Абылайханова Т.А.**

Нейрондық желілер адами капиталды басқарудың тиімділігін арттыру құралы ретінде: эмпирикалық талдау және болжамды модельдеу.....554

**Елтай Б.Б., Азатбек Т.А.**

Түсті металдарға әлемдік бағалардың өзгерісінің Қазақстанның түсті металлургиясының экспорттық динамикасына әсерін бағалау.....569

**Елшибекова К.Ж., Ералина Э.М.**

Қазақстан өнеркәсібіндегі отандық робототехникалық кешендердің бәсекелестік артықшылықтары.....592

**Ендыбаев С.Т., Жусипова Э.Е., Дүйсенбекұлы А.-х.**

Қазақстанда қаржылық ақпарат шектеулі жағдайда стартаптардың құнын бағалау әдістемелерін бейімдеу.....613

**Еримпашева А., Тарақбаева Р., Люй Ч.**

Қазақстан мен Қытай арасындағы инвестициялық өзара іс-қимыл трансконтиненталдық көлік дәліздерін қалыптастыру факторы ретінде.....631

**Жумалдинова Д., Ешенкулова Г., Wronka-Pośpiech M.**

Креативті индустрия стартаптарындағы жана әдістер мен технологиялар: конфигурациялық шолу.....647

<b>Қадырбекова Д.С., Климова Т.Б., Дүйсеннова Р.Ж.</b> Қазақстандағы халықаралық туризм: шетелдік туристерді тарту факторлары және ел брендин күшейту мүмкіндіктері.....	664
<b>Қадырова К., Давлетова М., Амиргалиева А.</b> Қазақстандағы шағын және орта бизнестің цифрлық трансформация жағдайындағы маркетингтік стратегиялары.....	681
<b>Кальбаева Н.Т., Сатенов Б.И., Хасенова Л.А.</b> Қаржылық факторлардың түркістан облысындағы ет өндірісін экспорттық дамуына әсері: сценарийлік тәсіл.....	699
<b>Каримова Б., Касенова Г., Супугалиева Г.</b> Қазақстанның қор нарығындағы қаржы құралдарының құбылмалылығы: өлшеу және болжау.....	722
<b>Қожахметова Ә.К., Есмұрзаева А.Б., Анархан А.Қ.</b> Жасыл энергетика жобаларының тиімділігін интегралды ESG-бағалау: экономикалық, әлеуметтік және экологиялық аспектілер.....	741
<b>Құралбаева А.Ш., Исаева Г.К., Махатова А.Б.</b> Финтех-инструменттер Қазақстанның ауылдық өңірлерінің тұрақты дамуына инвестицияларды ынталандыру механизмі ретінде.....	767
<b>Мелдебекова А., Канабекова М., Азбергенова Р.</b> Қазақстанның жоғары біліміндегі инновацияларды басқару: индикаторлар және модельдер.....	783
<b>Молдажанов М.Б., Тахтаева Р.Ш., Дюсембинова Ж.С.</b> Семей ядролық қауіпсіздік аймағы мен Курчатов қаласындағы экономикалық қызметтің Семей сынақ полигоны ядролық туризмінің дамуына әсері.....	807
<b>Нұрбатсын А., Киреева А.А.</b> Жоғары білім сапасын арттыру құралы ретіндегі цифрлық технологиялар.....	829
<b>Нурбекова Ш.К., Есімжанова С.Р., Алимжанова Л.М.</b> Цифрландыру негізінде ерекше экономикалық аймақтардағы көлік-логистикалық қызметтерді басқарудың тиімділігін арттыру.....	851
<b>Нұрмұханова Г.Ж., Абжатова А.К., Құрманғалиева А.К.</b> Қазақстанда еңбек нарығы мен жоғары білімнің өзара байланысы: үрдістері мен даму бағыттары.....	875
<b>Полежаева И.С., Суюндиков А.С., Стаценко О.А.</b> Қазақстан Республикасының энергетика саласының экономикалық тиімділігін арттыруға цифрландырудың әсері.....	892

**Разакова Д.И., Алшанов Р.А., Қазыбаева М.Н.**

Қазақстан өнеркәсібінің цифрлық трансформациясы: кәсіпорындардың дайындығы мен енгізу барьерлерінің эмпирикалық талдауы.....916

**Сагиндыкова Г.М., Тусибаева Г.С., Балгинова К.М.**

Қатысушылардың әлеуметтік жауапкершілігі мен уәждемесін қалыптастырудың инновациялық стратегиялары цифрландыру жағдайында  
ҚР зейнетақы жүйесі.....935

**Садықов Е.Т., Жамкеева М.К., Конырбеков М.Ж.**

Қазақстан экономикасындағы үстеме бағалардың құрылымы және оның инфляциялық үрдістерге ықпалы.....955

## СОДЕРЖАНИЕ

## ПЕДАГОГИКА

<b>Абуова Б.П., Абишева С.Д., Адибаева Ш.Т.</b> Методический потенциал детской литературы Казахстана в образовательном процессе на примере «казахстанских сказок» Юрия Серебрянского.....	19
<b>Азыбаев М., Жайдакбаева Л.К.</b> Педагогические и технологические аспекты реализации смешанного синхронного обучения.....	38
<b>Базарбаева А.Н., Мубаракوف А.М., Ибадулла С.Н.</b> Методические основы использования современных цифровых инструментов в преподавании изобразительного искусства.....	55
<b>Ерболатов Н.Н., Токтаганова Г.Б., Назарова Г.А.</b> Диагностика результатов обучения магистрантов на основе интеграции образования, науки и производства и перспектив совершенствования.....	69
<b>Жайынбаева С.К., Майматаева А.Д., Косауова А.К.</b> Формирование профессиональной компетентности будущих учителей биологии на основе технологии «перевернутый класс».....	87
<b>Жамбылқызы М., Байбосынова Т., Алейшо М.</b> Использование Action Research как метод профессионального развития преподавателей английского языка.....	102
<b>Жарылгапова Д.М., Карабала Т.М., Пирмаганбет А.Е.</b> Повышение интереса и интеллектуальных навыков студентов при преподавании физики через мобильные приложения.....	116
<b>Имангалиева Б., Ермаханов М., Алдиярова А.</b> Методика преподавания химии для учащихся с особыми образовательными потребностями: практика казахской средней школы.....	133
<b>Каженова Ж.С., Рахматуллина З.Т.</b> Организация образовательного процесса с использованием комплектов для образовательной робототехники.....	151
<b>Казбай П.А., Кудайбергенова К.Т.</b> Обучение образу "героини-девушки" в казахских эпосах в вузе по технологии критического мышления.....	174
<b>Кайсарова А.С., Женсикбаева Н.Ж., Сабырбаева Б.Т.</b> Краеведение как средство социализации личности учащегося.....	187

<b>Медеубаева К.Т., Хасанова И.У., Сейтенова С.С.</b> Потенциал искусственного интеллекта в персонализации образовательных траекторий подготовки будущих учителей: опыт Казахстана.....	204
<b>Наби Н.Б., Рахметова Р.С.</b> Значение модели 4К в формировании коммуникативных навыков и ее концептуальная основа.....	222
<b>Нуржанова А.Р., Жусупова Р.Ф., Яленяускене Э.</b> Искусственный интеллект в образовании: оценка образовательных платформ на основе ии.....	238
<b>Нуризинова М.М., Баймуханбетов Б.М., Исаев М.С.</b> Развитие гибких навыков (soft skills) у обучающихся: исследование влияния теоретических подходов.....	259
<b>Нурлан М.Н., Бакырджы Н., Аден Ж.Ш.</b> Актуальность преподавания жанра жыр с использованием инновационных технологий.....	275
<b>Орынбасар Т.О., Амирбекова А.Б.</b> Тезаурус писателя и методика обучения художественному стилю литературы: систематический обзор по методу PRISMA.....	295
<b>Пернебаева Ф.С., Бакеш З.О., Калымбетова А.А.</b> Важность использования технологий искусственного интеллекта при изучении языка.....	310
<b>Сейтбекова Г.О., Кокажаева А.Б., Сулейменкулова Г.Т.</b> Развитие и оценка математической функциональной грамотности учащихся через решение текстовых задач финансового содержания.....	338
<b>Семенихина С.Ф., Семенихин В.В.</b> Обзор по исследованию внедрения альянса «школа – вуз – наука – производство» в целостном педагогическом процессе.....	362
<b>Сматова К.Б., Алимбаева С.К., Оспанбаева М.П.</b> Исследование трансформации диагностики готовности к школе в цифровой формат.....	378
<b>Токтагулова У.С., Карменова Н.Н., Садыкова Д.А.</b> Формирование представлений обучающихся об определении роли и эффективности учебно-полевой практики в развитии теоретических знаний.....	396
<b>Уалиханова А., Абуов А.Е., Болысбаев Д.С.</b> Методологические подходы к изучению роли дворовых клубов в формировании духовных ценностей детей.....	417

**Усманова Х., Стычева О.**

Использование официально-делового стиля в образовательном процессе как средство профессиональной подготовки будущих учителей русского языка.....433

**Хасенова М.Т., Смагулов М.З.**

Химия без барьеров: стратегии инклюзивного обучения в классе.....455

**ЭКОНОМИКА****Абдуллаев А.М., Кадырова М.Б., Куралбаев А.А.**

Управление кадрами в системе местного самоуправления: подготовка и развитие профессиональных компетенций.....505

**Аманбай А., Рахимбердинова М.У., Массанова Л.Е.**

Анализ развития рынка жилищного строительства в Республике Казахстан.....523

**Амангожаева А.Б., Акпанов А.К., Касымбекова Г.Р.**

Детерминанты уязвимости банковского сектора казахстана: многометодный анализ рыночных, кредитных и ликвидных рисков.....523

**Бейсенбаева А., Ерназарова У., Турдалиева У.**

Оценка эффективности внутреннего контроля с учётом ESG-рисков: модель для банковского сектора Казахстана.....539

**Домалатов Е.Б., Абылайханова Т.А.**

Нейросети как инструмент повышения эффективности управления человеческим капиталом: эмпирический анализ и предиктивное моделирование.....554

**Елтай Б.Б., Азатбек Т.А.**

Оценка влияния изменений мировых цен на цветные металлы на экспортную динамику цветной металлургии Казахстана.....569

**Елшибекова К.Ж., Ералина Э.М.**

Конкурентные преимущества отечественных робототехнических комплексов в промышленности Казахстана.....592

**Ендыбаев С.Т., Жусипова Э.Е., Дуйсенбекұлы А.-Х.**

Адаптация методологий оценки стоимости стартапов в Казахстане в условиях ограниченной финансовой информации.....613

**Еримпашева А., Таракбаева Р., Люй Ч.**

Инвестиционное взаимодействие Казахстана и Китая как фактор формирования трансконтинентальных транспортных коридоров.....631

**Жумалдинова Д., Ешенкулова Г., Wronka-Pośpiech M.**

Новые методы и технологии в стартапах креативной индустрии: конфигурационный обзор.....647

<b>Кадырбекова Д.С., Климова Т.Б., Дүйсенкова Р.Ж.</b> Международный туризм в Казахстане: факторы привлечения иностранных туристов и возможности усиления бренда страны.....	664
<b>Кадырова К., Давлетова М., Амиргалиева А.,</b> Стратегии малого и среднего бизнеса Казахстана в условиях цифровой трансформации.....	681
<b>Кальбаева Н.Т., Сатенов Б.И., Хасенова Л.А.</b> Влияние финансовых детерминант на экспортное развитие мясного производства в Туркестанской области: сценарный подход.....	699
<b>Каримова Б., Касенова Г., Супугалиева Г.</b> Волатильность финансовых инструментов на фондовом рынке Казахстана: измерение и прогнозирование.....	722
<b>Кожаметова А.К., Есмурзаева А.Б., Анархан А.К.</b> Интегральная ESG-оценка эффективности проектов зеленой энергетики: экономический, социальный и экологический аспекты.....	741
<b>Куралбаева А.Ш., Исаева Г.К., Махатова А.Б.</b> Финтех-инструменты как механизм стимулирования инвестиций в устойчивое развитие сельских регионов Казахстана.....	767
<b>Мелдебекова А., Канабекова М., Азбергенова Р.</b> Управление инновациями в высшем образовании Казахстана: индикаторы и модели.....	783
<b>Молдажанов М.Б., Тахтаева Р.Ш., Дюсембинова Ж.С.</b> Влияние экономической деятельности в семипалатинской зоне ядерной безопасности и городе Курчатов на развитие ядерного туризма СИП.....	807
<b>Нурбатсын А., Киреева А.А.</b> Цифровые технологии как инструмент повышения качества высшего образования.....	829
<b>Нурбекова Ш.К., Есимжанова С.Р., Алимжанова Л.М.</b> Повышение эффективности управления транспортно-логистическими услугами в особых экономических зонах на основе цифровизации.....	851
<b>Нурмуханова Г.Ж., Абжатова А.К., Курмангалиева А.К.</b> Взаимосвязь рынка труда и высшего образования в Казахстане: тенденции и направления развития.....	875
<b>Полежаева И.С., Суюндииков А.С., Стаценко О.А.</b> Влияние цифровизации на повышение экономической эффективности энергетической отрасли Республики Казахстан.....	892

**Разакова Д.И., Алшанов Р.А., Казыбаева М.Н.**

Цифровая трансформация промышленности Казахстана: эмпирический анализ готовности предприятий и барьеров внедрения.....916

**Сагиндыкова Г.М., Тусибаева Г.С., Балгинова К.М.**

Инновационные стратегии для формирования социальной ответственности и мотивации участников пенсионной системы РК в условиях цифровизации.....935

**Садыков Е.Т., Жамкеева М.К., Конырбеков М.Ж.**

Структура наценок в экономике Казахстана и ее влияние на инфляционные процессы.....955

SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS

ISSN 1991-3494

Volume 1.

Number 419 (2026), 455-476

<https://doi.org/10.32014/2026.2518-1467.1118>

ӘОЖ 372.85

IRSTI: 14.25.07

© **Khasenovna M.T.\***, **Smagulov M.Z.**, 2026.

Pavlodar Pedagogical University named after A. Margulan, Pavlodar, Kazakhstan.

E-mail: maral\_176@mail.ru

## CHEMISTRY WITHOUT BARRIERS: STRATEGIES INCLUSIVE LEARNING IN CLASS

**Khasenovna Maral** — PhD, Senior Lecturer, Pavlodar Pedagogical University named after A. Margulan, Pavlodar, Kazakhstan,

E-mail: maral\_176@mail.ru, <https://orcid.org/0000-0001-7672-7407>;

**Smagulov Meirman** — PhD student, Pavlodar Pedagogical University named after A. Margulan, Pavlodar, Kazakhstan,

E-mail: meirmansmagulov@gmail.com, <https://orcid.org/0009-0005-2939-9275>.

**Abstract.** In today's world, chemistry plays a key role in addressing global challenges such as climate change, the energy crisis and human health. However, access to quality education in this field remains limited for many populations. The study «Chemistry without Barriers» analyses existing barriers to the teaching and practice of chemistry and looks at ways to overcome them. The article examines the main barriers, including lack of resources, language and cultural differences, and learners' lack of practical experience. We emphasise the importance of an inclusive approach in education that takes into account the diversity of learners and their needs. Innovative methodologies, such as the use of digital technologies, open educational resources and distance learning platforms, which can significantly increase access to knowledge, are proposed as solutions. In addition, the publication presents successful examples of programmes aimed at engaging diverse populations in the study of chemistry. We analyse the experience of international projects that have contributed to the creation of inclusive educational environments, and share recommendations for implementing such initiatives in educational institutions. The article aims to inspire educators to create more accessible and diverse educational environments in chemistry. We believe that Chemistry Without Barriers not only promotes the development of scientific thinking and practical skills among subject teachers, but also promotes the development of a more accessible and diverse educational environment in chemistry.

**Keywords:** Education, learning process, inclusive education, methods, learning technologies

*For citations:* Khassenova M.T., Smagulov M.Z. Chemistry without barriers: strategies inclusive learning in class. *Scientific Journal of Pedagogy and Economics*, 2026. — No.1. — Pp. 455-476. DOI: <https://doi.org/10.32014/2026.2518-1467.1118>

© Хасенова М.Т.\*, Смагулов М.З., 2026.

Ә. Марғулан атындығы Павлодар педагогикалық университет, Павлодар, Қазақстан.

E-mail: [maral\\_176@mail.ru](mailto:maral_176@mail.ru)

## КЕДЕРГІСІЗ ХИМИЯ: СЫНЫПТА ИНКЛЮЗИВТІ ОҚИТУ СТРАТЕГИЯЛАРЫ

**Хасенова Марал** — PhD, аға оқытушы, Ә. Марғулан атындығы Павлодар педагогикалық университет, Павлодар, Қазақстан,

E-mail: [maral\\_176@mail.ru](mailto:maral_176@mail.ru), <https://orcid.org/0000-0001-7672-7407>;

**Смагулов Мейрман** — докторант, Ә. Марғулан атындығы Павлодар педагогикалық университет, Павлодар, Қазақстан,

E-mail: [meirmansmagulov@gmail.com](mailto:meirmansmagulov@gmail.com), <https://orcid.org/0009-0005-2939-9275>.

**Аннотация.** Қазіргі әлемде химия климаттың өзгеруі, энергетикалық дағдарыс және адам денсаулығы сияқты жаһандық мәселелерді шешуде шешуші рөл атқарады. Алайда, осы саладағы сапалы білімге қол жетімділік көптеген адамдарға, балаларға шектеулі болып қала беруі мүмкін. «Кедергісіз Химия» зерттеуі химияны оқыту мен тәжірибеде бар кедергілерді талдауға бағытталған және жаңа жолдарды, әдістерді қолдану жолдарын қарастырады. Мақалада ресурстардың жетіспеушілігі, тілдік және мәдени айырмашылықтар, сондай-ақ білім алушылардың практикалық тәжірибесінің болмауы сияқты негізгі кедергілер қарастырылады. Біз оқушылардың әртүрлілігі мен олардың қажеттіліктерін ескеретін білім берудегі инклюзивті тәсілдің маңыздылығын атап өтеміз. Шешім ретінде сандық технологияларды, ашық білім беру ресурстарын және қашықтықтан оқыту платформаларын пайдалану сияқты инновациялық әдістер ұсынылады, бұл білімге қол жетімділікті едәуір кеңейте алады. Сонымен қатар, басылымда халықтың әртүрлі топтарын химияны зерттеуге тартуға бағытталған бағдарламаларды жүзеге асырудың сәтті мысалдары келтірілген. Біз инклюзивті білім беру ортасын құруға ықпал еткен халықаралық жобалардың тәжірибесін талдаймыз, сондай-ақ оқу орындарына осындай бастамаларды енгізу бойынша ұсыныстармен бөлісеміз. Мақала мұғалімдерді химия саласында қол жетімді және әр түрлі білім беру ортасын құруға шабыттандыруға арналған. Біз «кедергісіз химия» пән мұғалімдерінің ғылыми ойлауы мен практикалық дағдыларын дамытуға

ықпал етіп қана қоймай, қазіргі заманның өзекті мәселелерін шешуге дайын химиктердің жаңа буынын қалыптастыратынына сенімдіміз. Сайып келгенде, химиялық білімге қол жеткізу әркімнің құқығы болуы керек және біздің басылым осы маңызды идеяны қолдауға тырысады.

**Түйін сөздер:** Білім беру, оқу процесі, инклюзивті білім беру, оқыту әдістері, технологиялары

© **Хасенова М.Т.\***, **Смагулов М.З.**, 2026.

Павлодарский педагогический университет им.А. Марғулана,

Павлодар, Казахстан.

E-mail: maral\_176@mail.ru

## **ХИМИЯ БЕЗ БАРЬЕРОВ: СТРАТЕГИИ ИНКЛЮЗИВНОГО ОБУЧЕНИЯ В КЛАССЕ**

**Хасенова Марал** — PhD, ст. преподаватель, Павлодарский педагогический университет им. А. Марғулана Павлодар, Казахстан,

E-mail: maral\_176@mail.ru, <https://orcid.org/0000-0001-7672-7407>;

**Смагулов Мейрман** — докторант, Павлодарский педагогический университет им. А. Марғулана Павлодар, Казахстан,

E-mail: meirmansmagulov@gmail.com, <https://orcid.org/0009-0005-2939-9275>.

**Аннотация.** В современном мире химия играет ключевую роль в решении глобальных проблем, таких как изменение климата, энергетический кризис и здоровье человека. Однако доступ к качественному образованию в этой области остается ограниченным для многих групп населения. Исследование «Химия без барьеров» посвящена анализу существующих преград в обучении и практике химии и рассматривает пути их преодоления. В статье рассматриваются основные барьеры, включая недостаток ресурсов, языковые и культурные различия, а также отсутствие практического опыта у обучающихся. Мы подчеркиваем важность инклюзивного подхода в образовании, который учитывает разнообразие учащихся и их потребности. В качестве решения предлагаются инновационные методики, такие как использование цифровых технологий, открытых образовательных ресурсов и платформ для дистанционного обучения, которые могут значительно расширить доступ к знаниям. Кроме того, в публикации представлены успешные примеры реализации программ, направленных на вовлечение различных групп населения в изучение химии. Мы анализируем опыт международных проектов, которые способствовали созданию инклюзивной образовательной среды, а также делимся рекомендациями по внедрению подобных инициатив в учебные заведения. Статья призвана вдохновить педагогов на создание более доступной и разнообразной образовательной среды в области химии. Мы уверены, что «Химия без барьеров» не только

способствует развитию научного мышления и практических навыков у педагогов - предметников, но и формирует новое поколение химиков, готовых к решению актуальных проблем современности. В конечном итоге, доступ к химическому образованию должен быть правом каждого, и наша публикация стремится поддержать эту важную идею.

**Ключевые слова:** Образование, учебный процесс, инклюзивное образование, методы, технологии обучения

**Introduction.** Children in the «children with special educational needs» group face various difficulties. The inclusion of children with special educational needs requires the creation of pedagogical conditions that allow the child to grow and develop as a person, to realize themselves, and to acquire creative and professional knowledge and skills. The SEN (special educational needs) group includes not only children with disabilities, but also children living in remote rural areas, children with a language barrier, migrant children, gifted children etc., that is, all those categories that need special learning conditions.

Implementing the inclusive education program provides an opportunity for children with LHO (limited health opportunities) to receive an excellent education, enabling them to remain fully developed people (National Plan for Ensuring the rights and improving the quality of life of persons with disabilities in the Republic of Kazakhstan until 2025). The process of educating and raising children with SEN and LHO differs in several ways. Inclusion of children with LHO is a complex and time-consuming process, as it obliges not only the creation of a material and technical base for students, but also the training of qualified personnel. Involving «special» children is a time-consuming and unpredictable process for both the children themselves and their parents and teachers. Adaptation of children to a new environment is complicated not only by limited opportunities but also by psychological difficulties. Children need to adapt to social conditions; each child's capacity to adapt is individual and sometimes limited. In this regard, it is necessary to consider the challenges and create optimal conditions for the effective inclusion of children with LHO in an inclusive pedagogical setting.

Inclusive education is considered a key priority in current educational policy, with the main focus on providing equal educational opportunities for all students, including those with special educational needs. The work carried out abroad draws attention to the need for flexible educational tactics that will allow adapting the content, forms, and methods of teaching to the heterogeneity of students. In this context, Universal Design for Learning (UDL) is a prospective and innovative methodological model for developing inclusive pedagogical materials and programs, especially relevant for teaching scientific disciplines such as chemistry.

Applying UDL principles in chemistry classes improves the quality of learning and learning outcomes for students with special educational needs by using digital media, interactive tools, and adaptive complexity tasks (Nurramadhani et al., 2024).

**Literature review.** The problem of inclusive chemistry education is also

considered in foreign pedagogical publications. Thus, the Journal of Chemical Education considers the MiC (Model for Inclusive Chemistry Teaching), which aims to establish an inclusive teaching environment through interactive tools, media materials, and custom learning modules. The authors illustrate that the assimilation of these tools enables effective inclusion of students with varying levels of training and motivation in the learning process, as evidenced by empirical data (Kranz and Tiemann, 2022).

Scientists in Kazakhstan are also actively studying issues of inclusive education and their effective application in the country's educational space. The works of Bataev, Mamkina, and Shataeva address the specifics of preparing future chemistry teachers to work in inclusive learning classrooms, pointing out the importance of developing professional competencies to individualize instruction and address the educational needs of all students (Shatayeva et al., 2021). In other domestic studies, based on the works of Kazakhstani and foreign scientists, a meaningful analysis of the concept of «inclusive education» is carried out, and the main models and approaches concerning inclusiveness that can be adapted to the development of school pedagogical practice in the Republic of Kazakhstan are identified (Shadyrova, 2024).

In addition, domestic publications highlight the capabilities of up-to-date educational technologies, such as virtual laboratories, to expand access to chemical education for students with disabilities. The research by Abdurazov, Usenbai, and Aldanazarova shows the positive impact of virtual laboratory modeling on overcoming physical and cognitive barriers to studying chemistry in an inclusive pedagogical environment, stressing the need for greater application of digital resources in the learning process (Abdurazov et al., 2025).

The analysis of the scientific literature suggests that inclusive chemical education is an interdisciplinary field in which pedagogical theories, didactic methods, and educational technologies are closely intertwined. Despite the experience gained abroad, it is still necessary to continue developing strategies for teaching chemistry within the Kazakh scientific community, focusing on the diversity of students' educational needs and, as far as possible, on the features of an inclusive pedagogical environment.

At present, inclusive education is becoming an integral part of the Republic of Kazakhstan's general secondary education system. In general education schools, the number of inclusive classes in which children with different educational opportunities study together is growing. Thus, teachers across disciplines face the challenge of finding effective didactic approaches that ensure educational materials are available to all students, including those with special educational needs.

Teaching chemistry is particularly challenging in an inclusive teaching environment. This topic requires trained abstract thinking, the ability to work utilizing symbols, formulas, and equations, as well as active participation in laboratory and practical work. For some students, these qualities become a serious obstacle to learning the educational content. In practice, the situation is complicated

by the fact that most textbooks and teaching materials on chemistry are focused on the typical student and do not account for the diversity of educational needs, limiting the possibility of differentiation and individualization of training.

The analysis of teaching practice shows that chemistry teachers often do not have the opportunity to consult, and there is insufficient methodological and educational material suitable for inclusive teaching. In particular, tasks with step-by-step instructions, visual models of chemical processes, alternative methods of conducting laboratory work, and flexible methods for evaluating student performance are not sufficiently presented. As a result, teachers are forced to adapt the teaching material independently, based on their personal experience and intuition.

At the same time, implementing adaptive pedagogical practices, such as visual aids and diagrams, digital and virtual laboratories, modified experimental tasks, collaborative activities, and differentiated tasks, positively impacts students' motivation and learning success. These approaches help to reduce barriers to learning, arouse cognitive interest, and actively involve all students in the learning process.

Therefore, the approach to the problem of inclusive chemistry education is relevant for modern pedagogical practice and is inspired by the necessity for methodological support for teachers in inclusive classes. The study and systematization of proven techniques for teaching barrier-free chemistry can improve the quality of teaching the subject and ensure the implementation of inclusive education principles in schools.

**Materials and basic methods.** History shows that the formation of inclusive education was not easy; the founders of this form of education were philosophers, educators, and teachers since the ancient world. The concepts formulated by them showed the need to teach children with SEN.

The process of forming inclusive education shifted from one model to another, and the «Normalization Model» or integration strategy, began its movement in the middle of the 20th century. The unification strategy is aimed at a limitless society, a society without different groups, in which everyone learns, lives, works, and fulfills themselves together. When implementing this model, there is no need to create separate institutions; special conditions are not created, everyone is on an equal footing, and is forced to adapt to the system. The integration system has expanded the opportunities of people with LHO, allowing them to study in general education schools, colleges, and universities. The implementation of the strategy is possible with strict adherence to the action plan, a single educational algorithm, the application of the principle from simple to complex, and the complexity of teaching methods and techniques (Kotova, 2008).

The current model of organizing the educational process for children with LHO is taking a new trajectory, called the «social model» or inclusive strategy. Pedagogy, psychology, and humanistic philosophy have become the basis of an inclusive education strategy. This strategy signifies the needs of people with disabilities as much as possible. Acceptance by society of a person with SEN, creation of optimal

living conditions for him, assistance in adapting to the environment for each individual in need, these areas involve inclusion, inclusive education. An inclusive strategy includes not only people with disabilities, but also other categories, such as children from dysfunctional families, national minorities, by religion, and others. This strategy is not limited to certain stages or levels of the education system; its implementation is possible at all stages and levels of the education system, and it is aimed at each child, his individuality and personality. Inclusion is understood as a new approach, new psychological and pedagogical methods and techniques. Inclusive education differs from correctional education in that, on the one hand, it leads to the development of new teaching methods, and, at the same time, unifies the education system, allowing not only children with LHO to learn but also healthy ones, equalizing the opportunities of both categories. Teachers and students are components of the same system, organized as subject-subject relations, which is what inclusive education is all about. Children acquire subjectivity as an effective quality. Subjectivity allows children to take an active role in the life of the environment and the team, thus forming transformative relationships. The transformation of relationships is accompanied by a change in people's activities, towards themselves and the world, towards life and the people and events around them. In such conditions, a new feeling, called «subjective well-being» (Tsyrenov, 2014), is formed. This state is characterized by a completely new positive, active life position, expressed not only by a change in attitudes and attitudes to current events in the world and to the world itself, but also by a revision of the attitude to oneself and to one's life, the quality of life. With this form of organizing the educational process, the educational environment adapts and creates conditions for children with LHO, taking into account their characteristics and needs, but not vice versa, adjusting the child to the system.

The aim of the study is to substantiate and theoretically analyze efficient methods for inclusive chemistry education in general education schools, ensuring access to educational content and effective mastery of the discipline for students with special educational needs.

To achieve this goal, the article is supposed to solve the following tasks:

1. To identify the specifics and main difficulties of teaching chemistry in an inclusive learning classroom.
2. To consider pedagogical strategies and adaptive methods of teaching chemistry applied in an inclusive schooling environment.
3. Systematize effective methods and forms of work that help reduce educational barriers for students with special educational needs.
4. Determine the pedagogical conditions that ensure the effectiveness of inclusive chemistry education.

WHO data show the health status of the modern younger generation, and at the same time, the tendency to increase the number of children with various pathologies, including ASD, intellectual disabilities, etc. Students with SEN face difficulties in mastering the educational program, and the task of teachers and

heads of educational institutions is to create the necessary conditions for learning and upbringing, and these children should receive full support within the learning institutions. In other words, we need a barrier-free school environment that would allow children with disabilities to thoroughly actualize their educational needs. In this regard, it is necessary to create an inclusive schooling space for children with disabilities.

Each educational institution may have its own subtleties in choosing forms and methods, but there are general principles and laws that must be followed: the principle of respecting the best interests of the child; the principle of continuity; compliance with the principle of consistency; respect for the principle of humanization; the principle of assistance; the principle of variability.

Where to begin? How to build the education process? First of all, the educational environment determines whether the environment is ready to accept a child with special educational needs. The effectiveness of the implementation process of a child with SEN primarily depends on the organizational and pedagogical conditions. One of the most important indicators remains the development of the adaptive environment. Adaptive environment – a set of indicators

1. Adapting the learning process
2. No architectural barriers
3. No physical barriers
4. Individual training approaches

Thus, the priority questions are «Is the education system ready for inclusion?», «Where to start the process?». One of the most important aspects of the educational process's readiness to accept and include children with disabilities is the indicator of students' adaptability in the educational environment. The successful implementation of a student with SEN ensures the creation of organizational and pedagogical conditions that include not only the elimination of physical barriers through the resolution of architectural obstacles, but also the creation of conditions for the child's comfortable stay in this society. Such an environment allows the child not only to adapt successfully and feel comfortable, but also promotes individual advancement, increasing self-esteem and self-importance, and therefore self-realization. The role of the subject teacher is very important in this process; the degree of perception of the material depends on it, it creates an adaptive model of the educational process through methodological and technical capabilities.

Individualization of the learning process is aimed specifically at this child and may include such modifications as:

- Change of deadlines, task forms, and methods of presenting results.
- Concentration of the student's attention on precise details of the educational material;
- drawing up an individual «waybill» with a description of the route from learning new material to completing homework;
- Implementation of all possible methods of perception of the material;

The educational process is impossible without psychological and medical

support. Each child with SEN is different, and therefore the learning and development strategies are individual, taking into account their needs and characteristics. Through the educational process, the inclusion of a child with LHO is not only about educational activities but also about socio-cultural adaptation and integration. In this regard, the educational institution and teachers have a great responsibility to include a child with LHO in society. Teachers face the challenge of organizing the educational process with maximum efficiency and achieving the expected results, which means choosing the most rational ways to solve problems.

The traditional model of education, which has long been used in general secondary education, focuses on the average level of students and assumes uniform requirements for the pace of learning, forms of learning and assessment methods. Within this approach, the content and methods of teaching chemistry primarily do not take into account students' individual educational needs, which limit the possibility of full inclusion of children with special educational needs in the educational process. This is manifested in mastering the frontal forms of work, abstract-theoretical presentation of the material and standard laboratory tasks, the performance of which requires a high level of formation of abstract thinking and experimental skills.

For students with special educational needs, these demands frequently become a serious obstacle to learning, which leads to a decrease in motivation and difficulty in mastering educational content. According to foreign researchers, focusing only on a single educational standard without flexible adaptation of the content and instructional techniques does not correspond to modern principles of inclusive education (Abdurazov et al., 2025).

Unlike the traditional approach, inclusive education is based on the principles of accessibility, variability, and educational diversity of students. Inclusive education consists of adapting the content, methods, and forms of teaching chemistry to the individual capabilities of students. In pedagogical practice, this is done with the help of differentiated tasks, visual models of chemical processes, visual diagrams, alternative forms of laboratory and practical work, as well as flexible methods for evaluating academic results ( ).

The analysis of scientific research shows that in the context of inclusive education, modern models of teaching chemistry are of particular importance. The analysis of scientific research shows that Modern models of chemical education are becoming particularly important in an inclusive schooling environment. One of the most common is the universal model of learning design (Universal Design for Learning), which includes various ways of communicating information, organizing educational activities and displaying learning outcomes (Abdurazov, 2025). .

Kazakh academics point out that the transition to an inclusive model of teaching chemistry calls for not only updating educational materials, but also specific training of teachers to work in an inclusive learning classroom. The lack of development of adapted methodologies and practical recommendations complicates the implementation of inclusive education and reduces its effectiveness ).

Thus, a comparative study of traditional and universally accessible approaches shows that inclusive chemical education has a considerable capacity for improving access and the standard of education. Unlike the traditional model, the all-encompassing approach focuses on removing educational barriers, actively involving all students in the learning process, and setting requirements for achieving learning outcomes based on individual students' abilities.

This leads to the following questions: «How to organize a lesson?», «What methods to apply?», «What principles to build a lesson on?».

The fundamental principles of organizing a lesson with LHO children are: empathy, individualization, consistency, positive reinforcement, collaboration with parents, and other professionals.

Answering the following questions, the teacher considers the method of teaching «special» children, because the correct choice of learning methods for children with SEN (special educational needs) is an art that requires flexibility, sensitivity, and individual approach from the teacher. Using student-centered learning with an emphasis on interaction between students allows you to move from the traditional model, where the teacher is the central figure, to the model focused on the student. Instead of learning passively, students actively participate in the learning process, interacting with each other on an equal footing. Organization of the educational space (group seating, selection of materials and tasks, individual assessment) contributes to effective cooperation. This approach is effective in both specialized as well as inclusive classes, developing interaction skills between all students, regardless of their characteristics. Inclusive education is not able to be unified; it cannot have a universal «recipe», method, technology, but there are a number of general principles and methods that have proven their effectiveness.

Teaching children with SEN is a difficult yet gratifying task. Success depends on the teacher's professionalism, empathy, patience, and willingness to constantly learn and improve. Thus, openness and variability are among the main characteristics of the modern education system in the Republic of Kazakhstan. The instructional environment adapts to the child by identifying the child's needs and creating the necessary conditions, offering optimal, high-quality educational services to both the child and his parents.

The main factors of inclusion of school students in inclusive education are: creation of a barrier-free environment, development of an adapted educational program, and psychological and pedagogical support.

The principle of inclusive education is that teachers and administrators of general education schools accept children regardless of their intellectual, emotional, physical, and social status and create conditions for them based on pedagogical and psychological methods adapted to the needs of children are located.

Thanks to an integrative approach, the learning process allows students to acquire the necessary skills in accordance with educational standards. The main theme of inclusive education is the child with disabilities. In the field of education, the term «child with disabilities» describes children who are unable to complete

the regular curriculum due to mental, intellectual, and physical disabilities and who require specially designed content, methods, and learning standards.

Entering a new environment for children with SEN is a difficult process, given that up to this point they were taught at home, individually, and students have almost no socialization skills. At the first, ascertaining stage of the experiment, our task was to determine the difficulties that students faced in the new real-life conditions, to determine their interests and opportunities.

We are faced with the following questions: what training methods should we adopt? How do I organize the learning process?

For the successful implementation of mixed-ability classroom learning, it is important to use a variety of modern methodologies of instruction and technologies that take into account the individual educational needs of all students. An effective approach is differentiated learning, in which tasks and activities are adapted to each student's level of knowledge, competencies, and interests. In chemistry courses, this can manifest itself by offering students with special educational needs simplified versions of laboratory tasks with step-by-step instructions, while more prepared students complete in-depth tasks or mini-studies. Flashcards with visual guides and diagrams are an important tool for differentiation, which allows all children to learn the material successfully.

No less significant is the multi-modal offer of educational materials, which relies on different channels of perception: visual, auditory, and kinesthetic. Using videos, interactive presentations, 3D molecular models, and chemical process animations allows children with disabilities to better understand abstract concepts. For example, the structure of a molecule can be represented using a three-dimensional model or a virtual simulator, and a demonstration of the experience can be presented as a video that allows students to repeat actions at their own pace.

Project and research activities are another effective method of inclusive learning. Group projects and mini-studies allow children to put their knowledge into practice and develop group work capabilities. For students with disabilities, individual laboratory kits or digital measuring instruments can be used, and the work is evaluated not only by the accuracy of the results, but also by the degree of participation and understanding of the process.

Digital and virtual laboratories, such as PhET, ChemCollective, or Labster, are widely used to simulate chemical experiments in an interactive environment. This is especially useful for students who find it difficult to perform physical experiments, as they can safely observe reactions, change experiment parameters, and study the results under the guidance of a teacher.

Visualization and visual materials are essential for developing a strong understanding of the learning material. Diagrams, infographics, molecular models, and concept maps help children learn complex processes such as chemical reactions and the structure of substances. Students can create their own diagrams or posters that help consolidate their knowledge and develop cognitive skills.

Group training and pair work, in which students of different levels of education

jointly solve educational problems, which are also effective. Roles can be assigned to these groups so that each student is involved in the process, and children with special educational needs receive support from their peers. This approach promotes socialization and development of team skills.

Finally, special attention should be paid to flexible forms of assessment tailored to each student's capabilities. Evaluation can be done through portfolios, observations, oral reports, or multimedia presentations. Lab work is evaluated for participation in the process and understanding of the experience, rather than just the accuracy of results, which creates an environment that encourages the inclusion of all students in the learning process.

The integrated application of these methods and technologies makes chemistry education accessible to all students, reduces obstacles to learning, and forms the active involvement of children with special educational needs in the educational process. Implementing these approaches in chemistry classes improves the quality of education and develops the skills and competencies necessary for all children to successfully master the subject.

To ensure the effectiveness of inclusive chemistry education, it is necessary to create a complex of instructional settings that provide accessibility and quality of the educational process for all students. The fundamental condition is teachers' professional competence, which includes the knowledge and ability to address students' differentiated educational needs. Therefore, the preparation of future teachers for the formation of inclusive competencies requires the assimilation of special disciplines and modules into professional education programs, which is confirmed by research on the formation of inclusive competencies of future teachers in Kazakhstan .

An equally important pedagogical condition is the availability of adapted teaching materials and technologies that account for the specificities of information perception in children with special educational needs. The analysis of methodological aspects of inclusive education shows that the use of adaptive pedagogical technologies and multimedia materials promotes a higher successful assimilation of knowledge and reduces learning barriers for students with LHO.

The third important condition is the organization of psychological and pedagogical support, which creates a favorable emotional setting and supports individual educational trajectories of students. Psychopedagogical support includes systematic diagnostics, counseling, and corrective measures aimed at developing children's cognitive and social skills in an inclusive setting (Rakhmatova, 2024).

Creating an inclusive learning environment that ensures equal access to the learning process is an important factor in effectiveness. This includes adapting the spatial, logistical, and organizational environment to cater to the wide-ranging needs of students, as well as supporting teachers and parents in implementing inclusive practices. Creating a favorable environment in which every student perceives accepted and included in classes is the basis for successful implementation of inclusive education (Abidova and Yerkinzhonova, 2024).

Finally, one of the pedagogical conditions for academic achievement is systematic teacher training in inclusive practices, which includes mastering adaptive didactic approaches, differentiation and individualization competencies, as well as the ability to effectively organize the learning process using Moderna Educational Technologies. The analysis of pedagogical training shows that thorough training of teachers for inclusive activities significantly improves the quality of the educational process and the level of adaptation of students .

Thus, the impact of inclusive chemical education is accomplished by a combination of pedagogical environments, including teacher training, availability of adapted materials, psychological pedagogical support, creation of an inclusive teaching environment, and systematic methodological support. These factors facilitate the creation of a favorable learning environment in which all students have equal opportunities for successful learning and personal development.

**Results.** To identify the level of creation of pedagogical conditions, a survey was conducted among teachers. The purpose of the survey was to identify the best learning methods for children with SEN.

The first question is «What form of training do you prefer when working with children with LHO?». Teachers prefer an individual approach, which is working with the child separately from the main group.

The second question, «How do you feel about inclusive education?» was divided among teachers; some of them consider it a good solution, but the second part of respondents assume that individual training is the most acceptable in this situation.

The third question is «Are there any positive aspects in teaching healthy children together with LHO?». All teachers answered «yes», both to one and the other side of the students. in this form of training, such qualities as tolerance, empathy, mercy, kindness, caring and others are brought up. For children with LHO, this is a good opportunity to socialize, discover their abilities, hidden potential, and talents.

The fourth question, «Are there any drawbacks of co-education for healthy and children with LHO?» teachers noted the complexity, restructuring of didactic methods, that is, a change in the educational process is required.

The fifth question is «Have you completed professional development in the framework of inclusive education?». Professional development is a mandatory procedure for teachers, but they did not complete a course aimed entirely at inclusive education. Professional development, aimed at methodological literacy, partially addressed the issue of inclusion, it's some aspects.

Sixth, «What difficulties do you have to face when working with children with LHO?» For many, it was a methodical training of personnel.

In addition to conducting a survey, students' educational achievement and behavior were monitored. The aspect of adaptation, activity, and socialization of the child, through communication, the ability to ask or help fellow students/ teachers, was considered.

Thus, inclusive education has its own specifics, which do not allow the participation of methodically untrained teachers.

The learning process is fully planned and organized by the teacher, and a choice of methods and means is made to achieve the expected result. The trend of modern education is aimed at active cognitive activity of schoolchildren, the role of the teacher-organizer, «director» of the educational process, the main goal of which is to attract the student through a conscious attitude to learning, this means a change in thinking, perception of information by the student, which is possible during the transition from traditional authoritarian learning to teacher-student cooperation. The updated curriculum is based on a competency - based approach to learning, which means that there is a need for changes in the curriculum. The new standards are based not on the amount of material the student must learn, but on the results of training (Nazarova, 2011). The short-term transition to this form of education is quite difficult, so teachers and students should be prepared for it. One of the ways is to use methods and techniques based on students ' independence, which activates their activities. The teacher, in turn, bases his activity on methods, such as: research, personality-oriented, differentiated approach, active methods, modular, problem-based, etc. (Abdurazova et al., 2025).

Thus, the state standard focuses on teachers' use of innovative, interactive, and active teaching methods.

During the experiment, we used various forms and methods of organizing the educational process when teaching chemistry in groups with children with LHO. We focused on teaching methods such as research, case-based learning, and ICT. The survey of teachers showed that not all the proposed methods are considered to be a priority. Of the 117 teachers surveyed, they noted that they often use ICT methods and less often research and case technology (figure 1).

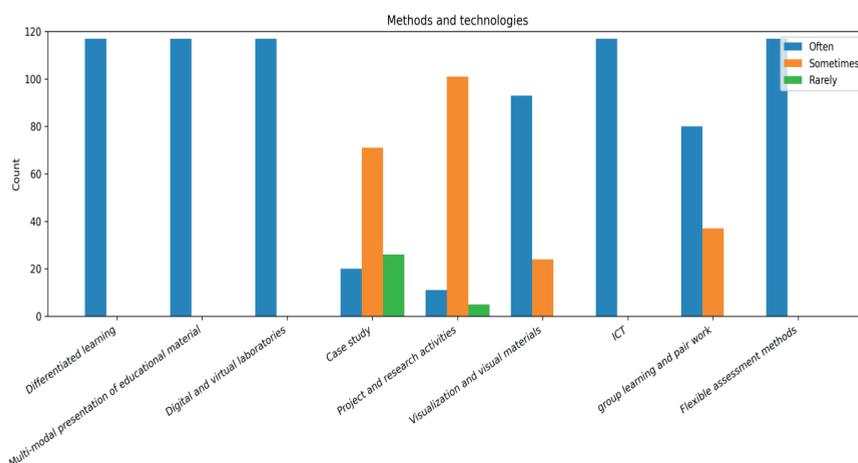


Figure 1 – Diagram of the frequency of application of training methods

As the survey shows, the methodological competence of teachers is quite high. They apply effective (according to the conducted research) methods and

technologies that allow creating the necessary pedagogical conditions for obtaining positive learning outcomes.

Differentiated learning, multi-modal presentation of educational materials, digital and virtual laboratories, flexible assessment forms, and ICT technologies are an integral part of the educational process for children with SEN. Teachers who teach inclusive classes' rate these methods as elementary and basic.

Visualization and visual materials, as well as group training and working in pairs, are also used quite often by teachers. Sometimes it is quite difficult to understand this without images of chemistry, and in this case, creating and presenting a model of a molecule, substance, reaction, virtual and real, makes it easier to perceive matter.

Of the proposed methods, the case method and project and research activities were among the «sometimes» and «rarely» used.

Research activities in chemistry classes are primarily laboratory experiments. Conducting and organizing an experiment means following the safety rules. Performing experiments requires students to have certain skills and abilities. The study of physical, chemical characteristics and methods of preparation is most effective through performing experiments. In this case, the student can clearly see the effect of the reaction, the release of gas, precipitation, the appearance of staining or, conversely, its disappearance, or a change in the color of the solution. Release of odors characteristic of certain substances and compounds.

As mentioned above, performing laboratory work calls for meticulous coordination of movements, knowledge of safety techniques, and compliance with the progress of work. In our case, students with impaired coordination of movement cannot be allowed to perform individual laboratory work. For these guys, we suggested using a virtual laboratory. The virtual laboratory allows you to perform experiments in a safe way, while visualizing the reaction effects that children observe in front of the screen, combining all this with self-performed manipulations. Another positive aspect of such work is the possibility of carrying out reactions with toxicity, explosion or fire hazard, radioactivity or other characteristics that do not allow performing in real mode (Abayeva et al., 2023).

Research work can also include the preparation and defense of research papers, presentations, projects, layouts, etc. When performing this type of work, the student needs to study the literature, information, and select the necessary work for subsequent defense. Research work allows you to form an interest in studying chemistry. Increasing cognitive activity and creativity. Research skills and skills of working with literature are improved, calling attention to the main idea, forming a connection with everyday objects and important processes, such as biological, medical, industrial, and creative abilities are developed. Revealing the hidden potential of a child (Abdigapbarova et al., 2024). Possible formation of professional knowledge and skills necessary for choosing a profession.

Case technology in inclusive chemistry education allows you to create learning situations that are close to real life, making the material understandable and

motivating for all students. For children with special educational needs, the cases are adapted with detailed instructions, visual diagrams, and multimedia materials, which facilitate the perception of information. The method promotes teamwork and socialization, allows you to assign roles in the group, and uses different strategies to solve problems in accordance with the abilities of each student. The use of case technology increases motivation, develops critical thinking, and ensures active participation of all students in the educational process, making chemistry teaching accessible and effective.

As part of the study, a survey was conducted among 45 students of an inclusive class to determine their views on the instructional techniques used: differentiated tasks, case technologies, virtual laboratories and multimedia materials.

The results showed that 82% of respondents said that visual diagrams, step-by-step instructions, and multimedia tools help them better apprehend complex chemical concepts. 76% of students noted that working with cases and participating in group projects increased their interest in the subject and contributed to the development of cooperation skills. Students with special educational needs emphasized that modifying materials and being able to work at their own pace reduced stress and created conditions for successful completion of tasks (93% of positive reviews).

At the same time, healthy students also noted that these methods contribute to the development of evaluative reasoning and analytical skills, and interaction with classmates from different educational backgrounds allows them to find new ways to solve problems.

In general, the results of the survey shown in Figure 2 confirm the effectiveness of the proposed methods, showing that their application creates favorable conditions for the assimilation of educational material, engaged involvement, and the formation of positive learning motivation in all students.

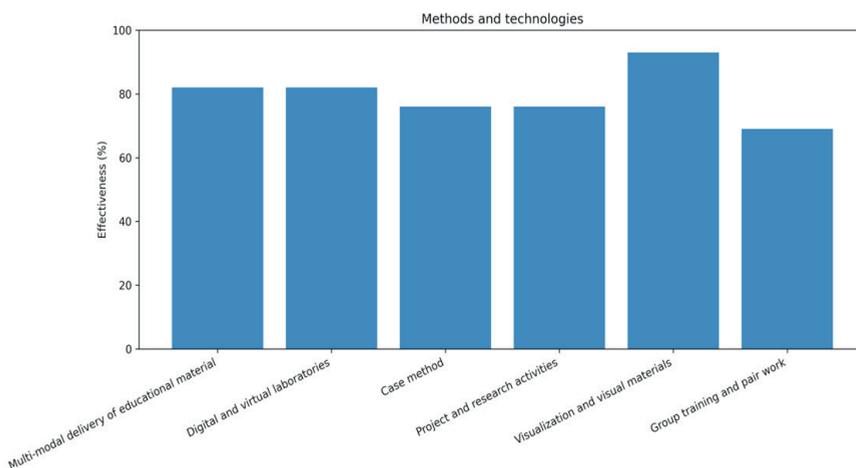


Figure 2 – Effectiveness of using training methods

However, teachers also noted the difficulty of working in inclusive classrooms. Teaching in the classroom inclusively is a rather complex and multifaceted task, which requires that the teacher have great professional competence and adaptability. One of the main difficulties is the need for an individual method for each student. Children with special educational needs can greatly differ in the level of development, cognitive abilities, psycho-emotional state, and speed of assimilation of material, which requires constant differentiation of tasks and instructional techniques.

Another major problem is the lack of methodological guidance and adequate teaching materials, especially in subjects that require abstract thinking and practical skills, such as chemistry. Teachers are often forced to develop individual assignments, lab work, and visual models on their own, increasing their workload and demanding considerable resources of time and creativity.

Organizational and pedagogical difficulties also manifest themselves in managing a class with students of various educational backgrounds. It is important to simultaneously maintain the motivation and interest of all students, monitor safety during experiments, and ensure that all children are included in group and individual tasks, which can be difficult without prior training.

The psychological aspects of working in an inclusive teaching space are also important. Teachers need to be able to manage the emotional atmosphere, help children adapt to the team, take into account behavioral characteristics, cope with conflict situations, and maintain positive learning motivation.

Finally, the lack of sufficient professional training and practical experience in inclusion is another major challenge. Many teachers do not have special training in inclusive pedagogy, which makes it difficult to effectively use adaptive technologies, case studies, virtual laboratories, and flexible assessment models.

Collectively, all these factors make working in an inclusive teaching setting time-consuming and require systematic support, including methodological, psychological, and organizational support from the school and educational system.

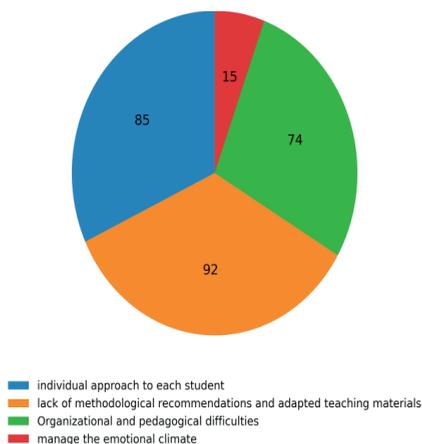


Figure 3 – Difficulties of working in inclusive classrooms

**Discussion.** The analysis shows that the use of inclusive strategies in teaching chemistry contributes to greater accessibility of the educational process and greater inclusiveness of students with different educational needs. An inclusive strategy permits creating conditions in which each student can develop chemical theoretical knowledge and hands-on skills in accordance with their abilities, meeting Moderna's requirements for the quality of education.

The model of inclusive chemistry education «Chemistry without Barriers» is a structured method focused on creating an accessible instructional environment for students with different educational needs. It includes five interrelated blocks: personnel-succession, diagnostic-preparatory, educational-methodical, practical-experimental, and evaluative-reflexive.

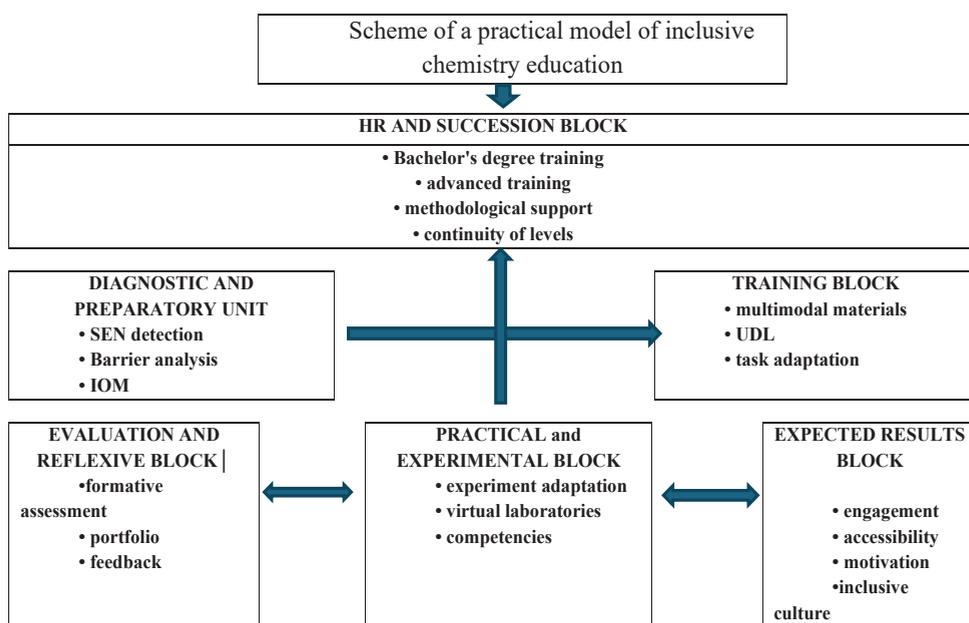


Figure 4 – Model of inclusive chemistry education

An important methodological basis for inclusive chemistry education is the principle of continuity of education, which implies the consistent formation of subject and metasubject competencies at all stages of training. The implementation of inclusive practices should be systematic and ensure continuity between levels of education, which is especially important for students with special educational needs. Lack of consistency in the application of adapted instructional techniques and tools can reduce the effectiveness of the educational process and make it difficult to further master chemical disciplines.

A special function in guaranteeing the continuity of inclusive education is played by the training of teachers, starting from the bachelor's level. The inclusion

in the educational programs of future chemistry teachers of disciplines and modules aimed at developing competencies in the field of inclusive pedagogy, adaptation of educational material, and organization of safe laboratory activities contributes to improving the professional readiness of graduates to work in a diverse student population. Practice-oriented training helps to reduce the professional difficulties of young professionals and ensure longer-lasting implementation of inclusive approaches pertaining to education practice.

The organization of laboratory and practical chemistry classes in an inclusive teaching space requires special attention to safety and inclusiveness. The use of personalized equipment, digital learning resources, and elements of virtual experiments expands the opportunities for students with health problems to participate and helps generate lasting interest in the subject. At the same time, the consistent use of these tools at different stages of learning improves the educational effect and contributes to the motivation of students.

Thus, the results of the discussion confirm that the effectiveness of inclusive chemical education is determined not only by the set of methods used but also by their systematic implementation, based on the principle of continuity of education and specific training of teachers at the university level. Further development of inclusive chemistry education in the education system should be linked to improving teacher training programs and expanding the methodological support for inclusive practice.

Based on the conducted pedagogical experiment, we can state that the use of cutting-edge teaching techniques is acceptable in classes and groups with children with SEN. Moreover, these methods can improve the effectiveness of the educational process. By organizing the process so that students strive to acquire knowledge independently, however, the teacher always needs to take into account the individual capabilities of students, choosing the most optimal conditions for learning.

**Conclusion.** The aim of the experiment was to consider instructional techniques as a factor for including students with LHO in the process of an inclusive educational environment when studying chemistry. Inclusive education is a new platform of opportunities, the principle of implementation of which is «everyone in society is equal», creating opportunities for people with disabilities to realize their life values and skills, both in children with SEN and healthy ones. Implementation of the direction of the inclusive education program provides an opportunity for children with SEN to receive a high-quality education, which allows them to continue to be fully developed person. The direction of inclusive education is considered in the «State Program for the Development of Education in the Republic of Kazakhstan».

The development and implementation of inclusive education in the educational process, through the use of various methods and techniques, can increase students' motivation to acquire knowledge and therefore improve academic results among students with different needs. Students who studied using adapted materials and

differentiated tasks showed a higher level of understanding and assimilation of the material. Inclusive methods, such as group work and hands-on experiments, contributed to greater student involvement in the learning process. This, in turn, helped create a more motivational and helpful ambiance in chemistry classes. Working in mixed groups contributed to the development of students' social and communication skills. Students learned to cooperate, express their thoughts, and help each other, which had a positive impact on their relationships.

The results of the research show the significance of ongoing professional development of teachers in the field of inclusive education. Teachers who completed special courses and training were more effective in applying inclusive approaches and modifying educational material. The results of this study open up prospects for additional studies in the field of inclusive education in the sciences, including experiments with other subjects, scaling successful strategies, and exploring the long-term effects of an inclusive model. Overall, the study confirmed the importance of an inclusive methodology to chemistry education as a means to overcome learning obstacles and establish a fairer teaching environment that promotes the development of all students.

Therefore, the development of inclusive education in the Republic of Kazakhstan is a key priority of the state educational policy aimed at implementing the principles of humanism, equality and social justice. In the context of modernizing public awareness, it is particularly important to ensure equal availability of high-standard education for all categories of students, including children with special educational needs. At present, inclusive education is becoming an integral part of the general secondary education system with an increase in the number of inclusive classes in general education schools. This, in turn, actualizes the problem of methodological support of the educational process and preparation of teachers for work in conditions of educational diversity.

A special problem of inclusive practice is the teaching of chemistry as an academic discipline that requires well-formed abstract thinking, mastery of the symbolic and mathematical language of science, and participation in experimental laboratory activities. The lack of educational materials adapted to different categories of students with special educational needs makes it difficult to apply the principles of differentiation and individualization of learning. The analysis of pedagogical practice shows that chemistry teachers lack scientifically based methodological recommendations for organizing inclusive education. Adaptive forms of presentation of educational materials, alternative methods of practical and laboratory work, as well as flexible models for assessing academic performance, are not sufficiently developed. As a result, teachers have to independently find ways to overcome obstacles in education, which does not always guarantee a long-term positive result. At the same time, the use of inclusive educational tactics, such as visual aids, diagrams and models, digital and virtual laboratories, differentiated tasks, forms of cooperative work and adapted experimental tasks, shows a positive

impact on students' motivation to study and cognitive activity. These approaches help diminish cognitive and psychological barriers and ensure that all students are included in the learning process. In this regard, the search and systematization of successful approaches to inclusive chemistry education seems relevant and relevant for modern pedagogical practice, since they can improve the quality of teaching the discipline and ensure the implementation of the principles of unhindered modern education.

### References

Abayeva G.A., Issaliyeva S.T., Alimovic Sonja, Butabayeva L.A. (2023) [The use of a digital platform for the development of an inclusive educational environment]. *Vestnik KazNPU im. Abaja. Seriya: Pedagogika i psihologiya* (4). — P. 105-111, DOI10.51889/2960-1649.2023.15.4.002 (In Eng.)

Abdigapbarova A.B., Seitmuratov A.Zh., Menlikozhaeva S.K. (2024) Criteria for evaluating students' achievements in mathematics in inclusive education. - *Bulletin of national academy of sciences of the republic of Kazakhstan*, Volume 6. Number 412. — P. 5–15, <https://doi.org/10.32014/2024.2518-1467.850> (In Eng.)

Abdurazova P., Ussenbay A., Aldanazarova M. (2025) Advancing inclusive education: the impact and potential of virtual laboratory simulations for students with disabilities in chemistry. - *Bulletin of national academy of sciences of the republic of Kazakhstan*, Volume 1. Number 413. — P. 5–22, <https://doi.org/10.32014/2025.2518-1467.879> (In Eng.)

Abidova N., Erkinjonova M. (2024) Sozdanie inklyuzivnoj obrazovatel'noj sredy dlya detej s osobymi obrazovatel'nymi potrebnostyami [Creating an inclusive educational environment for children with special educational needs]. *Razvitie i innovacii v nauke*, 3(6). — P. 57–62. <https://inlibrary.uz/index.php/dis/article/view/53074>, <https://doi.org/10.5281/zenodo.11655336> (in Russian)

Glodkowska I., Shatayeva A.M., Batayev D.A. (2023) Osobennosti podgotovki budushchih uchitelej himii v kontekste inklyuzivnogo obrazovaniya [Features of preparing future chemistry teachers in the context of inclusive education]. *Vestnik KazNPU imeni Abaya. Seriya: Pedagogicheskie nauki*, 77(1). — P. 140–151, <https://doi.org/10.51889/1728-5496.2023.1.76.015> (in Russian)

Kvasnykh G., Pustovalova N., & Kolesnikova G. (2022) Podgotovka budushchih pedagogov k rabote v usloviyah inklyuzivnogo obrazovaniya [Preparing future teachers to work in inclusive education]. *Pedagogika i psihologiya*, 3(52). — P. 164–172, <https://journal-pedpsy.kaznpu.kz/index.php/ped/article/view/352> <https://doi.org/10.51889/2680.2022.76.73.018> (in Russian)

Kotova E. (2008) Social'naya tekhnologiya «integrirovannogo obrazovaniya» [Social technology of integrated education]. *Vyshee obrazovanie v Rossii*, 2, 161–163. (in Russian)

Kranz J., & Tiemann R. (2022) Three steps to an inclusive education: MiC, a model for inclusive chemistry teaching. *Journal of Chemical Education*, 99(5), 1868–1876. <https://doi.org/10.1021/acs.jchemed.1c01240> (In Eng.)

Magauova A., Makhambetova, Zh. (2019) Inklyuzivnoe obrazovanie za rubezhom: problemy, opyt i perspektivy [Inclusive education abroad: Problems, experience, and prospects]. *Journal of Educational Sciences*, 58(1). — P. 91–100, <https://doi.org/10.26577/JES.2019.v58.i1.010> (in Russian)

Nazarova N.M. (2012) Inklyuzivnoe i special'noe obrazovanie: prepyatstviya i riski razvitiya [Inclusive and special education: Obstacles and risks of development]. In *Sbornik nauchnyh statej IV mezhdunarodnogo teoretiko-metodologicheskogo seminar. M.: Logomag*. (in Russian)

Nurramadhani A.Z., Pratama K.P.S., Amelia L., Kusuma A., Erika F. (2024) Literature review: Universal Design for Learning (UDL) approach of chemistry learning in inclusion schools. *Hydrogen: Jurnal Kependidikan Kimia*, 12(6). — P. 1324–1337. (In Eng.)

Programma «Nacional'nyj plan po obespecheniyu prav i uluchsheniyu kachestva zhizni lic s invalidnost'yu v Respublike Kazahstan do 2025 g.» [National plan for ensuring the rights and improving the quality of life of persons with disabilities in Kazakhstan until 2025] (2019) *Postanovlenie Pravitel'stva Respubliki Kazahstan № 326*, <https://adilet.zan.kz/rus/docs/P1900000326> (in Russian)

Rakhmatova Sh.N. (2024) Psihologo-pedagogicheskie i organizacionnye usloviya inklyuzivnogo obrazovaniya [Psychological, pedagogical, and organizational conditions of inclusive education]. *Pedagogs*, 54(2). — P. 63–66, <https://pedagogs.uz/ped/article/view/999> (in Russian)

Shatayeva A.M., Makina L.Kh., & Batayev D.A. (2021) Osobennosti podgotovki budushchih uchitelej himii v usloviyah inklyuzivnogo obrazovaniya [Features of preparing future chemistry teachers under inclusive education]. *Vestnik KazNPU imeni Abaya. Seriya: Pedagogicheskie nauki*, 70(3). — P. 91–101, <https://doi.org/10.51889/2021-1.1728-5496.12> (in Russian)

Shadyrova A.B. (2024) Kontent-analiz ponyatiya «inklyuzivnoe obrazovanie» v trudah uchenyh issledovatelej [Content analysis of the concept of inclusive education in scientific research]. *Vestnik KazNPU imeni Abaya. Seriya: Pedagogicheskie nauki*, 81(1). — P. 78–88, <https://doi.org/10.51889/2959-5762.2024.81.1.008> (in Russian)

Shuakbayeva Zh.R., Ospanova B.K., & Oryngaliev Sh.O. (2024) Pedagogicheskie usloviya formirovaniya inklyuzivnoj kompetentnosti budushchih pedagogov [Pedagogical conditions for developing inclusive competence of future teachers]. *Vestnik KazNPU imeni Abaya. Seriya: Pedagogicheskie nauki*, 84(4). — P. 150–159, <https://doi.org/10.51889/2959-5762.2024.84.4.014> (in Russian)

Tamabayeva M.K., Abildina S.K., & Zhekibaeva B.A. (2025) Inklyuzivnoe obrazovanie v Respublike Kazahstan: pravovye osnovy i sovremennoe sostoyanie [Inclusive education in the Republic of Kazakhstan: Legal basis and current state]. *Izvestiya. Seriya: Pedagogicheskie nauki*, 78(3). — P. 1–13, <https://doi.org/10.48371/PEDS.2025.78.3.005> (in Russian)

Tsyrenov V.Ts. (2014) Organizacionno-pedagogicheskie usloviya realizacii inklyuzivnogo obrazovaniya [Organizational and pedagogical conditions for implementing inclusive education]. *Vestnik Kalmyckogo instituta gumanitarnyh issledovaniy RAN*, 2. — P. 163–169. (in Russian)

## **Publication Ethics and Publication Malpractice in the journals of the Central Asian Academic Research Center LLP**

For information on Ethics in publishing and Ethical guidelines for journal publication see <http://www.elsevier.com/publishingethics> and <http://www.elsevier.com/journal-authors/ethics>.

Submission of an article to the journals of the Central Asian Academic Research Center LLP implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see <http://www.elsevier.com/postingpolicy>), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The Central Asian Academic Research Center LLP follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct ([http://publicationethics.org/files/u2/New\\_Code.pdf](http://publicationethics.org/files/u2/New_Code.pdf)). To verify originality, your article may be checked by the Cross Check originality detection service <http://www.elsevier.com/editors/plagdetect>.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/ or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the Central Asian Academic Research Center LLP.

The Editorial Board of the Central Asian Academic Research Center LLP will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

**[www: nauka-nanrk.kz](http://www.nauka-nanrk.kz)**

**ISSN 2518–1467 (Online),**

**ISSN 1991–3494 (Print)**

**<http://www.bulletin-science.kz/index.php/en>**

Ответственный редактор **А. Ботанкызы**

Редакторы: **Д.С. Аленов, Т. Апендиев**

Верстка на компьютере: **Г.Д. Жадырановой**

Подписано в печать 27.02.2026.

46,0 п.л. Заказ 1.