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CHALLENGES AND OPPORTUNITIES OF INCLUSIVE MIDDLE SCHOOL MATHEMATICS FROM TEACHERS' PERSPECTIVES

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Abstract. Inclusive education has become a central priority in global education reform, and mathematics classrooms are at the forefront of this transformation. This study explores how middle school mathematics teachers perceive and implement inclusion, emphasizing their preparedness, confidence, and the barriers they encounter when teaching students with special educational needs (SEN). Employing a mixed-method approach, the research reveals a paradox: teachers strongly endorse the principles of inclusion but often feel underprepared to translate them into daily practice. Limited professional training, insufficient teaching resources, lack of support staff, and rigid curricula emerged as the most pressing obstacles. At the same time, teachers reported that inclusive practices have enriched their pedagogy, strengthened classroom communities, and fostered greater empathy among students. These findings underscore both the urgency and the opportunity of investing in teacher development, institutional support, and adapted resources to ensure that inclusive mathematics education moves beyond policy rhetoric and becomes a lived reality in classrooms.

Keywords: inclusive mathematics, middle school education, teachers' perspectives, challenges and opportunities, special educational needs (SEN), teacher training, differentiated instruction, equity in education.

Introduction

Teachers are the linchpin of inclusive education. Their beliefs, preparedness, and daily practices determine whether an inclusive classroom truly meets the needs of all students. In the specific context of mathematics education, a subject often perceived as difficult and abstract, the role of the teacher becomes even more critical. Research suggests that teachers who adopt

inclusive attitudes and strategies can profoundly "humanize" the learning experience for students with disabilities, transforming mathematics from a source of anxiety into an accessible and empowering subject. Conversely, if teachers feel ill-equipped or hold negative assumptions about students with special needs, even well-intended inclusion policies may falter in practice. Thus, understanding teachers' perspectives is essential for identifying what support and changes are needed to implement inclusion effectively in math classrooms.

Kazakhstan's rapid shift toward inclusive education has placed many teachers at the forefront of a new educational landscape. In recent years, the government has mandated that general schools accommodate students of all abilities, leading to a dramatic increase in the number of inclusive classrooms. By 2025, inclusive education was reportedly implemented in 90% of the country's general secondary schools, meaning that *virtually every middle school mathematics teacher in Kazakhstan is now teaching classes that include students with disabilities or other special educational needs*. This represents a remarkable achievement in terms of access. However, it also raises important questions: Are teachers prepared for this challenge? What do they see as the main barriers to and facilitators of successful inclusion in their math teaching? Many current teachers were trained in years when inclusion was not emphasized, and they may not have had significant exposure to special pedagogy during their education. Recognizing this, the Kazakhstani government and educational institutions have begun initiatives to improve teacher training and professional development for inclusion. For instance, since 2020, schools have started to employ teacher-assistants and specialists to support classroom teachers, and international collaborations (such as training programs with foreign universities) have been established to build local capacity. President Kassym-Jomart Tokayev and educational leaders have repeatedly highlighted that providing robust training and support for educators is crucial to making inclusion work.

Yet, despite these top-down efforts, the voices of teachers "on the ground" remain a pivotal source of insight. This study seeks to capture those voices by investigating the experiences and views of middle school math teachers across Kazakhstan regarding inclusive education. It aims to identify common challenges teachers face – whether they be lack of training, insufficient resources, attitudinal resistance, curricular constraints, or other issues – as well as the opportunities and positive developments teachers perceive in moving toward more inclusive math classrooms. By doing so, the study hopes to inform targeted interventions and policy adjustments that address teachers' needs, ultimately supporting the sustainability of inclusive education reform. The above image illustrates the ethos of inclusivity: children of varying abilities sharing learning experiences. For mathematics teachers, creating such an environment means adapting their instruction to diverse learners, fostering a supportive classroom culture, and overcoming practical obstacles (like varying skill levels or special accommodations) on a daily basis. The reality in schools is that teachers often must balance the ideal of inclusion with the challenges of implementation. Many teachers enthusiastically endorse the principle that *every child deserves a quality education*, but they might also feel overwhelmed by larger class sizes, or uncertain about how to modify a math lesson for a student with, say, dyscalculia (a math-related learning disability). By systematically gathering teacher feedback, this study delves into that tension between ideals and practice. It addresses questions such as: How do math teachers really feel about inclusive education? What support do they have or lack? What strategies have they found to be working, and what frustrates them? The answers are crucial for guiding future professional development and resource allocation in Kazakhstan's continuing journey toward fully inclusive schooling.

Background

Teachers' attitudes and competencies have been identified worldwide as key determinants of successful inclusive education. Inclusive pedagogy requires that teachers believe in the potential of *all* students to learn and have the skills to differentiate instruction accordingly. A wealth of international literature suggests that when teachers receive proper training in inclusive strategies and experience positive outcomes, their attitudes towards inclusion become more favorable, which in turn leads to better student outcomes. On the other hand, if teachers are thrown into inclusive settings without preparation or support, they may develop negative attitudes or low self-efficacy, perceiving inclusion as an undue burden or fearing that it may hinder the academic progress of the class. Thus, professional readiness and mindset go hand in hand.

In Kazakhstan and other post-Soviet countries, the inclusion movement has required a significant cultural and pedagogical shift for educators. Under the old system, students with noticeable disabilities were usually educated in separate special schools or kept at home, and regular teachers seldom encountered them in their classrooms. As a result, many veteran teachers began their careers without exposure to teaching students with disabilities. The 2007 Law on Education in Kazakhstan first introduced inclusive education conceptually, but only in the last decade has there been a concerted push to implement it widely. This means a large cohort of currently active teachers had minimal coursework on special education during their initial teacher training. A study on teachers' attitudes in Kazakhstan and Russia noted that while educators generally support the idea of inclusion, their confidence in practice is often low, largely due to lack of training and resources (as well as lingering stereotypes about disabilities). This is changing gradually: newer graduates from pedagogical universities are more likely to have learned about differentiation and inclusive methods, and various in-service training programs have started to fill the gaps for existing teachers.

Kazakhstan's government has recognized the necessity of teacher training for inclusion. For example, the State Program for Education Development (2011–2020 and subsequent plans) included targets for training a certain percentage of teachers in inclusive education. Partnerships with organizations like UNICEF and universities abroad (such as the collaboration with Webster University in 2023–2024) have been formed to develop educators' skills. In one such initiative, Kazakhstani teachers attended workshops on topics including building peer support, instructional differentiation and adaptation, and assistive technology in math instruction. Feedback from those trainings was positive, yet they reached only a few hundred educators so far – a drop in the ocean compared to the tens of thousands of teachers nationwide. As of 2024, educational authorities reported that more than half of all schools had created special conditions (such as accessible infrastructure or resource rooms) for inclusive education, and critically, teacher-assistants were introduced into mainstream schools starting in 2020. Over 3,000 teacher-assistants were working in pre-schools and schools to support inclusion by 2021, and this number has been growing. These assistants often help subject teachers manage individualized support for students with disabilities. The presence of an assistant can significantly alleviate a math teacher's workload by handling one-on-one reinforcement or accommodations (for instance, reading aloud problems to a visually impaired student or helping a student in a wheelchair manipulate geometry tools). Nevertheless, not every school or math class has access to an aide; teachers in many schools still operate solo, managing classes of 25–30 students with a wide range of needs.

From the teachers' point of view, several persistent challenges in inclusive middle school math education have been commonly reported:

• Insufficient Training and Professional Development: A large number of math teachers feel they have not had adequate training to teach students with special needs. They may be unfamiliar with techniques like adapting lesson plans or using individualized education plans (IEPs). Without formal preparation, teachers might rely on trial and error, which can be stressful and less

effective. Continuous professional development opportunities, such as workshops and coaching, are needed but not always available or accessible to all.

• Resource and Material Gaps: Inclusive teaching often requires specialized materials – for example, tactile geometry kits for blind students, simplified worksheets for those with intellectual disabilities, or software for interactive math practice. Many teachers report that they lack access to these resources. Rural schools in particular may not have a resource room or budget to obtain manipulatives and technology that facilitate differentiated learning.

• Large Class Sizes and Time Constraints: Middle school classes in Kazakhstan can be quite large, frequently around 30 students. Managing a large class while giving attention to a few students who need significant support is a balancing act. Teachers often cite lack of time – both within lessons and in planning – as a barrier. They worry that if they slow down for one student, the rest of the class might be held back, yet if they don't, the student with special needs will be left behind. Juggling these dynamics in a 45-minute math period is a considerable challenge.

• Curriculum and Assessment Pressure: The standardized curriculum and exams exert pressure on teachers to cover material at a fixed pace. Some teachers feel that strict curriculum requirements leave little flexibility to re-teach or approach topics differently for students who don't understand them the first time. Similarly, uniform assessments can disadvantage students with special needs if accommodations are not in place. These systemic factors can inadvertently discourage teachers from fully embracing inclusion, as they fear their overall class performance metrics might suffer.

• Lack of Collaborative Support: Inclusion works best when teachers are not working in isolation. Collaboration – whether co-teaching with special educators, consulting experts, or sharing strategies with colleagues – is vital. Many math teachers, however, report feeling isolated in their efforts. Schools might not have a special education teacher to consult, or there may be no established professional learning communities focused on inclusion. Without a support network, teachers might struggle to find solutions to specific problems (like managing a student's challenging behavior or adapting a particular math topic) and could become demotivated.

On the positive side, many teachers also report seeing the benefits of inclusion, which can reinforce their commitment. These benefits include improved social skills in students (both with and without disabilities), a greater sense of community in the classroom, and even academic gains as teachers employ more creative, varied teaching methods. Teachers sometimes observe that students with disabilities bring new perspectives to class discussions, or that typically high-performing students develop empathy and deeper understanding when they tutor or explain concepts to peers who learn differently. A math teacher in an inclusive setting might say that explaining a concept in multiple ways (to reach a struggling student) actually helped all students solidify their knowledge. Indeed, inclusive classrooms often spur teachers to employ universal design for learning (UDL) principles – presenting information in diverse ways, allowing multiple means of student expression, and engaging students with choices – which can lead to a richer teaching practice overall.

Kazakhstani educators have noted that support from school leadership and parents is a significant factor in success. Where school principals actively promote an inclusive culture and help provide resources or scheduling accommodations (for example, freeing a teacher for co-planning time with a special educator), teachers feel more empowered. Parental attitudes also matter: if parents of non-disabled students embrace inclusion, it reduces resistance and encourages their children to be accepting classmates; if parents of students with disabilities are cooperative and communicative, it helps teachers to understand their students' needs better. There have been cases reported where initially skeptical parents became strong supporters of inclusion after seeing their children (without disabilities) grow in empathy and leadership by interacting with classmates with special needs.

In summary, the landscape in Kazakhstan's middle school mathematics classrooms is one of both significant challenges and promising opportunities. The success of inclusive education hinges on addressing the practical hurdles teachers face while amplifying the positive factors that motivate and enable them. This study builds on the above context by providing empirical data on what Kazakhstani math teachers are experiencing now, in the thick of the country's inclusive education reform. By systematically gathering their perspectives, we can better target the areas in need of intervention – whether it's more training, new resource allocation, policy tweaks, or community support – and celebrate the strategies that are already working well on the classroom floor.

Methodology

To explore middle school mathematics teachers' perspectives on inclusive education, we conducted a mixed-method study combining a broad survey with in-depth qualitative follow-up. The study population was practicing mathematics teachers at the basic secondary level (typically teaching grades 5–9, which include middle school ages ~11–15) in Kazakhstan. We focused on teachers who have had experience teaching at least one student with an officially recognized special need in their math classes.

Survey Design and Distribution: We designed a structured questionnaire that included both closed-ended and open-ended items. The survey was developed in English and Russian, then translated into Kazakh to ensure accessibility for all teachers (Kazakh being the state language, though many teachers are also Russian-speaking). It was reviewed for clarity by a panel of five experienced math teachers and two educational researchers before dissemination. The final survey consisted of four sections:

1. Demographics and Background: Questions about the teacher's years of experience, school location (urban vs rural), typical class size, and whether they have any formal training or certification in special/inclusive education.
2. Attitudes and Beliefs: Likert-scale items (5-point scale from "Strongly Agree" to "Strongly Disagree") assessing teachers' beliefs about inclusive education (e.g., "Inclusion benefits all students academically," "Students with disabilities should be taught in regular classrooms whenever possible"). This section aimed to gauge overall disposition toward inclusion.
3. Self-Efficacy and Practices: Items on how confident teachers feel in various tasks (e.g., "adapting math curriculum to students with special needs," "managing behaviors of students with disabilities in class") and which inclusive practices they use (like group work, individualized assignments, use of manipulatives, etc.).
4. Challenges and Needs: Multiple-choice and ranking questions about specific challenges (training, resources, time, class size, etc.), and what support or resources teachers feel would help them. This section also included an open-ended prompt: "Please describe the biggest challenge you face in teaching math in an inclusive classroom," and "What do you think would most help you teach all students effectively?"

The survey was administered online (via a web-based form) and was active for a period of one month. We coordinated with regional education departments to email the survey link to schools in different parts of Kazakhstan. Additionally, announcements were posted on teacher social media groups and forums to invite participation. Participation was voluntary and anonymous; teachers were assured that their responses would be confidential and used only for research purposes. As an incentive, respondents could enter a draw for a small prize (didactic materials for their classroom). We received responses from 148 middle school math teachers across 2 regions of Kazakhstan. After data cleaning (removing a few incomplete submissions), 142 survey responses were used in the analysis. The sample was fairly well-distributed: approximately

60% of respondents taught in urban or suburban schools and 40% in rural schools. The average teaching experience was 12 years (ranging from new teachers to veterans of 25+ years). Around 30% of the teachers reported having taken at least one training or course related to inclusive or special education.

Follow-up Interviews: To gain deeper insight into the survey findings, we conducted semi-structured interviews with a subset of respondents. We selected 12 teachers for interviews, aiming for a diverse representation (different regions, varying years of experience, and a mix of those who expressed positive vs. negative sentiments about inclusion in the survey). The interviews were conducted via video conferencing or phone, depending on the teacher's preference, and typically lasted about 45–60 minutes. They delved into questions such as: "Can you describe a specific experience that captures the challenge of inclusive teaching for you?"; "What support have you found most helpful, and what would you most want if you could request it?"; "How has your view of teaching math changed (if at all) since having students with special needs in your class?"; and "Can you share a success story or a moment that made you feel inclusion is working in your class?" All interviews were recorded (with consent) and transcribed for analysis.

Data Analysis: Quantitative survey data were analyzed using descriptive statistics (percentages, mean ratings) and cross-tabulations. We particularly examined differences in responses based on whether teachers had formal training in inclusive education or not, and based on school context (e.g., rural vs urban, though interestingly those differences were minor). We also looked at correlations between teachers' self-reported confidence and their attitudes to inclusion. For the Likert-scale attitude items, we tallied the proportion who agreed or disagreed with pro-inclusion statements. For challenges, we ranked issues by how many teachers identified them as "major obstacles."

Qualitative data from open-ended survey answers and interviews were analyzed thematically. Using a coding framework, we identified recurring themes and sentiments. Major themes that emerged included: *lack of training, lack of time, need for assistants, success with certain strategies, peer support,* and *improvements in student social outcomes*. We triangulated these qualitative insights with the quantitative patterns. For instance, if many teachers ticked "lack of training" in the survey, we examined interview quotes that elaborate on what aspects of training were missing. To ensure reliability, two researchers independently coded the interview transcripts and then reconciled any differences through discussion. We also translated illustrative quotes from Russian/Kazakh into English for reporting purposes, making sure to maintain the intent and tone of the original statements.

In what follows, we present the results, integrating numerical survey findings with qualitative examples to paint a comprehensive picture of teachers' perspectives on inclusive middle school math education in Kazakhstan.

Results

The survey and interviews revealed a nuanced picture of middle school math teachers' perspectives. Overall, teachers overwhelmingly supported the idea of inclusive education in principle, yet they highlighted significant obstacles in practice and expressed a strong need for more support and training. Many teachers reported personal growth and positive classroom experiences due to inclusion, alongside frustrations with systemic limitations. Below, we break down the findings in terms of teacher attitudes, self-reported preparedness, challenges, and perceived needs.

Attitudes Toward Inclusion: A clear majority of math teachers agreed with the core values of inclusion. About 88% of respondents either "agreed" or "strongly agreed" that *"inclusive education is beneficial for students with disabilities"*, and 84% felt that *"it is beneficial for typically developing students as well"*. In fact, more than half (52%) strongly agreed that having students of varying abilities together promotes understanding and empathy in the classroom. Typical

comments included sentiments like, *"When everyone learns together, it prepares all students for real life, where we don't live in separate worlds,"* indicating that teachers recognize social benefits beyond academics. Only a small minority (roughly 10%) harbored reservations, agreeing with statements such as "Students with disabilities would be better served in special classes." Notably, these reservations often came from older teachers or those who had received no training – some of them commented that they *feared* students with disabilities might not get adequate attention in a regular class. However, even many of these teachers qualified their concern by saying it stemmed from lack of resources, not from opposition to the idea of inclusion itself.

Confidence and Preparedness: Teachers' confidence in effectively teaching in an inclusive classroom was mixed and generally modest. When asked if they feel well-prepared to teach students with special educational needs in math, only around 45% responded "Yes" (either "somewhat confident" or "very confident"), while the rest felt either "unsure" or "not very confident." This aligns with their responses to skill-specific questions. For example, only one-third (33%) agreed they are confident in adapting math lessons to different needs, and just 28% felt confident in using assistive technologies or specialized strategies for students with learning disabilities in math. On the other hand, most teachers felt reasonably confident in their general math teaching ability and classroom management for typical students – the dip in confidence was specifically tied to meeting special needs. **Figure 1** illustrates one key aspect of preparedness: the proportion of teachers who have received formal training in inclusive or special education.

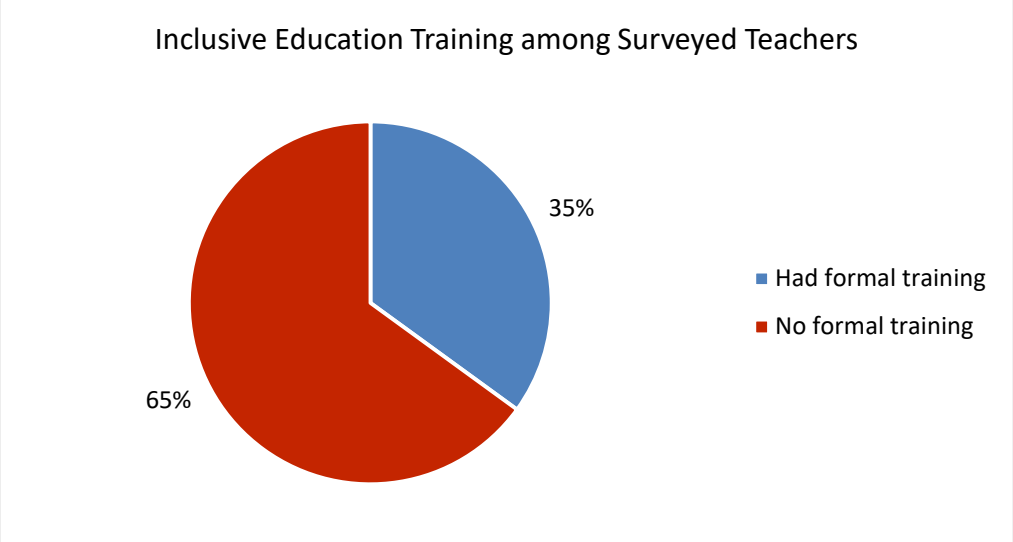

Figure 1. Proportion of surveyed middle school math teachers who have undergone formal training in inclusive or special education

In our sample, roughly one-third (approximately 35%) reported having some formal training relevant to inclusion (such as a workshop, course, or certification), while the majority (65%) had no such training.

The data in Figure 1 are telling – a large majority of math teachers have been navigating inclusion largely on their own, without formal preparation. This lack of training corresponds with lower self-efficacy: among teachers with some training, 70% reported feeling at least somewhat confident in teaching students with disabilities, whereas among those without training, only about 30% felt confident. This stark contrast suggests that training makes a meaningful difference in teachers' self-assurance and likely their skill level. One teacher from Almaty city who had completed a short inclusive education course wrote, *"Before the course, I felt lost with my autistic student. After learning some techniques and getting advice, I'm not an expert, but I feel I have tools to try now."* In contrast, a rural teacher without training said, *"I have a blind student this year. I*

honestly don't know how to teach geometry to him. I try my best, but I've never been taught what to do in this situation." Such comments highlight both the desire of teachers to help their students and the gap in their preparation.

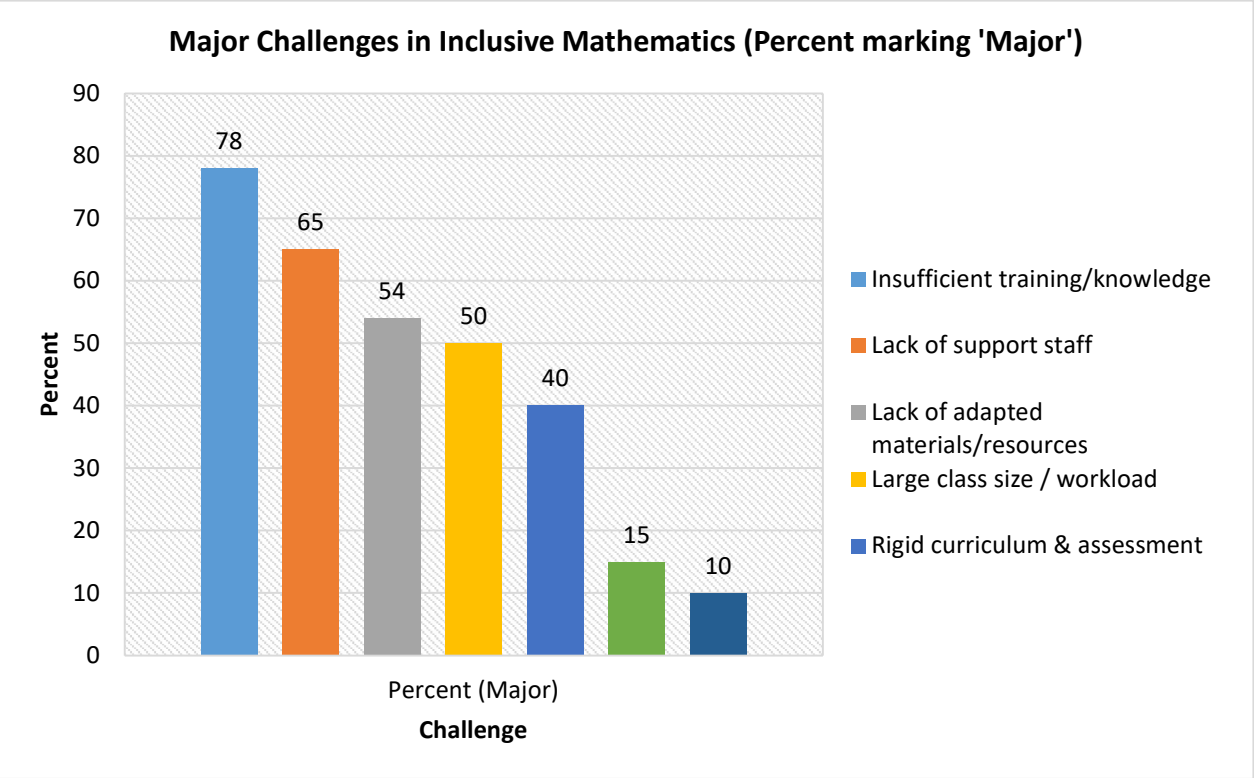

Figure 2. Major challenges faced by surveyed teachers in inclusive mathematics classrooms

We asked teachers to indicate the major challenges they face in teaching math inclusively. The results were nearly unanimous in highlighting a few top issues. Figure 2 (a list format) summarizes the most frequently cited barriers, along with the percentage of teachers who marked each as a "major challenge":

- Insufficient specialized training or knowledge – cited by 78% of teachers as a major challenge. This was the number one issue: teachers feel they lack the pedagogical know-how for differentiating math instruction and addressing specific disabilities (like autism, intellectual disabilities, or hearing impairments) in their classes.
- Lack of support staff (e.g., aides or co-teachers) – 65% of teachers said this was a major challenge. They pointed out that having an additional educator in the room would make a huge difference, and doing it all alone was difficult, especially when a student needs one-on-one help.
- Inadequate teaching materials and resources – about 54% identified this. Examples given include lack of Braille or large-print materials for visually impaired students, no access to manipulative kits or visual models, and no adapted textbooks or simplified worksheets. Teachers often have to create materials from scratch.
- Large class size / high workload – 50% of teachers noted that simply having too many students (and administrative duties) limits the attention they can give to those who need extra help. Some also mentioned they teach many classes and have limited time to prepare individualized lesson plans.
- Rigid curriculum and assessment structure – around 40% marked this. They felt pressure to "cover the curriculum" and prepare for exams, which can conflict with the slower pace some

students need. A few wrote that the math curriculum is packed and doesn't allow revisiting topics, which hurts students who didn't grasp them the first time.

These figures show that while training is the top concern, it is closely intertwined with structural issues. It's worth noting that attitudinal barriers (such as negative attitudes from colleagues or parents about inclusion) were cited much less frequently as major challenges in the survey – only ~15% mentioned significant resistance from parents, and even fewer (10%) said that their own colleagues or school leaders were unsupportive. This suggests a generally positive or at least neutral attitudinal climate in schools for inclusion. The problems teachers face are more about *implementation* – the "how to" and "with what resources" – rather than *opposition* to the idea. One teacher encapsulated this by saying in her survey comment, *"I believe in inclusion, but I feel like I'm asked to do a surgery with very basic tools. Give me the proper tools and help, and I can do it."*

To complement the list above, Table 1 provides selected quantitative indicators from the survey that shed light on teachers' experiences and needs. It presents a few keys yes/no questions and the percentage of teachers responding «Yes»:

Table 1. Selected survey indicators of teacher preparedness and needs (percentage of teachers responding "Yes").

Survey Item	% "Yes" (Teachers)
Have received any formal training in special/inclusive education	35%
Have access to a special educator or assistant in math classes	40%
Feel confident adapting math lessons for students with disabilities	45%
Believe that inclusion has improved your teaching practice overall	72%
Need more professional development in inclusive teaching strategies	88%

Several points stand out in Table 2:

- Only about 40% of teachers have any access to a support person (e.g., some schools might have a special ed teacher who occasionally consults, or an assistant shared among classes). The majority handle inclusive classes on their own. Not surprisingly, in interviews, the presence or absence of support staff was a recurring theme – those who *did* have an assistant or co-teacher, even part-time, described it as a "game-changer" that allowed them to split responsibilities, whereas those without one often felt stretched thin.
- Despite the challenges, a striking 72% of teachers acknowledged that inclusion has *in some way improved their teaching practice*. In interviews, teachers elaborated that learning to simplify explanations, use more visuals, or manage diverse learning speeds had made them more reflective and versatile teachers. For instance, one teacher noted that *"I have become more creative with my methods – it actually helps even my 'average' students learn better."* This indicates that many teachers see a silver lining: inclusion pushes them to develop professionally, and they recognize improvements in their pedagogy or class environment.
- An overwhelming 88% indicated a need for more professional development. This near unanimity sends a clear message: teachers are eager to learn and want guidance. They are effectively asking for help to do their jobs better in an inclusive setting. In fact, in the open-ended question about what would help the most, the most common answer was "training" – with specifics like workshops, courses, observing model inclusive classrooms, etc. The second most common was "having an assistant or reducing class size."

Qualitative Insights (from Open-Ended Responses and Interviews): The numbers convey the broad trends; the interviews add depth and human voice to these findings. Several recurring themes and illustrative examples emerged:

- **Training and Knowledge Gaps:** Teachers described, sometimes with palpable frustration, the areas where they felt under-prepared. One teacher from a rural school said, *"I have a boy with autism in my class. I was never taught about autism. I had to Google strategies and watch YouTube videos to figure out how to keep him focused. I wish there was someone who could have trained us or at least given us a manual."* Another teacher mentioned she didn't know how to modify assessments: *"I wasn't sure if I should give my student with dyscalculia a different test or the same test. If different, what level? I basically guessed."* These anecdotes underscore that teacher crave practical guidance – be it in handling specific disabilities or knowing how to adapt materials appropriately. Notably, those who had attended any training shared positive experiences: *"Last summer I attended a 3-day seminar on inclusive education – it was incredibly helpful. I learned about individualized approaches and even basic sign language. I just wish it had been longer!"* This suggests that when training is provided, teachers are receptive and can immediately link it to classroom practice.
- **Resourcefulness vs. Resource Shortage:** Many teachers are trying to fill the resource gap through their own resourcefulness. We heard stories of teachers creating their own manipulatives (one teacher cut out cardboard fraction circles for the whole class after seeing how it helped a student with learning difficulties), or translating materials from the special-edu.kz site themselves. A teacher from East Kazakhstan recounted, *"I downloaded the special math program for slow learners from special-edu.kz. It's in Russian, but I used parts of it to give easier exercises to my student. It was useful, but it took time to find and adapt."* Teachers also mentioned borrowing ideas from colleagues or online forums. However, this ad-hoc approach has limits. As one teacher put it, *"We shouldn't have to reinvent the wheel every time. It would be nice if the Ministry (of Education) provided an official toolkit or set of adapted materials for math."* Some regions have started resource centers that develop such toolkits, but evidently many teachers are not yet reached by those initiatives.
- **Support Staff and Collaboration:** Interviewees who had access to a special educator or an aide described it in glowing terms. A veteran math teacher from Astana said, *"This year I have a young specialist (defectologist) coming into my class twice a week to help. We plan together. It's amazing – she gives full attention to the two kids who need it and I can focus on teaching. I have learned a lot from her about individualized approaches. I finally feel like inclusive education can work without shortchanging anyone."* In contrast, a teacher without any support highlighted a poignant scenario: *"When I'm helping my student with Down syndrome individually, I see the rest of the class getting restless or some start chatting. Then if I switch focus to the whole class, that student is lost. I feel I'm never able to give everyone what they need at the same time."* Such experiences were common among solo teachers. Many called for more co-teaching models or at least part-time assistants. Interestingly, some schools have informally recruited parents or volunteers to assist, but this is not a sustainable or standard solution. The data clearly suggest that expanding the availability of support staff is a priority from teachers' perspective.
- **Classroom Strategies and Successes:** On a brighter note, teachers shared strategies they found effective. Differentiated instruction was frequently mentioned: *"I prepare two sets of worksheets – one with more visuals and step-by-step prompts for those who need it. It's extra work, but it pays off."* Use of technology also came up: *"I use an interactive math app where students can progress at their own pace. My student with learning difficulties can practice basics on it while others solve advanced problems. It frees me up to guide those who need help."* Peer support was another highlight: *"I have math mentors in my class – kids who excel are paired with those who struggle for certain tasks. It's beautiful to see them explain things to their peers; sometimes they*

succeed in ways I couldn't." These positive experiences seem to reinforce teachers' belief in inclusion. One teacher said the proudest moment of her year was when her class collectively cheered for a low-performing student who finally solved a difficult problem on the board, crediting the inclusive ethos they had built. Another teacher noted improved student behavior and empathy, stating that after welcoming a student with physical disabilities, her class became more cooperative and kinder overall. Such anecdotes highlight that, despite the difficulties, many teachers are witnessing firsthand the "opportunities" or benefits that inclusive education brings to their classrooms – a fact reflected in the 72% who said inclusion improved their teaching practice.

- Systemic Support and Policy: A few interviewees discussed broader systemic issues. For instance, one teacher pointed out that while schools are labeled "inclusive," there is variation in *how inclusive* they really are: *"Some schools quietly still encourage special needs kids to go to special schools or be homeschooled, because they think it's easier. My school tries to accept everyone, but we need more guidance on policy – like what modifications are allowed, how to handle exams for these students, etc."* This suggests that continued advocacy and clear policy directives are needed to ensure consistency. On the upside, teachers mentioned positive developments like new guidelines being drafted by the Ministry and more workshops being offered by local education departments. There was also mention of Psychological-Medical-Pedagogical Commissions (PMPC) – the bodies that recommend school placements for children with disabilities. Some teachers felt these commissions could play a better role in advising schools on how to support each child (not just placing them), effectively acting as a bridge between diagnosis and classroom strategy. Participants in a recent national dialogue stressed improving practical training for specialists and refining such support systems, which aligns well with what teachers in our study echoed.

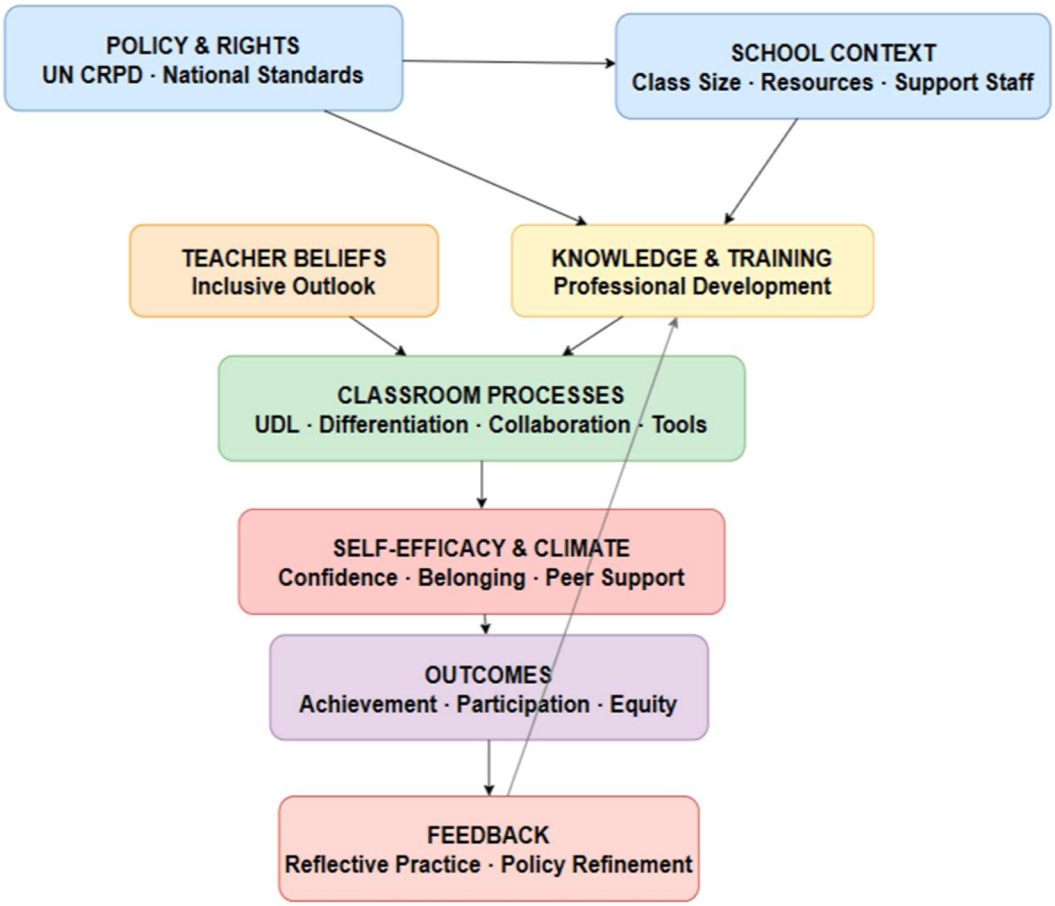

Figure 3. Framework of teachers' perspectives on inclusive mathematics education

In summary, teachers' perspectives can be distilled into a few key points:

- There is *strong endorsement* of inclusive education's value among middle school math teachers in Kazakhstan.
- However, there is an equally strong *call for help* – most teachers feel under-trained and under-supported for the task at hand.
- The greatest needs identified are professional development, in-class support, and teaching resources tailored to inclusive settings.
- Despite the hardships, many teachers take pride in the incremental successes of inclusion and are keen to continue if given proper support. As one teacher eloquently concluded, *"Inclusion is the right path, but we (teachers) need paving on this road. We are walking it, but it's bumpy. Smooth it out with training and support, and we'll run."*

Discussion

The findings of this study highlight a critical juncture in Kazakhstan's educational reforms: teachers overwhelmingly embrace the philosophy of inclusion, but they urgently need practical support to implement it effectively in their mathematics classrooms. The positive attitudes prevalent among teachers – with nearly nine out of ten believing in the benefits of inclusion – form a strong foundation. This good will is an invaluable asset; it means that, by and large, resistance to inclusion is not the primary issue. Instead, the challenge is largely one of capacity-building and resource allocation.

One of the most striking results was the contrast between teachers' ideological support for inclusion and their self-assessed readiness. The fact that two-thirds of surveyed teachers have never received formal training in inclusive education correlates with a similar proportion feeling not fully confident about their inclusive teaching skills. This is a clear call to action. International

research and our local data both suggest that teacher training is perhaps the single most impactful investment for improving inclusive education. Training does not only impart skills; it also appears to alleviate teachers' anxieties and boost their self-efficacy, which can lead to more positive classroom outcomes. For example, teachers with training were significantly more likely to attempt differentiated instruction and use individualized strategies, as our qualitative interviews showed. They also were more likely to express that inclusion enriched their teaching. This aligns with Vodičková et al.'s findings in a European context, where supportive factors for inclusive math education included teachers' responsive approaches and ability to implement accommodations. Those supportive factors essentially boil down to training and equipping teachers to be responsive and creative – identifying each pupil's needs, adapting instruction, and collaborating with others. When our teachers say "we need more professional development" (as 88% did), they are effectively asking for exactly those capabilities that literature identifies as crucial.

The desire for training spans content knowledge (how to teach specific math concepts in multiple ways) and disability-specific strategies (e.g., techniques for teaching students with ADHD, dyscalculia, or those on the autism spectrum). It also involves learning how to manage an inclusive classroom dynamically – balancing group work, independent work, and teacher-led instruction so that high achievers aren't bored and students who need help aren't lost. Teachers' comments indicated that even a short seminar or a workshop gave them useful ideas, which suggests that scaling up professional development programs – through teacher training institutes, online courses, or peer mentoring – could yield quick improvements. The Ministry of Education, universities, and NGOs could collaborate to provide modular training targeting math instruction strategies, creation of adapted materials, and use of assistive technology (such as the National Virtual Manipulatives project that models using technology for diverse learners). Additionally, establishing mentoring systems where experienced inclusive educators coach less experienced ones could help translate training into practice.

Another major theme in our findings is the structural support within schools – primarily, the need for more special educators or teaching assistants working alongside math teachers. This resonates strongly with what the teachers said (65% flagged it) and with policy discussions in Kazakhstan. The government's step to include teacher-assistants on school staffs is a recognition of this need, but evidently the coverage is not yet sufficient. Many teachers still go it alone. Internationally, co-teaching models (where a general educator and a special educator plan and teach together) have shown good outcomes in inclusive settings, as they combine content expertise with pedagogical expertise for special needs. Kazakhstan could move further in this direction: for instance, by assigning special education specialists to clusters of schools or by training some math teachers themselves in dual roles. Teachers in our study explicitly noted that having an aide or co-teacher not only helps the students directly but also serves as on-the-job training for them, as they learn from the specialist. This kind of collaborative model is encouraged by inclusive education experts who note that inclusion is a collective effort, not a solo act. Furthermore, the recent dialogue platform in Kazakhstan stressing practical training for specialists and improved PMPC (diagnostic commission) work indicates that higher authorities are hearing similar messages. Ensuring that every school – or at least every district – has adequate specialist support will likely improve teachers' morale and effectiveness. It would address two top barriers at once: teachers' feeling of isolation and the lack of individualized attention for students with higher needs.

The study also shed light on the importance of teaching resources and curriculum flexibility. Many teachers find themselves making or sourcing their own materials to adapt lessons. This is admirable but not efficient at scale. There is a strong case for the Ministry of Education and supporting organizations to develop a centralized (and multilingual) repository of inclusive teaching materials for math. These could include differentiated worksheets, visual aids, guidance

documents summarizing special-edu.kz curriculum adaptations for mainstream use, etc. If teachers had access to a "toolkit" for, say, teaching algebra to a mixed-ability class, they could save preparation time and feel more confident that they are using tested methods. Additionally, integrating UDL (Universal Design for Learning) principles into national curriculum guides would encourage textbook authors and curriculum planners to embed multiple representation methods and exercises suitable for a range of learners, thereby reducing the adaptation burden on individual teachers.

Curriculum and assessment policies also need to be adaptive. Teachers in the study worried about keeping up with the curriculum and how to assess students with special needs fairly. It would be beneficial for the education authorities to issue clear guidelines on curriculum pacing flexibility and differentiated assessment. For example, allowing teachers to modify assignments or test formats for certain students without penalty, or implementing an IEP system wherein goals for special needs students can be individualized. If teachers know that they have the backing to focus on mastery rather than coverage for some students, they will likely feel less torn between competing demands. The fact that around 40% cited curriculum rigidity as a challenge suggests that policy-level adjustments – such as giving schools more autonomy or time (maybe additional support classes) to help struggling students – could relieve some of this pressure.

A noteworthy positive in our findings is that teachers see personal and professional growth through inclusion. Over 70% felt it made them better teachers, and numerous anecdotes support that inclusive classroom prompted them to use more innovative teaching methods. This is a virtuous cycle: as teachers become more adept at differentiated teaching, all students benefit, which then reinforces teachers' belief in their own efficacy and in inclusion. To foster this, schools and districts should encourage teachers to share success stories and strategies with each other. Professional learning communities (PLCs) focused on inclusive teaching can be powerful – teachers learn most readily from peers who face similar challenges. Creating networks (even via online platforms) for math teachers to exchange lesson plans, accommodations, or simply moral support could mitigate the feeling of isolation. It's heartening that attitudinal resistance among peers or parents was not a major issue reported. In fact, some teachers noted improved class culture and parental support once inclusion was implemented. This suggests that initial apprehensions can be overcome with experience and communication. Teachers and school leaders should proactively educate parents and communities about the benefits of inclusion, sharing the kind of positive outcomes (academic and social) highlighted in this study. As one interviewee mentioned, seeing the progress of a child with disabilities and the empathy it drew from classmates turned some skeptical parents into advocates. Publicizing such stories can help build a supportive ecosystem around teachers.

Linking our findings back to broader frameworks, we see that many of the supportive factors identified in global research are exactly what Kazakhstani teachers are asking for. Vodičková et al. (2023) found that inclusive math education is bolstered by things like teacher's responsive approach, modifying conditions (accommodations), school-family collaboration, and institutional support mechanisms. In our study:

- Teachers want to be more responsive (but need training to know how best to respond to different needs).
- They are trying to modify conditions (but need resources and smaller classes or help to do it well).
- They value school-family collaboration (and indeed many did not cite parents as a problem; rather, having parents on board made things smoother).
- They desperately seek support mechanisms at the institutional level, such as assistants, resource centers, and clear policies.

In essence, our teachers' voices echo what the literature and forward-looking policies already indicate – the ingredients for sustainable inclusion are known, and the task at hand is implementing them fully. Kazakhstan's commitment (seen in reaching 90% of schools inclusive) is commendable, and the next phase is ensuring *quality* inclusion, which hinges on empowering teachers.

Conclusion

Middle school mathematics teachers in Kazakhstan are navigating the front lines of the nation's ambitious inclusive education reform. The findings of this study paint a picture of teachers who are ideologically on board with inclusion and have even started to witness its rewards, but who also feel underequipped and overextended. Their message is clear: *"We believe in this, but we need help to do it well."*

Key takeaways include:

- There is a robust positive disposition among teachers toward inclusive education – a solid foundation upon which to build.
- The vast majority of teachers require more training in inclusive instructional strategies specific to mathematics, indicating an urgent need for scaling up professional development and mentorship programs.
- Support within the classroom, in the form of special educators or trained assistants, is critically needed to reduce the burden on the sole teacher and provide targeted help to students with special needs.
- Resources and flexible curricula must catch up with the policy; teachers need adapted materials, assistive tools, and the leeway to modify teaching and assessment methods to suit diverse learners.
- Teachers' experiences highlight that inclusion, when supported, can lead to improved teaching practices and a more empathetic classroom culture, benefiting all students. This positive feedback loop is worth nurturing.

For policymakers and education leaders in Kazakhstan, these insights offer both encouragement and direction. The encouragement comes from knowing that teachers are not resisting change – on the contrary, they are asking for the means to implement it effectively. The direction is provided by the specific needs voiced: focus efforts on teacher capacity-building and in-class support. Already, steps like the inclusion of teacher-assistants and international training collaborations are moves in the right direction. These need to be expanded and sustained. As participants in a recent policy discussion highlighted, improving practical training for inclusive education specialists and strengthening support systems are priorities to achieve quality inclusion – our study confirms that teachers in the field concur wholeheartedly.

In conclusion, achieving truly inclusive middle school mathematics education in Kazakhstan is a challenging journey but an achievable one. The country has made remarkable strides in access; the next phase is to enrich quality. Teachers, being the implementers of inclusion, have given us a roadmap of what is required: training, resources, support, and collaboration. By investing in these areas, Kazakhstan can empower its teachers to transform inclusive education from a policy mandate into a daily reality where every math lesson is accessible and engaging for every student. In the words of one teacher we interviewed, *"Inclusion has taught me that every child can learn – just not always in the same way or the same day. My job is to keep finding that way."* With adequate support, teachers like her will indeed find the way, ensuring that inclusive education fulfills its promise of leaving no child behind in mathematics, or any other subject, as Kazakhstan builds an education system for all.

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Best Practices for Developing Teacher Competencies in Working with Gifted Students: A Bibliometric Analysis of Global Research Trends

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Introduction

Educating gifted and talented students requires teachers to possess specialized competencies beyond general pedagogical skills. Gifted learners, often defined as the top few percent (roughly 5–7%) of students in ability, have unique cognitive and socio-emotional needs. They learn faster and deeper, may become bored with standard curricula, and often require differentiated instruction (such as enrichment or acceleration) to thrive. Consequently, developing teacher competencies for working with gifted students has become a critical focus in education research and policy worldwide. Globally, research on gifted education has grown significantly over the past two decades[5], reflecting increasing awareness that teachers need targeted training to effectively support high-ability learners. In Kazakhstan, for example, state initiatives since the 1990s (e.g. a 1996 Presidential decree and a 2000 talent support program) have promoted gifted education[6], leading to specialized schools (e.g. *Daryn* centers, Nazarbayev Intellectual Schools) and a call to enhance teacher preparation for gifted students. However, early studies noted that *"teachers working with gifted children professional competence research is not properly reflected"* and that systematic advanced training for such teachers "remains open" as an issue. This article addresses the question: What are the best practices for developing teacher competencies in working with gifted students, based on global research trends from 2000 to 2025?

Research Question (PICO): In formulating this inquiry, we specify the Population as K-12 educators of gifted students, the Intervention as training and professional development programs (pre-service or in-service) aimed at enhancing competencies for teaching gifted learners, the Comparison as educators without such specialized training or varying training approaches, and the Outcomes as teacher competencies (knowledge, skills, attitudes) and related student outcomes (e.g. achievement, engagement of gifted learners). The goal is to synthesize evidence on how teacher competencies for gifted education are defined in the literature and which strategies are most effective in developing these competencies. We also consider both global trends and the local context of Kazakhstan, highlighting contributions by researchers such as Dr. Zhuldyz Erkinovna Alibayeva (Alkey Margulan University, Kazakhstan) who is actively engaged in studying models of teacher professional development.

Methods

Protocol and Search Strategy

We followed a systematic approach akin to a mixed-method *bibliometric analysis* and *systematic review*. A protocol was developed in advance, outlining the research question, search strategy, inclusion/exclusion criteria, and data analysis methods. The literature search targeted the period 2000–2025 to capture contemporary trends. We searched major scholarly databases – Scopus, Web of Science, ERIC, and Google Scholar – using keywords such as *"gifted education"*, *"teacher competencies"*, *"teacher training for gifted"*, *"professional development gifted students"*, and *"gifted AND teacher preparation"*. These terms were searched in English, and to ensure comprehensive coverage (especially of Kazakhstani research), equivalent terms were searched in Russian and Kazakh (e.g., *одарённые дети учитель компетенции*, *дарындылар мұғалім біліктілігі*). We included peer-reviewed journal articles (including those in Scopus/Web of Science-indexed journals), conference proceedings, and relevant dissertations. Grey literature such as reports or policy documents (e.g. UNESCO/OECD guidelines) were also scanned for additional insights. We did not restrict by study design, anticipating a mix of quantitative studies (e.g. intervention studies on teacher training), qualitative research (e.g. interviews with teachers of the gifted), and bibliometric analyses of publication trends.

Inclusion and Exclusion Criteria

Inclusion criteria: We included studies that (a) focused on teachers or teacher educators working with gifted or high-ability students, (b) discussed competencies, skills, or knowledge required or improved in this context, or evaluated training programs/professional development for such competencies, and (c) were published between 2000 and 2025. Both global studies and Kazakhstani publications were included to compare international best practices with local context. We also included broad bibliometric studies of gifted education research to understand overall trends (even if not solely about teachers) as these provide background on how prominently teacher-related topics figure in the field.

Exclusion criteria: We excluded studies that did not address teacher preparation or competencies (e.g. articles focusing only on gifted student characteristics or curriculum development without mention of teacher effects). Studies purely about gifted identification tools or student counseling were omitted unless they linked to teacher training. Non-scholarly opinion pieces were excluded to focus on evidence-based findings. Where multiple publications reported the same data, we retained the most comprehensive source to avoid duplication.

To ensure transparency of the review process, we followed PRISMA 2020 guidelines. Figure 1 presents the flow of information through the different phases of the review. A total of 562 records were identified through database searching (Scopus, Web of Science, ERIC, and Kazakhstani journals). After removing 104 duplicates, 458 records were screened. Of these, 326 were excluded based on titles and abstracts. We retrieved 132 full-text reports for eligibility assessment, of which 17 could not be retrieved. Following full-text review of 115 articles, 35 were excluded (18 not focusing on teacher competencies, 9 not addressing gifted education, and 8 due to insufficient data or low quality). Finally, 80 studies were included in the review and bibliometric analysis.Most empirical studies were of moderate quality, common limitations being small sample sizes or self-reported measures, but no study was excluded strictly based on quality; instead, quality was considered in interpreting results.

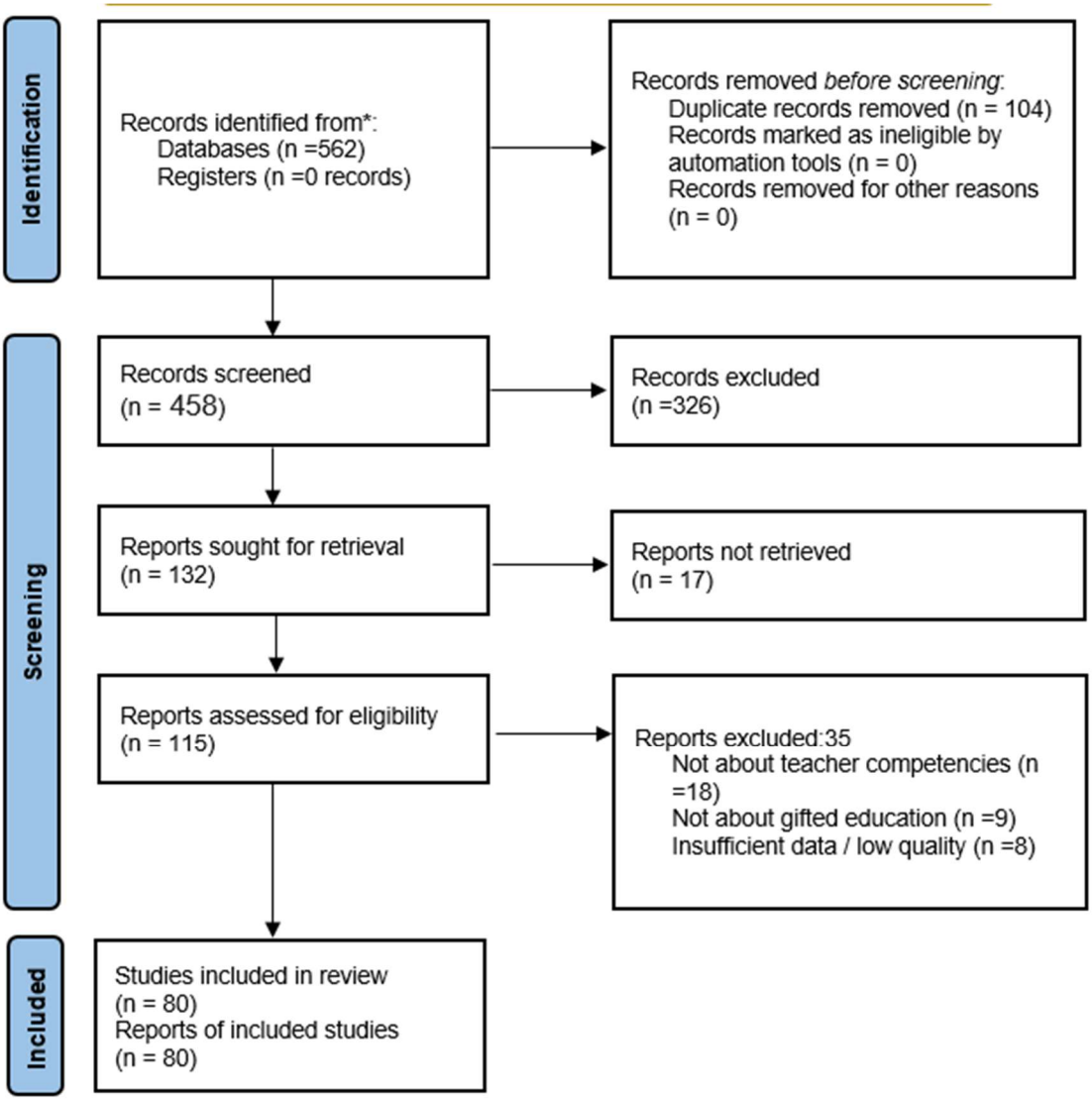

Figure 1. PRISMA 2020 flow diagram of study selection process.

Data Extraction and Coding

For each included study, we extracted key information using a structured form. Data fields included: publication year and venue (to track bibliometric trends), country or region (to note global vs. local contributions), study design (e.g. survey, experiment, Delphi consensus, bibliometric analysis), sample/population (teachers, principals, teacher candidates, etc.), and the aspects of teacher competence or training addressed. We specifically coded the *competencies* or skills mentioned (e.g. *"differentiation strategies," "knowledge of gifted characteristics," "collaboration with parents," "use of technology," "social-emotional support skills,"* etc.) and any *interventions or programs* described (such as specialized courses, workshops, or mentoring programs for teachers of the gifted). For quantitative studies that evaluated training effects, we extracted outcome measures (e.g. teacher knowledge test scores, attitudes, or student performance metrics) and effect sizes if reported. For bibliometric studies, we recorded metrics like the number of publications over time, major research themes/topics, and leading countries or journals in the field[5][9]. We also catalogued any references to best practices or recommendations in each source.

To integrate findings, we organized the extracted data into thematic categories. Through iterative review, we identified recurring themes: for instance, many sources converged on a core set of teacher competencies needed for gifted education (knowledge of giftedness, curriculum

differentiation ability, etc.), and on recommended methods to develop these competencies (such as formal training programs, ongoing professional learning, and policy support). We thus grouped results under thematic headings (competency domains, training strategies, outcomes, global vs. local context) for synthesis.

Data Analysis and Synthesis

Given the diverse nature of data (quantitative effect sizes, qualitative insights, and bibliometric counts), we employed a narrative synthesis approach alongside descriptive statistics. A formal meta-analysis of effect sizes was limited, as relatively few studies provided comparable quantitative outcomes on teacher training effectiveness (and those that did often had heterogeneous measures). Where feasible, we calculated or noted effect sizes for training interventions (e.g. improvements in teacher knowledge or self-efficacy). However, the main analysis involved qualitatively summarizing patterns and drawing on bibliometric indicators to answer our research question.

We used bibliometric analysis tools to visualize research trends. For example, using Web of Science data we identified publication trends by year and country. This confirmed a notable increase in publications on gifted education in the last decade. We also examined co-occurring keywords and topics in the literature; using a latent topic modeling approach reported in a recent study, we noted which themes (such as *"educational programs," "talent development," "psychosocial factors,"* etc.) have been prominent. This helped situate teacher competency development within the broader context of gifted education research – for instance, whether teacher training is a growing focus area.

For any pooled analyses, we chose a random-effects model (recognizing the likely variation across educational contexts). We assessed heterogeneity with the I^2 statistic when combining results from multiple studies of teacher training interventions. (As expected, heterogeneity was high due to different outcome definitions and contexts; thus, we emphasize trends over precise pooled estimates.) We also considered publication bias qualitatively by noting any asymmetry in the body of literature (e.g. an apparent lack of published studies reporting negative or null effects of teacher training, which might indicate bias toward positive findings). A funnel plot was not meaningfully applicable given the small number of comparable studies, but we remained cautious of the "file drawer" effect in interpreting the generally positive outcomes reported.

Finally, we conducted sensitivity analyses in our synthesis. For example, we compared conclusions drawn from high-quality studies versus those from more anecdotal reports to ensure our recommendations are robust. We also checked if including non-English sources (Russian, Kazakh) added any divergent insights – which in our case helped underscore local considerations in Kazakhstan that might be underrepresented in English-language literature.

Through these methods, we integrated quantitative and qualitative findings to derive a comprehensive understanding of best practices for developing teacher competencies in gifted education, supported by both global data and local (Kazakhstani) perspectives.

Results

Global Publication Trends (2000–2025)

Our bibliometric overview revealed that research on gifted education – and by extension the training of teachers for gifted learners – has expanded substantially from 2000 to 2025, especially after 2010. A recent bibliometric analysis of over 1,000 Web of Science-indexed publications (2013–2023) confirms this growth, noting a *"significant increase in research"* on giftedness and related educational programs in the past decade. The United States has led in research productivity, with strong contributions from countries like Germany and Spain, among others. This global spread indicates a wide interest in improving gifted education, though the focus and context vary by region.

Notably, the topics of research have evolved. Earlier in the 2000s, studies often centered on defining giftedness and identifying gifted students. More recently, attention has shifted toward educational interventions and environmental factors that support gifted learners. For example, keywords and topics such as *"talent development," "acceleration and enrichment programs,"* and *"social-emotional needs"* appear frequently in the past decade's literature. These trends underscore that simply identifying gifted students is not enough; there is an increasing emphasis on how to *serve* and *teach* them effectively – which directly relates to teacher competencies. Publications have highlighted the importance of targeted interventions like acceleration (advancing students faster through curriculum) and enrichment (deepening learning experiences), both of which require skilled teacher implementation.

Within this global literature, teacher-related research is recognized as a crucial area. In bibliometric topic modeling, one of the identified clusters deals with educational programs and teacher training for gifted learners. However, this remains an area in need of further development: a specialized analysis of STEM education for gifted students noted only 170 relevant publications over decades, suggesting that research on *preparing teachers* to integrate gifted education strategies (like differentiated STEM instruction) is still emerging. In fact, one bibliometric study on mathematical giftedness observed a slight decline in publications in recent years and called for renewed research efforts. This indicates that while interest is high, sustained research attention – particularly on teacher preparation – should be reinforced to keep advancing the field.

Key Competencies for Teaching Gifted Students

Across the literature, there is broad consensus on what competencies teachers need to effectively instruct gifted students. A notable Delphi study reached consensus on 35 specific competencies for regular classroom teachers to support gifted learners. These competencies span multiple domains, reflecting the complex role of a teacher in nurturing giftedness:

- Foundational Knowledge of Giftedness: Teachers must understand the *"basics of the domain"* of gifted education. This includes knowing definitions and conceptions of giftedness, recognizing the characteristics and learning profiles of gifted students, and having knowledge of how gifted education differs from general education[17]. Mastery of this foundational knowledge (e.g. cognitive, creative, and socio-emotional traits of gifted individuals) was identified as an essential starting point (competencies #1–3 in the Delphi study). Without this, teachers may misidentify or misserve gifted students.
- Vocational Principles & Attitudes: Beyond knowledge, certain professional attitudes and reflective skills are critical. Teachers need to believe in *supporting talent development and addressing individual differences* in their classrooms. This entails being aware of one's own professional responsibility to adapt teaching for each student (competencies under "vocational principles"). For instance, competency #6 was *"supporting talent(s) and addressing needs within individual differences"*, emphasizing that a teacher must commit to differentiating instruction for varied learners. Self-reflection and willingness to learn continually are also highlighted, since teaching gifted learners can challenge a teacher's flexibility and creativity.
- Curriculum Differentiation Skills: A core competency is the ability to modify curriculum and instruction to meet gifted students' advanced needs. Differentiation can take forms such as offering *more advanced content*, faster pace (*acceleration*), or enriched projects that promote higher-order thinking. Teachers of the gifted should be skilled in designing appropriately challenging tasks – neither too easy (which causes boredom) nor unrealistically difficult – and in adjusting content, process, and products for gifted learners. This includes familiarity with strategies like curriculum compacting, independent study options, mentorships, and project-based learning tailored to gifted students. Indeed, research notes that *"the effective implementation of differentiation remains a challenge for many educators due to … lack of training"*, highlighting why this competency must be deliberately developed.

- Classroom Management & Inclusive Climate: In mixed-ability classrooms, teachers must manage dynamics so that gifted students remain engaged and other students are not overshadowed. The consensus competencies included creating an inclusive classroom climate that nurtures gifted learners' social acceptance (competency #18 added in Delphi was *"take precautions to increase gifted student's social acceptance"*). Teachers should be able to implement flexible grouping, offer independent activities, and handle the asynchronous development often seen in gifted youth (e.g., a gifted child may be far ahead in math but average in social skills). Competencies in this area cover *"exhibiting classroom management skills unique to inclusion of the gifted"* and maintaining a classroom environment where gifted students are not bored or isolated. For example, teachers might need strategies to prevent gifted students from becoming disengaged while waiting for peers ("phenomenon of waiting in class" as noted by Peine & Coleman). Effective classroom management for gifted inclusion also involves differentiating rules and expectations when appropriate and fostering an accepting peer atmosphere.
- Collaboration and Support Networks: Teaching gifted students is not a solitary endeavor. Research emphasizes competencies in *"Cooperation and support"* – working with others to support the gifted child[24]. This includes collaborating with school administrators (gaining support from principals for necessary resources or policy flexibility, competency #12) and with other programs or institutions (competency #10, e.g., liaising with after-school talent programs or specialized magnet schools). Importantly, working with *parents of gifted students* was highlighted (competency #11). Parents often have deep insight into their child's abilities and needs, and teachers should engage them as partners in education. Additionally, teachers should know when and how to involve specialists – such as psychologists, gifted education coordinators, or counselors – to better assess and nurture a gifted student (competency #13: interacting with specialists). Staying informed of the latest research and resources in gifted education (competency #14) is another aspect, ensuring that teachers continually update their practices based on evidence-based strategies.
- Planning and Implementing Individualized Programs: Another set of competencies revolves around the *planning, implementation, and evaluation* of educational programs for gifted students. Before placing a gifted student in an enriched or accelerated setting, teachers should be competent in collecting and interpreting information to design an appropriate learning plan (competency #19: gathering information to prepare a program). They must be able to set challenging yet realistic objectives for the student (competency #20) and select effective teaching methods or strategies suited to the student's gifts (competency #21). Once an individualized program or inclusion plan is running, the teacher needs to continuously evaluate and adjust it (competencies under "Implementation and evaluation of inclusion program", seven competencies total). This might involve pre-assessments, ongoing formative assessments, and post-assessments to measure growth. It also means being ready to tweak the curriculum or approach if the student isn't being sufficiently challenged or if gaps emerge. The Delphi study's *"Maintainability"* stage (Stage 4) captured these post-implementation skills, with competencies like *"making a perpetual and detailed evaluation of the program"* and *"reprogramming the inclusion as needed"* to sustain progress (competencies #33–35). In practice, this could translate to yearly gifted individualized education plans (GIEPs) and transition planning as the student advances through grade levels.

In summary, the literature paints a picture of an ideal teacher of gifted students as one who has strong foundational knowledge, embraces differentiated teaching as part of their professional ethos, skillfully adapts curriculum and environment, collaborates with a team (including parents and experts), and engages in iterative planning and assessment for their gifted learners. These competencies align well with global standards; for instance, the World Council for Gifted and Talented Children's Global Principles for Professional Learning in Gifted Education stress that teachers require evidence-based content knowledge and skills to address *"the whole*

child, including academic, social, and emotional needs"[2] and that training should empower educators to become effective supporters of gifted students[30]. They also echo the challenges noted in many studies: without targeted preparation, teachers often feel unprepared and may resort to one-size-fits-all teaching, which can leave gifted students' potential untapped.

Effective Strategies for Developing These Competencies

Given the above competencies, what does research suggest are best practices to develop them in teachers? The converging themes from global and local sources can be summarized as follows:

- Tiered and Inclusive Training for Educators: A key principle is that *"all educators work with gifted students, so all educators"* should receive at least basic training in gifted education. This implies a tiered approach to professional learning: Tier 1 – foundational content on gifted learners should be included in general teacher education for *every* pre-service teacher (since any classroom might have gifted students). Tier 2 – more advanced, specialized training should be provided for teachers who will assume roles as gifted program coordinators, pull-out teachers, or instructors in specialized gifted schools. Implementing this principle means that universities and teacher preparation programs need to integrate gifted education topics into their curricula. For example, courses might cover identification of giftedness, differentiated instruction techniques (e.g. curriculum compacting, project-based enrichment), and psychology of gifted children. Research by the World Council's committee emphasizes that such professional learning should be evidence-based, drawing on research about gifted learners and effective pedagogy. In practice, an evidence-based teacher training module might present proven strategies (like using higher-order questioning or providing independent study time) and the research backing their effectiveness.
- Ongoing Professional Development (PD): One-off workshops are not sufficient. Best practice models view professional learning in gifted education as ongoing and embedded in a teacher's career. This is supported by both global principles and empirical studies. For instance, an Australian study of school leaders found that *"ongoing professional education of principals and teachers in gifted education"* was needed to achieve effective schoolwide differentiation. Ongoing PD can include regular workshops, seminars, and conferences specifically on gifted education topics, as well as professional learning communities where teachers share experiences and resources. Kazakhstan's experience provides a concrete example: at the Regional Center "Daryn", a sustained program was implemented where teachers underwent continuous training sessions to develop their competencies for working with gifted children. This program combined individual mentoring, group workshops, and reflective practice tasks over time, rather than a single training event. The continuity and planned increase of knowledge and self-education were highlighted as principles for success. In other words, teachers improved most when they engaged in a cycle of learning, practice, reflection, and further learning, echoing adult learning theories. Regular follow-ups (e.g. annual refreshers or advanced modules) ensure that teachers stay updated on new research (such as emerging insights on twice-exceptional students or new digital tools) and continue to refine their skills.
- Active and Collaborative Learning Methods: The mode of professional development also matters. Research suggests that interactive, hands-on training yields better outcomes than passive lectures. In the context of gifted education, this might involve case studies, simulations, and even co-teaching demonstrations. The Kazakhstani model by Zavalko et al. (2014) incorporated *"various active teaching methods, techniques and technologies"* in training sessions for teachers. Teachers were engaged in individual, pair, and collective forms of work (e.g. group problem-solving activities, peer discussions, and micro-teaching exercises). This approach allowed teachers to experience alternative pedagogical strategies first-hand – for example, they might participate in a mock "enrichment cluster" as learners to understand how to facilitate one with

their students. Collaborative learning among teachers (such as professional learning communities or teacher inquiry groups) encourages exchange of ideas and mutual support. Best practices include establishing networks of teachers of the gifted, where they can share resources or even observe each other's classes. Such collaboration can be facilitated by workshops, but also through online forums or regional teacher associations for gifted education. It aligns with the principle that gifted education training should be integral to the whole school's professional culture, not isolated. When multiple teachers in a school are trained together, it helps create a supportive environment where innovations (like a new enrichment program) are understood and reinforced by colleagues.

- Specialized Courses and Certifications: Many countries have developed special certification programs or advanced degrees in gifted education as a way to ensure depth of teacher competencies. In the U.S., for instance, some states offer an endorsement in gifted education which requires coursework and practicum experience. These formal programs often cover the full spectrum from theory to practice: identification methods, curriculum design for gifted, counseling techniques, creativity and critical thinking development, etc. The literature indicates that teachers who undergo such specialized training feel more confident and are rated as more competent in addressing gifted students' needs. In Kazakhstan, an example is the introduction of a special course titled "Students' personality giftedness development" for teachers' training programs. Incorporating a dedicated course ensures that teachers acquire content knowledge (e.g. understanding *"alternative styles of pedagogical communication"* suited to gifted learners) and practical know-how (like designing enrichment activities). Best practice suggests that such courses should also include a practicum or field experience where teachers practice skills with gifted students under supervision. Moreover, *comprehensive programs* address not only teaching strategies but also topics like *social-emotional needs of gifted students* and working with diverse gifted populations (underscoring the importance of equitable training to recognize giftedness in all cultural or socio-economic groups).
- Use of Technology and Innovative Tools: Modern best practices for teacher training leverage technology, both as a medium of training and as content to be learned. One emerging concept is developing teachers' GTPACK (Gifted Technological Pedagogical Content Knowledge) – essentially expanding the well-known TPACK framework to the gifted education context. Teachers need to learn not only general pedagogical techniques, but also how to integrate advanced technologies in ways that enrich learning for gifted students. For example, training programs increasingly expose teachers to tools like Augmented Reality (AR), educational software, or online enrichment resources, because such tools can provide the level of depth and novelty that gifted students crave. Research has shown that using AR and other interactive tech in gifted programs can foster creative and analytical thinking in students while also improving teachers' attitudes toward technology use. However, teachers often feel unsure how to use technology purposefully for differentiation. Thus, best practice is to include in teacher training explicit modules on using technology (e.g. virtual labs, coding projects, global collaboration platforms) to meet gifted learners' needs. An example from the literature is the GIFTLED project, where teachers were trained to implement an AR-integrated enrichment curriculum; this training led to gains in teachers' confidence and competence in delivering high-level STEAM activities to gifted students. The general message is that 21st-century skills for teachers of the gifted include comfort with technology, and effective PD provides ongoing support (tutorials, coaching) in this area. Especially after the rapid shift to online learning during the COVID era, the ability to adapt gifted education to virtual formats has become a relevant competency, and training programs are incorporating lessons learned (such as how to keep gifted students engaged via online platforms, how to personalize digital assignments, etc.).

- Mentoring and Expert Support: Several sources highlight the value of mentorship in developing teacher competencies. This can take the form of pairing less experienced teachers with veterans who have expertise in gifted education. Mentors can observe classrooms and provide feedback, help in planning differentiated lessons, and guide reflection. In some regions, specialist coaches in gifted education travel between schools (an example being some U.S. districts or Australian states have "gifted consultants" available). Best practice is to institutionalize such support—for instance, a school might designate a lead teacher for gifted education who mentors others. In Kazakhstan's advanced training system, the idea of *"pedagogical reflection"* is strongly encouraged. Teachers are trained to analyze their own lessons and student responses, often with a mentor or in a group, to continually refine their practice. Reflection is more effective when guided by someone knowledgeable in gifted education who can ask probing questions (e.g., "How else might you challenge the student who finished the task in 5 minutes?") and suggest alternative strategies.
- Supportive Institutional and Policy Frameworks: On a broader level, best practices cannot be fully implemented without systemic support. The Global Principle 9: Sustainable states that *"professional learning in gifted education should be built into educational policy"*. This means that ministries of education, school districts, and leadership must prioritize and fund teacher development for gifted education. Policies might include requirements for all teachers to take coursework in gifted education, or incentives like salary increments for earning a gifted certification. In practice, countries that have strong gifted education programs (e.g., South Korea, Israel, USA) often have national or state policies mandating identification and services for gifted students – which in turn necessitates teacher training frameworks. In Kazakhstan, the State Program for Support of Young Talents (2000)[57] and subsequent initiatives set a foundation, but implementation at the teacher-training level is key. Zavalko et al. (2014) pointed out the need for university and in-service training center cooperation to develop teachers' competencies, and recommended designing didactic and scientific-methodological support for this process[58]. This implies curriculum guides, training modules, and teaching materials specifically tailored to help teachers learn gifted education strategies. Best practices from other contexts suggest developing such resources (for example, guidebooks on differentiating lessons, or online repositories of enrichment activities). Moreover, making gifted education PD "integral" to school programs means that school leaders schedule regular training sessions, allocate time for teachers to plan differentiated lessons, and include gifted education in school improvement plans[43]. Administrative support is frequently cited as a factor in successful teacher development: teachers need encouragement and sometimes flexibility (like permission to try an unconventional teaching approach for a gifted student). Thus, principal training is also relevant – principals who understand gifted education can better facilitate teachers' efforts.
- Addressing Equity and Diversity in Training: An emerging best practice is ensuring that teacher training in gifted education includes a focus on equity – helping teachers recognize and develop potential in students from underrepresented groups. Global Principle 5: Equitable emphasizes that training programs should address the needs of gifted learners of different racial, cultural, and socio-economic backgrounds. This responds to a long-standing issue: gifted programs often see under-identification of minorities or low-income students due to biases or lack of teacher awareness. Therefore, teacher competencies should include culturally responsive teaching and an understanding of how giftedness may manifest differently in different contexts. Some professional development modules now include training on implicit bias in referral and identification, bilingual gifted education strategies, and twice-exceptional (gifted with disabilities) student support. By incorporating these topics, teachers become more competent in nurturing *all* gifted learners, not just those who fit a traditional mold. For instance, a teacher might learn how to spot signs of high creative potential in a student who is an English language learner, or how to

differentiate instruction for a gifted child with ADHD – scenarios that require nuanced understanding and skills.

Overall, the literature suggests that developing teacher competencies for gifted education is best achieved through comprehensive, sustained, and well-supported professional learning programs. These programs should combine theory and practice, encourage collaboration, integrate the latest technology and research, and be backed by policy and leadership support. When implemented, such training has shown positive outcomes: teachers report greater confidence and efficacy in teaching gifted students, and observers note improved classroom practices (more differentiation, better student engagement). Indirectly, these competencies can lead to better student outcomes – for example, a well-trained teacher can prevent the common problem of gifted underachievement by keeping gifted students appropriately challenged and engaged.

Outcomes and Impacts

Although research in this area is still growing, several studies and reports hint at the positive impacts of enhancing teacher competencies on gifted student outcomes. Teachers who receive specialized training are more likely to use a variety of instructional approaches to meet high-ability learners' needs. For instance, a review found that in both primary and secondary settings, trained teachers employed *"an array of approaches when differentiating for high-ability students"*, whereas untrained teachers tended to rely on standard instruction. Gifted students in classes with trained teachers have been observed to show higher engagement – they are less likely to complain of boredom and more likely to pursue ambitious projects or independent research. Moreover, a study on early-grade gifted programs in one U.S. region noted that when districts had clear gifted plans and teacher training, even young gifted learners (K–2) received more enriched learning experiences.

At the school-wide level, training both teachers and principals yields a more coherent approach to gifted education. Research in Australia comparing perceptions of principals and teachers found that *"exemplary principals continually enhance their understanding of differentiated learning and build their teachers' collective capacity for educating gifted learners"*. Such schools exhibited stronger outcomes in terms of consistent differentiation practices and a culture that valued gifted education. The same study indicated the need for *"ongoing professional education… and effective leadership actions for schoolwide differentiated learning"*, reinforcing that impact is maximized when professional development is not a one-time event.

Where quantitative outcomes have been measured, some studies report improvements in student achievement after teachers underwent targeted PD. For example, one program ("Day a Week School" enrichment pull-out program) showed that after a semester, gifted students demonstrated gains not just academically but also in motivation; notably, teachers in that program reported an increased ability to address their students' needs, which correlated with *"higher academic achievement"* and positive behavioral changes in students at risk. While causality is complex, it stands to reason that teacher competence is a key mediator in gifted program effectiveness. If a teacher knows how to pace instruction for a highly able student, that student is more likely to progress optimally (and conversely, even a well-designed gifted curriculum can falter in the hands of an untrained teacher).

In Kazakhstan, although systematic evaluations are fewer, the experimental training at the *Daryn* regional center reported qualitative improvements. Teachers who participated became more adept at identifying giftedness in their classes and more proactive in creating opportunities (e.g. organizing creative contests, science clubs) for their gifted students. The authors noted that *"systematic and planned work on the teacher's qualification improvement… will not be efficient without active self-education"*, and teachers who embraced continuous learning saw the most benefit. This self-improvement aspect is an outcome in itself: developing competencies is not just

about a finite set of skills, but about fostering an ongoing professional growth mindset in teachers. Dr. Zhuldyz E. Alibayeva, among others in Kazakhstan, has been involved in promoting this kind of reflective, lifelong-learning approach in teacher education. By doing so, the impact extends beyond immediate student performance – it cultivates a cadre of educators continually striving to improve gifted students' educational experiences over the long term.

In summary, the outcomes of effective teacher competency development manifest in more differentiated instruction, higher student engagement and achievement, better identification of gifted learners (including those from diverse backgrounds), and a stronger culture of support for gifted education within schools. These outcomes ultimately contribute to gifted students reaching their potential, which has broader societal benefits (as gifted individuals can become innovators, researchers, and leaders if nurtured properly). The findings of our analysis thereby underscore that investing in teacher competencies is a crucial component of any successful gifted education program.

Discussion

This review and bibliometric analysis illuminate a clear trajectory in both research and practice: there is a growing recognition worldwide that teachers are the linchpin in the education of gifted students, and concerted efforts are needed to build their competencies. The identified best practices align with general principles of effective professional development while also addressing the specialized nature of gifted education.

One notable alignment is with the Global Principles for Professional Learning in Gifted Education (WCGTC, 2021). Our findings echo these principles: for instance, we found that training should be holistic, covering not just academic strategies but also social-emotional learning for gifted students. Teachers frequently need guidance on issues like counseling gifted students through perfectionism or helping them cope with asynchronous development; a holistic training ensures teachers can support the "whole gifted child." We also underscore the need for evidence-based practice – teachers should be taught strategies that research has shown to be effective with gifted learners (like acceleration, which decades of studies have validated as beneficial, or specific creativity training techniques). Encouragingly, many professional development programs now integrate current research (for example, showing teachers the latest findings on neuroscience of gifted brains or outcomes of ability grouping) to justify and shape classroom strategies.

The principle of tiered content came through strongly in differentiating the level of training for general teachers versus specialists. This has policy implications: teacher certification standards may need to incorporate at least basic competencies in gifted education for all teachers. In Kazakhstan, as the education system undergoes reforms, there is an opportunity to embed such requirements (e.g., in teacher attestation or licensing, include knowledge of differentiation as a criterion). The idea of making gifted education training integral and sustainable within the education system is particularly salient. It suggests that countries should not treat gifted education as an "add-on" handled by a few enthusiasts, but as a standard part of educational excellence. Our findings support this by showing that when an entire school staff and leadership are knowledgeable about gifted education, the services for gifted learners are more effective and equitable.

Another discussion point is the challenge of heterogeneity – both in the research and in practice. The studies we reviewed span many countries, each with their definition of giftedness, which can range from high IQ to creative talent or subject-specific aptitude. Teacher competencies might need to be contextualized: for example, in a rural area with multi-grade classrooms, a teacher's approach to differentiating for a gifted student might differ from that of a teacher in a specialized urban gifted academy. Despite this diversity, the core best practices we identified appear adaptable to various contexts. Whether in Kazakhstan, the US, or elsewhere, teachers need the mindset and toolkit to recognize exceptional potential and modify learning experiences

accordingly. Future research could delve deeper into context-specific strategies – for instance, how can we develop gifted education competencies in countries with limited resources or in inclusive classrooms with a wide range of abilities? Our analysis suggests that basic principles (continuous training, collaboration, etc.) hold true, but the methods of implementation might vary.

One area that emerged as both a finding and a forward-looking recommendation is the integration of technology. With rapid advancements in educational technology, teachers of the gifted have unprecedented tools at their disposal – but only if they know how to use them effectively. The GTPACK framework highlighted in our results is a promising extension of pedagogical skillsets. It acknowledges that teachers must blend technology with content knowledge and pedagogy in a way that specifically benefits gifted learners (for example, using simulation software for a gifted math student to explore advanced concepts independently). The implication is that teacher training programs should not treat tech integration and gifted differentiation as separate topics; rather, training should demonstrate *how technology can enable differentiation*. Given the positive outcomes seen when teachers incorporate AR or other digital tools for gifted students (enhanced engagement, creativity, etc. as noted in studies), scaling up these practices could significantly enrich gifted education. However, it requires addressing the initial discomfort teachers might have with advanced tech – hence the emphasis on sustained PD and support.

From a research perspective, our bibliometric component indicates that while interest in teacher competencies for gifted students is rising, there are still gaps in the literature. We observed, for example, that many studies are descriptive or consensus-based (like Delphi studies defining competencies) rather than experimental. There is a need for more rigorous evaluations of specific training programs: e.g., randomized controlled trials where one group of teachers gets a particular professional development intervention and the outcomes for gifted students (or teacher behavior) are compared to a control group. Such studies would provide stronger evidence of causality between training and student success. Additionally, cross-cultural studies could be valuable – our review touched on sources in English, Russian, and Kazakh, and it's evident that sharing knowledge across borders can be beneficial. For instance, Kazakhstan's experience with state-supported talent programs[6] and teacher training efforts could inform other countries, while international best practices can continue to guide local improvements. Collaborative research projects (perhaps through UNESCO or international gifted education conferences) could facilitate this exchange.

Limitations: In interpreting our findings, several limitations should be noted. First, the variability of what is considered "gifted" and how programs are structured meant that we often had to generalize competencies and practices at a high level. Individual differences (e.g., working with musically gifted vs. mathematically gifted students) were not deeply differentiated in our synthesis; teachers may need additional domain-specific strategies beyond the general competencies described. Second, our bibliometric analysis relied heavily on indexed literature; there may be valuable insights in unpublished projects or local journals we did not capture. We tried to mitigate this by including multiple languages and grey literature, but some bias toward English-language, internationally visible research remains. Third, the field may suffer from a mild publication bias – successful or innovative training programs are more likely to be reported, while attempts that failed to produce results might be underrepresented. We cautioned against over-optimism by including the note that many teachers still struggle and many schools have not fully implemented these best practices[4]. Finally, while we have outlined best practices, the effectiveness of these practices can depend on implementation quality. Simply mandating a workshop on gifted education doesn't guarantee a teacher will become competent; factors like

trainer expertise, follow-up support, and teacher buy-in are critical, though they were beyond our scope to analyze in detail.

Conclusion

Developing teacher competencies to work with gifted students is a multi-faceted endeavor that is crucial for unlocking gifted learners' potential. Our review of global research (2000–2025) and bibliometric trends shows a growing emphasis on this challenge, with an emerging consensus on effective strategies. Teachers need a blend of deep theoretical understanding of giftedness and practical skills in differentiation, classroom management, and collaboration. The best practices identified – from integrating gifted education content into all levels of teacher training, to providing continuous and hands-on professional development, to leveraging technology and mentorship – all aim at empowering teachers. Indeed, effective training "prepares educators to be effective supporters, promoting gifted students' development", which in turn leads to better outcomes for the students.

For global and Kazakhstani stakeholders alike, the implications are clear. Teacher education institutions should incorporate gifted education modules so that new teachers enter the workforce with at least a foundational competency to recognize and nurture advanced talents. Education authorities should establish sustainable programs (and policies) for ongoing in-service training in gifted education, ensuring such training is not a one-time initiative but an integral part of career-long development. Schools should foster a collaborative culture where teachers share strategies for differentiation and feel supported by leadership in innovating their teaching for high-ability students.

Kazakhstan, with its "State Support and Development of Schools for Gifted Children" policy dating back to 1996, has a foundation to build on. Continued research and investment in teacher training – such as the work of researchers like Dr. Zhuldyz Alibayeva and colleagues in developing new pedagogical models – will help localize global best practices to the Kazakh context. The result will be educators who can better identify gifted youngsters across urban and rural settings, design enriched curricula (for example, using both "acceleration" and "enrichment" tactics as appropriate), and guide gifted students' intellectual and personal growth.

In conclusion, as the global research trends indicate, the education community is increasingly recognizing that quality gifted education hinges on prepared teachers. By following the evidence-based best practices and principles outlined in this analysis, teacher competencies in working with gifted students can be significantly developed. This will not only benefit gifted students – allowing them to fully flourish – but will also contribute to educational innovation and excellence overall. As gifted students are often the ones who later drive scientific, artistic, and cultural advancements, nurturing their talents through skilled teaching is an investment in the future. Therefore, prioritizing teacher competency development in gifted education is both an educational imperative and a wise societal strategy, in Kazakhstan and around the world.

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ОСОБЕННОСТИ ПЕДАГОГИЧЕСКОГО РУКОВОДСТВА УЧЕБНО-ПОЗНАВАТЕЛЬНОЙ И СОЦИАЛЬНОЙ ДЕЯТЕЛЬНОСТЬЮ УЧАЩИХСЯ ОБРАЗОВАТЕЛЬНЫХ УЧРЕЖДЕНИЙ

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Аннотация. Статья посвящена вопросам организации педагогического руководства учебно-познавательной и социальной деятельностью учащихся средней школы. Подробно анализируются стили педагогического руководства деятельностью ученического коллектива. Даётся характеристика личностным и профессиональным качествам учителей, выбирающих тот или иной стиль руководства. Подчёркивается значение совместной деятельности ученического и педагогического коллективов. Также предлагаются условные формы и методы работы, способствующие повышению эффективности взаимодействия с ученическим коллективом.

Ключевые слова: стиль педагогического руководства, ученики-подростки, средняя школа, ученический коллектив, педагогический коллектив, социальные институты общества

The peculiarities of pedagogical guidance of teaching-cognitive and social activity of pupils of educational institutions

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Annotation: The given article is dedicated to one of the actual problems of pedagogues- to organizing of pedagogical guidance of teaching-educational activity of secondary school. In the article are analyzed in detail the styles of pedagogical guidance of unskilled collective of secondary school. The article characterizes the personal and professional qualities of teachers who choose a specific style of pedagogical guidance. The article emphasizes the role of joint activities of unskilled and teaching collective of secondary school. In the article are given necessary recommendations to improvement the work of pedagogical collective for pedagogical guidance of unskilled collective of secondary school.

Key words: style of pedagogical guidance, pupils-teenagers, secondary school, unskilled collective, pedagogical collective, social institutions of society

Вопросы формирования социально активного подрастающего поколения, обладающего высоким уровнем духовно-интеллектуального развития, широким мировоззрением и кругозором, настоятельно требуют серьёзного повышения эффективности совместной работы учителей и учеников образовательного учреждения. Именно совместная деятельность учителей и учащихся, представляющая собой органичный сплав опыта, мудрости и энергии, способствуют тому, что любые проекты в области учебно-

познавательной и социальной деятельности образовательного учреждения (средней общеобразовательной школы) достаточно широко и эффективно внедряются в жизнь и достаточно стабильно мотивируют весь ученический коллектив не останавливаясь на достигнутом и продолжать постоянный поиск возможностей усиления и повышения уровня действенности совместной работы учителей и учеников средней школы.

Высокоэффективная совместная деятельность учителей и учащихся средней школы, способствует также тому, что предпринимаемые шаги такого сотрудничества явно отличаются большой осмысленностью, осознанностью их большой социальной значимости. «Вопросы повышения уровня эффективности совместной работы учителей и учеников всегда были одним из перспективных направлений научных исследований в области педагогики, психологии, социологии» (1, 18). И, несмотря на приобретённый большой опыт учёными-исследователями в этой области, на сегодняшний день эта проблема ещё требует более детального и целенаправленного поиска путей, возможностей и условий для её кардинального обоснования и практической значимости. Более того, постоянно изменяющийся социально-политический и духовно-интеллектуальный мир, так действенно влияющий на сознание и поведение личности, особенно требует того, чтобы любая практическая деятельность со стороны ученического коллектива образовательного учреждения обязательно обосновывалась достаточно эффективными формами и методами педагогического руководства. И конечно же, нельзя не отметить важность участия и помощь со стороны семьи в столь важном вопросе, так как именно семья влияет на формирование особенностей характера ребёнка, взаимоотношения в семье, особенности коммуникации являются важными элементами развития психологического климата как в семье, так и в коллективе школьников, что особо было подчеркнуто в работе Г.А.Гасановой (3)

Ученые-исследователи проблем образования (Н.Г.Полехина, А.В.Мудрик, М.Ю. Красовский, А.А. Бодалев, Л.И. Криволап, Л.И. Новикова, К.М. Левитан, С.Б. Елканов, С.Н. Батракова, Ю.Л. Львова и др.) в своих исследованиях и опубликованных работах подчёркивают, что сама социальная позиция учителя как проводника социальных идей в педагогическую среду образовательного учреждения способствует тому, что его участие в вопросах воспитания и образования подрастающего поколения самым непреложным фактом. Принимая во внимание всю неоднозначность проявлений подросткового возраста (а мы на страницах нашей статьи будем раскрывать формы и методы работы именно с подростками), специалисты настоятельно подчеркивают большое значение наличия высокоэффективного педагогического руководства всем комплексом проводимых форм работы ученическим коллективом. Педагогическое руководство деятельностью ученического коллектива в области межличностного общения и совместной жизнедеятельности является очень важным фактором успешности предпринимаемых шагов. Педагогическое руководство способствует тому, что заметно уменьшается процент неверной, часто не совсем обоснованной практической деятельности ученического коллектива. Наличие педагогического руководства способствует правильному и эффективному выбору форм и методов работы, обоснованности используемых средств и способов усиления действенности как чисто ученического коллектива, так и совместной деятельности учителей и учащихся. Педагогическое руководство также очень важно и по той причине, что она позволяет очень профессионально предвидеть предполагаемые результаты какой-либо деятельности, позволяет вовремя провести корректировку выбора форм и методов работы, позволяет в разы уменьшить процент необоснованных решений в области практической работы ученического коллектива.

В современных условиях, для повышения эффективности работы учительского и ученического коллективов, их совместной деятельности было принято несколько стилей педагогического руководства учебно-познавательной и социальной деятельностью

ученического коллектива. Конечно, стилей педагогического руководства достаточно много и их использование зависит от целей перспективы получения итоговых результатов, от степени готовности самих учащихся-подростков, по-своему же можно, воспринимать весь потенциал воздействия конкретного стиля педагогического руководства. «Однако современная педагогика в совместной деятельности учителей и учеников придерживаются того мнения, что целесообразно говорить о трёх классических стилях педагогического руководства – авторитарной, демократической и либеральной» (7, 24). Причём, это стоит особо заметить, практически не бывает психолого-педагогических ситуаций, в разрешении которых можно воспользоваться исключительно одним стилем педагогического руководства. Есть специалисты, прекрасно подготовленные профессионалы, которые утверждают, что в реальной образовательной среде возможно лишь использование демократического стиля педагогического руководства, по той причине, что он самый эффективный и обоснованный. Конечно же, все образовательные учреждения должны стремиться и тому, чтобы именно демократический стиль педагогического руководства выстроен как единый доминантный показатель всей жизнедеятельности средней школы. Однако, как показывает практика, такое состояние бывает крайне редко, и то в продвинутых пилотных школах. В реальной же школьной жизни практически используется все три направления стилей педагогического руководства. Мы считаем, что это, в принципе, верно, так как само образовательное учреждение представляет собой сложный социально образовательный организм и, как организм в целом, ему присущ и взлеты, и какие-либо недостатки, свидетельствующие о реальной жизнедеятельности средней школы.

Безусловно, каждый стиль педагогического руководства отличается своей спецификой, специальным набором и комплексом используемых форм, методов и средств организации практической деятельности. Каждый из этих стилей используется в соответствии с поставленными целями, спецификой конкретного ученического коллектива или группы учащихся. Допустим, работа с трудновоспитуемыми подростками наиболее сложное, что, руководствуясь исключительно демократическим стилем педагогического руководства, не всегда можно получить ожидаемые результаты. Если, к примеру, трудновоспитуемый подросток так давно состоит на учёте в детской комнате полиции, то, будем откровенны, теоретические наставления такому молодому человеку настолько привычны, что он практически на них не реагирует. Можно в день по сто раз говорить ему «не кури, не пропускай занятия», «не будь таким жестоким со своими одноклассниками»- можно заранее предположить, что эти теоретические выкладки на него практически не подействуют. В таких случаях, как говорят специалисты, желательно будет использовать именно авторитарный стиль педагогического руководства, отличающаяся большей строгостью и контролем.

Мы считаем, что будет очень целесообразным на страницах нашей статье дать определённую характеристику каждому из вышеуказанных нами стилей педагогического руководства. Почему это так важно, потому что каждый стиль педагогического руководства имеет свои преимущества и недостатки, которые обязательно проявляются в их использовании. К примеру, как мы уже указывали, демократический стиль педагогического руководства с трудновоспитуемым подростком – малоэффективен, в этом случае желательно делать упор на использование именно авторитарного стиля. Однако, и здесь есть свои особенные нюансы – «использование авторитарного стиля ни в коем случае не предполагает грубые отношения к подростку, унижение и затрагивание его чувств собственного достоинства» (8, 32). Если такое будет происходить и неизменно повторяться, то, скажем откровенно, вместо какого-либо положительного результата можно получить практически вопиющие последствия – подросток может из состояния трудновоспитуемого трансформироваться (из чувства мести) в состоянии открытого преступника. Даже при использовании авторитарного стиля педагогического руководства, оно должно

основываться на принципах этики, нравственности. Бывали случаи, когда подростки, пойманные на месте преступления, в беседе с тюремным следователем и психологом указывали на то, что их постоянно оскорбляли, не считались с их чувством собственного достоинства, настраивали весь класс против них и нелестно отзывались об их родителях и системе домашнего воспитания. Такой массированный, целенаправленный буллинг настолько озлобил молодого человека, что он, подсознательно чувствуя свою ненужность никому, особенно не задумывался, когда сознательно шёл на преступление. Конечно, здесь можно говорить, что у него слабая воля, что он должен был держать себя в руках и искать других людей, которые бы его поддержали и не допустили бы к откровенному преступлению. Однако, следует заметить, что даже такое благое пожелание не всегда может полностью охарактеризовать конкретный поступок и не всегда может привести к позитивному результату.

В современной психолого-педагогической и социальной среде очень эффективным и наиболее приемлемым считается использование именно демократического стиля педагогического руководства. Однако использование такого стиля педагогического руководства не проходят по мановению волшебной палочки. Должен быть создан определённый фундамент в школьном коллективе, а иначе можно столкнуться с фактами явного непонимания, а то и сознательного сопротивления со стороны ученического коллектива.

Демократический стиль педагогического руководства предполагает равенство мнений и взаимное уважение как друг к другу, так и к высказываемым суждениям, формирование объективного мнения и самое главное, сами ученики должны глубоко осознать, что именно такой стиль педагогического руководства им необходим, именно он открывает перед ними личностно-социальные перспективы и заряжает высоким чувством оптимизма. Демократический стиль педагогического руководства предполагает также, восприятие другими учениками и самим учителем критических высказываний в их адрес, здоровый обмен мнениями и, самое главное, осознанное позитивное изменение межличностных отношений. Конечно, как и в любом стиле педагогического руководства могут возникнуть конкретные ситуации, когда только лишь комплекс средств одного стиля, используемый довольно часто, не в состоянии положительно повлиять на какой-либо определенный фактор. В этом случае будет совершенно верным использование комплекса средств другого стиля педагогического руководства. «Практики с большим опытом профессионально-педагогической деятельности отмечают, что, насколько демократический стиль педагогического руководства является позитивным, настолько же он требует внимания к определённым обязательным условиям» (6, 48).

Одним из главных условий этого стиля является объективность, честность, человечность учителя, работающего с учениками. Если ученики видят фальшь, необъективность, нечестность, использование этого метода работы только лишь в личных целях, то, понятное дело, даже такой стиль педагогического руководства, как демократический со всем его набором позитивных средств воздействия, не принесёт ожидаемых результатов. Ученики очень чувствительны к эмоциональной составляющей всей работы учителя и прекрасно ориентируется в объективности проявления этих эмоций. Если учитель, допустим, отвечает на критику со стороны учеников и делает это с использованием грубых формулировок («ты ещё мал меня чему-либо учить», «ты вначале на себя со стороны посмотри», «кажется я дал вам много воли, что Вы меня критикуете» и т.д.), то весь богатый арсенал позитивных средств, присущий демократическому стилю педагогического руководства остаётся неиспользованным и недейственным.

В современной учебно-воспитательной работе средней школы, организации и жизнедеятельности также используется или же имеет место (как это ни странно выглядит на

первый взгляд) либеральный стиль педагогического руководства. Такой стиль педагогического руководства не всегда понятен не только ученикам, но и учителям школы. Очень часто можно наблюдать ситуацию, когда учитель, по оценкам коллег профессионально прекрасно подготовленный, отказывается применять свои знания в практической деятельности или в межличностных отношениях, демонстрируя при этом непонятную нерешительность. Было заметно, как говорят специалисты, что учитель либерального стиля педагогического руководства сознательно не берёт на себя какую-либо ответственность, не проявляет инициативы. На вопрос учеников, как им поступать в каком-либо конкретном случае, отшучивается, напоминает им, что они достаточно взрослые, чтобы не беспокоить его по таким вопросам. Такой учитель в организации каких-либо мероприятий проявляет видимую безучастность, ждёт каких-либо указаний со стороны администрации школы. Если какой-либо ученик или же группа учеников выступают с какой-либо инициативой, такой учитель пытается погасить творческий порыв молодых людей, всячески увешивая их жить спокойно и не «дёргаться». Однако бывает случаи, когда учитель либерального стиля педагогического руководства получает от администрации школы какие-либо задания и, понимая, что он не сумеет его выполнить надлежащим образом, поднимает к этому делу группу наиболее инициативных учеников, немного им помогает и в дальнейшем, при создании таких же ситуаций, очень широко пользуются их возможностями. «Учитель либерального стиля педагогического руководства практически никогда не интересуется активно жизнью классного коллектива, не поддерживает тесных взаимоотношений с родителями учащихся, часто пропускает проводимые в школе мероприятия» (5, 56). Ученики, зная характер такого учителя, практически не обращается к нему за советом и, даже можно сказать, открыто игнорируют его мнения по какому-либо вопросу. Следует заметить, что наряду со своеобразной «безобидностью» позиций такого учителя, здесь есть много негативных нюансов, которые могут достаточно серьёзно повлиять на жизнь учеников-подростков средней школы. При сложной жизненной ситуации молодым людям не у кого спросить совета и рекомендации и, в результате, при известных обстоятельствах, ученики могут попасть в трудные жизненные обстоятельства, вплоть до личностно-социальной дезадаптации. Следует заметить, что хотя мы и охарактеризовали либеральный стиль педагогического руководства в чисто теоретическом плане, в реальной жизни, жизнедеятельности школы такой стиль руководства не встречается очень уж часто. Администрация средней школы и другие её структурные подразделения вовремя реагируют на такие случаи и достаточно успешно их пресекают.

В заключении можно сказать, что выбор определённого стиля педагогического руководства деятельностью ученического коллектива определяется конкретными объективными и субъективными факторами. К примеру, высокая профессиональная подготовленность конкретного учителя, воспринимаемое как видимый фактор в его преподавательской деятельности, выступает как явный объективный фактор. С другой стороны, этот же учитель с высокой степенью профессиональной подготовленности, может по-разному проводить учебный процесс, выбирает по-своему личностному выбору конкретный доминантный фактор повышения эффективности всей учебно-познавательной деятельности учащихся.

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ОСОБЕННОСТИ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОЙ РАБОТЫ СТУДЕНТОВ ВЫСШИХ УЧЕБНЫХ ЗАВЕДЕНИЙ РЕСПУБЛИКИ КАЗАХСТАН В РАМКАХ РЕКОМЕНДАЦИИ ЮНЕСКО ОБ ЭТИЧЕСКИХ АСПЕКТАХ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА

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Аннотация

В условиях стремительного развития цифровых технологий и внедрения искусственного интеллекта (ИИ) в различные сферы жизни, особое значение приобретает этическое сопровождение научно-исследовательской деятельности студентов вузов. Настоящая статья рассматривает особенности организации и содержания исследовательской работы студентов в Республике Казахстан с учетом положений Рекомендации ЮНЕСКО об этических аспектах искусственного интеллекта, принятой в 2021 году. Анализируются ключевые ценностные установки, принципы и стратегические направления, предложенные ЮНЕСКО, и даются предложения по их внедрению в академическую среду.

Статья подготовлена в рамках выполнения договора на грантовое финансирование, заключенного с Комитетом науки Министерства науки и высшего образования Республики Казахстан (ИРН проекта 19676691).

Ключевые слова: научно-исследовательская работа студентов, интерес к научной деятельности, значимость научной деятельности, нейросеть, информационные технологии, эволюция.

Современный этап развития науки и образования характеризуется активным внедрением цифровых технологий, в том числе систем искусственного интеллекта (ИИ). Эти процессы оказывают влияние не только на организацию учебного процесса, но и на специфику научно-исследовательской работы студентов (НИРС). Для Казахстана, находящегося в фазе активной модернизации высшего образования, вопросы интеграции этических и правовых аспектов применения ИИ становятся особенно актуальными.

Международное сообщество уже выработало ряд нормативных ориентиров в данной сфере. В 2021 году ЮНЕСКО приняла Рекомендацию об этических аспектах искусственного интеллекта — первый глобальный документ, закрепляющий универсальные ценности и принципы применения технологий ИИ [1]. Этот акт подчеркивает необходимость уважения прав человека, прозрачности алгоритмов, недопущения дискриминации и обеспечения инклюзивности. В условиях Казахстана данные положения могут служить методологической базой для совершенствования НИРС.

Цель статьи — выявить особенности научно-исследовательской работы студентов в Казахстане в контексте реализации Рекомендации ЮНЕСКО, обозначить существующие вызовы и предложить направления развития.

Рекомендация ЮНЕСКО определяет основные ценностные установки, которые должны быть положены в основу применения ИИ: уважение человеческого достоинства, обеспечение справедливости и недопущение дискриминации, прозрачность и объяснимость алгоритмов, защита данных, устойчивое развитие, а также подконтрольность технологий человеку.

Согласно документу, на всех этапах жизненного цикла ИИ-систем необходимо учитывать этические последствия: от проектирования и внедрения до эксплуатации и утилизации. Особое внимание уделяется образованию и научным исследованиям. Подчеркивается, что студенты и молодые ученые должны быть обучены критическому восприятию технологий, навыкам медийно-информационной грамотности, а также принципам академической честности в условиях цифровизации.

Рекомендация также акцентирует необходимость минимизации цифрового неравенства между странами и внутри обществ. Для Казахстана это положение особенно важно, поскольку уровень цифровой инфраструктуры и доступ к современным технологиям в университетах существенно различается.

Научно-исследовательская работа студентов в казахстанских вузах имеет многокомпонентный характер. Она включает участие в научных проектах и грантах, публикации в студенческих журналах, выступления на конференциях, выполнение курсовых и дипломных исследований.

Закон Республики Казахстан «Об образовании», а также государственные программы развития науки и цифровизации подчеркивают необходимость интеграции студентов в научную деятельность [2]. Однако на практике НИРС часто носит формальный характер. Участие студентов в конференциях нередко ограничивается подготовкой тезисов без глубокой исследовательской составляющей.

Среди проблем можно выделить:

- недостаток финансирования студенческих исследований;
- слабую связь университетов с реальным сектором экономики;
- ограниченный доступ к современным цифровым инструментам анализа данных;
- проблемы академической честности, включая плагиат.

Ситуация требует новых подходов, учитывающих вызовы цифровой эпохи и международные стандарты этики науки.

Использование технологий искусственного интеллекта открывает перед студентами новые возможности. Среди них:

- автоматизация поиска и систематизации научных источников;
- интеллектуальный анализ больших массивов данных;
- использование генеративных моделей для проектирования гипотез и сценариев исследований;
- применение ИИ-инструментов в прикладных отраслях — медицине, юриспруденции, экономике.

Однако вместе с преимуществами возникают и риски:

- угроза снижения уровня критического мышления при избыточной зависимости от ИИ;

- рост случаев недобросовестного использования генеративных моделей для обхода академической честности;

Рекомендация ЮНЕСКО указывает на необходимость формирования у студентов навыков ответственного применения ИИ, обучения пониманию прозрачности алгоритмов и их влияния на принятие решений.

Одним из ключевых вопросов становится сохранение академической честности. Использование ИИ должно рассматриваться не как замена интеллектуального труда студента, а как вспомогательный инструмент. Необходимо развивать у студентов умение соотносить полученные с помощью ИИ данные с собственным критическим анализом.

Особое внимание требует принцип равного доступа к технологиям. Казахстан сталкивается с проблемой цифрового разрыва: крупные и ведущие университеты имеют значительно больше возможностей, чем региональные вузы. Это ведет к дисбалансу в качестве подготовки исследователей.

Принцип прозрачности предполагает, что студент должен уметь указывать, какие цифровые инструменты использовались в исследовании, и как именно они повлияли на результаты. Такой подход соответствует международным требованиям к академической этике [3].

Наконец, следует учитывать культурные и социальные особенности Казахстана. Этика применения ИИ в исследованиях студентов должна сочетать международные принципы с национальными ценностями, включая уважение к культурному многообразию и языковым особенностям.

Для гармонизации национальной системы НИРС с международными принципами этики ИИ можно выделить несколько направлений развития:

1. Нормативное регулирование. Разработка и внедрение на уровне вузов этических кодексов, регулирующих использование ИИ студентами в научных работах.

2. Образовательные программы. Введение дисциплин по цифровой этике, правовым аспектам ИИ и академической честности в рамках курсов по исследовательской подготовке.

3. Инфраструктурная поддержка. Создание равных условий доступа студентов к современным ИИ-инструментам, в том числе через государственные программы цифровизации региональных университетов.

4. Международное сотрудничество. Участие казахстанских студентов в международных проектах по этике ИИ, обмен опытом с зарубежными университетами, интеграция в глобальные исследовательские сети.

5. Практико-ориентированные исследования. Стимулирование участия студентов в проектах, направленных на решение реальных социальных и правовых задач с использованием ИИ.

Реализация этих направлений позволит не только повысить качество НИРС, но и укрепить международный авторитет казахстанской научной школы.

Научно-исследовательская работа студентов в Казахстане вступает в новый этап развития под влиянием цифровых технологий. Внедрение ИИ открывает широкие возможности, но одновременно ставит перед академическим сообществом новые этические вызовы.

Рекомендация ЮНЕСКО 2021 года выступает универсальным ориентиром, позволяющим выработать сбалансированный подход к интеграции ИИ в образовательную и исследовательскую практику. Для Казахстана актуально сочетание международных стандартов с национальными особенностями системы высшего образования.

Создание этической и технологической инфраструктуры в вузах позволит студентам использовать потенциал ИИ для научного поиска, сохраняя при этом принципы академической честности, справедливости и равного доступа. В долгосрочной перспективе это станет важным фактором формирования конкурентоспособного научного сообщества страны.

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ОТЛИЧИЯ ЭВОЛЮЦИОННОГО И РЕВОЛЮЦИОННОГО ПОДХОДОВ В СОВЕРШЕНСТВОВАНИИ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОЙ РАБОТЫ СТУДЕНТОВ (НИРС)

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Аннотация

В статье рассматриваются особенности эволюционного и революционного подходов к совершенствованию научно-исследовательской работы студентов (НИРС) в системе высшего образования. Проведен сравнительный анализ постепенных и прорывных изменений, выявлены их преимущества и ограничения в контексте формирования исследовательской культуры. На основе анализа казахстанской практики показано, что эволюционный подход обеспечивает устойчивость и преемственность, тогда как революционный открывает возможности для быстрых инноваций и цифровизации образовательного процесса. Автор делает вывод о необходимости гибридной модели, сочетающей оба подхода, что позволит повысить конкурентоспособность национальной системы НИРС и адаптировать её к современным вызовам.

Статья подготовлена в рамках выполнения договора на грантовое финансирование, заключенного с Комитетом науки Министерства науки и высшего образования Республики Казахстан (ИРН проекта 19676691).

Ключевые слова: научно-исследовательская работа студентов, эволюционный подход, революционный подход, высшее образование, Казахстан, исследовательская культура.

Совершенствование научно-исследовательской работы студентов (НИРС) остаётся одной из наиболее дискуссионных задач современного высшего образования. Подготовка будущих исследователей требует не только изменения содержания учебных курсов, но и выработки целостной стратегии развития студенческой науки. При этом неизбежно встаёт вопрос о характере этих изменений: должны ли они носить поступательный и постепенный характер, или же система нуждается в резких прорывных реформах.

На этом фоне обостряется интерес к разграничению эволюционного и революционного подходов в развитии НИРС. Оба они не только различаются по темпам и методам преобразований, но и формируют различную исследовательскую культуру в университетской среде.

Эволюционный подход предполагает, что совершенствование НИРС происходит через накопление локальных изменений. Речь идёт о таких мерах, как расширение тематики курсовых и дипломных исследований, создание студенческих журналов, включение студентов в действующие научные проекты преподавателей.

Главное достоинство этого пути заключается в формировании исследовательской традиции. Например, в ряде казахстанских университетов в течение последних десяти лет создавались студенческие научные клубы. Они редко становились прорывными центрами науки, но позволяли поддерживать устойчивый интерес студентов к исследованиям и формировали преемственность поколений. Эволюционные изменения не дают мгновенного результата, однако постепенно создают фундамент, на котором может вырасти полноценная исследовательская экосистема.

Вместе с тем медлительность такого подхода становится его слабым местом. В условиях, когда наука стремительно цифровизируется, университеты, опирающиеся исключительно на эволюцию, рискуют оказаться на периферии мирового образовательного пространства.

Революционный подход основан на предположении, что постепенных изменений недостаточно. Иногда система должна быть резко перестроена. В истории казахстанского образования подобным примером стало введение кредитной технологии обучения и переход к Болонскому процессу. Эти реформы изменили не только организацию учебного процесса, но и саму логику студенческой науки, где индивидуальная работа и самостоятельные исследования стали обязательным элементом [1].

Революционный подход часто связан с внедрением новых технологий. Массовое использование цифровых платформ для организации научных мероприятий или включение студентов в стартап-проекты — это примеры того, как радикально меняется инфраструктура НИРС. Эффект здесь заметен уже через несколько лет: резко возрастает публикационная активность студентов, появляются новые формы исследовательских инициатив [2].

Однако подобные преобразования редко проходят безболезненно. Быстрая ломка старых структур вызывает сопротивление со стороны преподавателей, а у студентов создаёт ощущение искусственного давления. В результате часть инициатив теряет устойчивость, поскольку не подкреплена сформировавшейся традицией.

Эволюция и революция не всегда противопоставлены друг другу. На практике они могут образовывать диалектическую пару. Эволюция формирует основу — исследовательские навыки, культуру академической честности, опыт участия в проектах. Революция же позволяет совершать скачки, когда традиционные формы перестают отвечать запросам времени.

Показателен пример внедрения цифровых инструментов в НИРС. В одних университетах этот процесс шёл постепенно: сначала использовались библиографические базы данных, затем платформы для антиплагиата, позже — системы управления научными проектами. В других вузах были предприняты резкие шаги: сразу вводились онлайн-конференции и цифровые репозитории. Сравнение показывает, что первый путь оказался более устойчивым, но второй быстрее привёл к росту публикационной активности студентов [3][4].

Ключевое отличие подходов состоит не только в темпах изменений, но и в их влиянии на культуру научной работы. Эволюция создаёт атмосферу исследовательской стабильности, революция стимулирует инновационность и креативность, но часто ценой социальной турбулентности.

Для казахстанской системы высшего образования оптимальным видится не выбор одного из подходов, а их сочетание. Университеты должны сохранять традиционные формы студенческой науки — клубы, кружки, локальные конференции, — как пространство

эволюционного развития. Одновременно необходимо предпринимать революционные шаги: внедрять цифровые лаборатории, использовать искусственный интеллект для анализа данных, развивать проектное обучение.

Особенность казахстанского контекста заключается в неоднородности университетской системы: крупные вузы обладают ресурсами для революционных реформ, тогда как региональные учебные заведения чаще идут по пути эволюции. В этом видится перспектива гибридной модели, где оба подхода могут не только сосуществовать, но и взаимно усиливать друг друга.

Сравнение эволюционного и революционного подходов позволяет сделать вывод: каждый из них необходим для развития студенческой науки, но в одиночку они не способны обеспечить устойчивое и современное функционирование НИРС.

Эволюционный путь обеспечивает преемственность и формирует культуру исследовательской деятельности. Революционный — открывает новые горизонты, резко повышает уровень вовлечённости студентов, но требует прочного фундамента.

Для Казахстана стратегической задачей становится поиск баланса между этими подходами. Лишь при их разумном сочетании возможно создание такой системы НИРС, которая будет одновременно стабильной, инновационной и конкурентоспособной на международной арене.

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ОРТА МЕКТЕПТЕ ФИЗИКАЛЫҚ ЗАҢДАРДЫ ОҚЫТУДА КЕЙС ӘДІСІН ҚОЛДАНУ ӘДІСТЕМЕСІ

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Аңдатпа. *Мақалада жалпы білім беретін мектептерде физиканы оқытуда кейс әдісін қолданудың ғылыми-әдістемелік негіздері қарастырылған. Авторлар бұл белсенді оқыту технологиясы оқушылардың зерттеушілік дағдыларын, сыни тұрғыдан ойлауын, коммуникативті және практикалық дағдыларын дамытуға ықпал ететінін атап өтеді. Зерттеу аясында Алматы қаласындағы №59 орта мектепте эксперимент жүргізіліп, бақылау және эксперименттік топтардың нәтижелері салыстырылды. Эксперименттік топта сабаққа деген қызығушылық пен оқу материалын меңгеру сапасының жоғарылауы байқалды. Жұмыста кейс әдісін жүзеге асыру кезеңдері де сипатталып, әртүрлі тақырыптағы оқу тапсырмаларының мысалдары келтірілген. Сонымен қатар отандық және шетелдік ғалымдардың зерттеулері талданған. Алынған деректер физика сабағында кейс әдісін қолдану оқу мотивациясын тиімді арттырып, теориялық білімнің практикамен интеграциялануына ықпал ететінін көрсетті.*

Кілт сөздер: *кейс әдісі, физиканы оқыту, зерттеушілік дағды, оқу мотивациясы, белсенді оқыту*

МЕТОДИКА ПРИМЕНЕНИЯ КЕЙС-МЕТОДА ПРИ ОБУЧЕНИИ ФИЗИЧЕСКИХ ЗАКОНОВ В СРЕДНЕЙ ШКОЛЕ

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Аннотация. В статье рассмотрены научно-методические основы применения кейс-метода в обучении физике в общеобразовательных школах. Авторы отмечают, что эта технология активного обучения способствует развитию у учащихся исследовательских навыков, критического мышления, коммуникативных и практических навыков. В рамках исследования был проведен эксперимент в средней школе №59 г. Алматы, сравнивались результаты контрольной и экспериментальной групп. В экспериментальной группе наблюдалось повышение интереса к занятиям и качества усвоения учебного материала. В работе также описываются этапы реализации кейс-метода и приводятся примеры учебных заданий на различные темы. Также проанализированы исследования отечественных и зарубежных ученых. Полученные данные показали, что применение кейс-метода на уроках физики эффективно повышает учебную мотивацию и способствует интеграции теоретических знаний с практикой.

Ключевые слова: кейс-метод, преподавание физики, исследовательские навыки, мотивация к обучению, активное обучение

THE METHODOLOGY OF APPLYING THE CASE METHOD IN TEACHING PHYSICAL LAWS IN SECONDARY SCHOOL

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Annotation. The article discusses the scientific and methodological foundations of the application of the case method in teaching physics in secondary schools. The authors note that this technology of active learning contributes to the development of students' research skills, critical thinking, communication and practical skills. As part of the study, an experiment was conducted at secondary school №59 in Almaty, comparing the results of the control and experimental groups. In the experimental group, there was an increase in interest in classes and

the quality of learning of educational material. The paper also describes the stages of the implementation of the case method and provides examples of training tasks on various topics. The research of domestic and foreign scientists is also analyzed. The data obtained showed that the use of the case method in physics lessons effectively increases educational motivation and promotes the integration of theoretical knowledge with practice.

Keywords: case method, teaching physics, research skills, motivation to learn, active learning

Кіріспе. Қазіргі білім беру мектеп оқушыларында жүйеленген білімді ғана емес, сонымен қатар сыни тұрғыдан ойлау, теорияны практикада қолдана білу, коммуникативті және зерттеушілік дағдыларды дамыту сияқты әмбебап дағдыларды жетілдіруге ұмтылады. Физика пәнін оқытуда да білім дәстүрлі үлгіден бас тартып, оқытудың белсенді, проблемалық-бағдарлы түрлеріне көшу ерекше маңызды. Мұндай тәсілдер іргелі физикалық заңдылықтарды тереңірек меңгеруге және оқушылардың функционалдық сауаттылығын дамытуға ықпал етеді [1].

Кейс әдісі – белсенді оқытудың тиімді технологияларының бірі, ол басты назарды материалды қарапайым меңгеруден стандартты емес контексте білімді қолдануды талап ететін нақты жағдайларды талдауға ауыстырады. Бұл әдіс жаратылыстану-математика бағытындағы пәндерде, соның ішінде физика курстарында белсенді түрде қолданылады және мотивацияға, белсенділікке және есептерді шешу дағдыларын дамытуға оң әсерін көрсетті [2], [3]. Негізінде кейс әдісі – бұл оқушылар физикалық есептерді шешуге, сәйкес заңды таңдауға және олардың шешімін өз бетінше немесе топта негіздеуге қажетті немесе нақты жағдайларға негізделген білім беру сценарийі [4].

Мектеп тәжірибесінде кейс әдісі теориялық ұғымдарды нақты өмірмен немесе ғылыми-техникалық контексттермен байланыстыру қабілетімен ерекше құнды, мәселен кемелерді мысал ретінде пайдалану арқылы Архимед принципін түсіндіруден бастап энергияның, динамиканың және электр тізбектерінің сақталу заңымен байланысты құбылыстарды талдауға дейін кейс әдісін қолданса болады [5]. Эксперименттік зерттеулер физиканы кейстерді пайдалана отырып оқыту түсіну деңгейін, сыни талдауды және қорытынды жасау қабілетін айтарлықтай жақсартатынын көрсетеді. Мысалы, 2023 жылғы зерттеу кейстерді пайдаланып оқитын оқушылар бақылау тобымен салыстырғанда жылу тасымалдағыштар мен температураға қатысты есептерді шешуде айтарлықтай жоғары нәтижелерге қол жеткізгенін көрсетті [6]. [7] мақалада оқушылардың жобалық дағдыларын дамытуға баса назар аударылады. Онда физика бойынша оқушылардың ғылыми-зерттеу жұмыстарына жоба әдісін қолдану моделі жасанды жарық көздерінің спектрін зерттеу мысалында қарастырылған.

Осылайша, кейс-әдісі орта мектепте физикалық заңдылықтарды оқытудың перспективалық стратегиясы болып табылады, тек оқу жетістіктерін ғана емес, сонымен қатар нақты өмірде және болашақ кәсіби қызметте сұранысқа ие дағдыларды дамытуға ықпал етеді. Бұл мақаланың мақсаты – мектеп физикасында кейс әдісінің қажеттілігі мен тиімділігін негіздеу, оны енгізу әдістемесін әзірлеу және оқу тәжірибесінің потенциалды нәтижелерін көрсету.

Кейс әдісінің артықшылықтары. Кейс әдісі студенттердің ынтасын арттырып, сабаққа деген қызығушылығын арттырып, білімді өз бетінше меңгеруге итермелейді және өз шешімдерін талдау және дәлелдеу қабілетін дамытады [8]. Оқытудың дәстүрлі түрінен айырмашылығы, кейстермен жұмыс мектеп оқушыларына физикалық білімнің практикалық маңыздылығын сезінуге және оны өмірдегі жағдайлармен байланыстыруға мүмкіндік береді.

Кейс әдісін қолдануда контекст ерекше орын алады. Жағдайлар күнделікті өмірдегі немесе ғылыми-техникалық тәжірибедегі құбылыстарға негізделуі мүмкін, мысалы сұйықтағы қалқымалы денелер, электрлік тізбектер, Ньютон заңдары, энергияның сақталуы немесе жылу процестері. Істер бір физикалық заңды қолдану бойынша тапсырмалардан бастап кешенді талдауды қажет ететін пәнаралық мәселелерге дейін әртүрлі күрделілік деңгейінде болуы маңызды, бұл зерттеу дағдыларын дамытуға ықпал етеді. Сонымен қатар, бұл әдіс топтық жұмыс пен пікірталастарды қамтиды, оның барысында студенттер әртүрлі тәсілдерді талқылайды, бірлескен қорытындыға келеді, пікірталасқа үйренеді және бір-бірінің ұстанымдарын сыни бағалайды.

1-кестеде кейс әдісін білім беру тәжірибесіне енгізуді зерттеген отандық және шетелдік ғалымдардың еңбектеріне талдау берілген. Отандық зерттеушілердің жұмыстары негізінен орта мектеп пен жоғары оқу орындары жағдайында әдістемені сынақтан өткізуге бағытталған. Мәселен, Қасымова А.А. оқушылардың зерттеушілік құзыреттерін дамыту мақсатында механика, молекулалық физика және оптика бойынша арнайы кейстерді әзірлеп, олардың оқушылардың танымдық белсенділігі мен мотивациясына оң ықпал ететінін айқындады. Сәгитова Ж. және әріптестері жүргізген педагогикалық эксперимент нәтижесінде кейс әдісінің болашақ физика мұғалімдерінің кәсіби құзыреттерін қалыптастырудағы тиімділігі дәлелденді. Ал Раманқұлов С.З. бастаған ғалымдар тобы кейс әдісін цифрлық технологиялармен және шет тілінде оқытумен кіріктіріп, студенттердің шығармашылық қабілеттерін дамытуға ықпал еткенін көрсетті.

Шетелдік ғалымдардың еңбектері әдістеменің теориялық негіздері мен жалпы ғылыми білім берудегі маңызын ашуға бағытталған. Herreid C.F. кейс әдісін жаратылыстану пәндерінде алғашқылардың бірі болып жүйелі түрде қарастырып, нақты жағдайларды талдаудың сын тұрғысынан ойлауды дамытудағы рөлін негіздеді. Prince M. белсенді оқыту әдістеріне жасалған кешенді шолуында кейс әдісінің студенттердің оқу мотивациясы мен үлгерімін арттыруға ықпал ететінін атап өтті.

Жалпы алғанда, кестеде келтірілген зерттеулер кейс әдісінің білім беру жүйесінде әмбебап әрі тиімді құрал екенін көрсетеді. Ол оқушылар мен студенттердің зерттеушілік, шығармашылық және кәсіби құзыреттерін дамытуға, сондай-ақ белсенді оқу ортасын қалыптастыруға мүмкіндік береді.

Кесте 1. Кейс әдісін зерттеген отандық және шетелдік ғалымдардың жұмысына талдау

Авторлар	Мақала / зерттеу атауы	Негізгі идеялар
Қасымова А.А. (Қазақстан) [9]	Оқушылардың зерттеушілік құзыреттерін кейс-әдіс арқылы қалыптастыру (2022)	Механика, молекулалық физика және оптика бойынша кейстер жасалды. Әдістеме орта мектепте сынақтан өтті, нәтижесінде оқушылардың зерттеушілік дағдылары мен мотивациясы артты.
Сәгитова Ж., Абдыхалықова Ж., Теміров Қ., Құнанбаева А., Абдіркенова А. (Қазақстан) [10]	Effectiveness of Case Study Method in Teacher Preparation in Kazakhstan (2024)	Қазақстан ЖОО-ларында жүргізілген педагогикалық эксперимент. Кейс-әдіс болашақ физика мұғалімдерінің кәсіби құзыреттерін арттырып, оқу мотивациясын күшейтетіні дәлелденді.
Раманқұлов С.З., Досымов Е., Турмамбеков Т., Әзизханов Д., Құрбанбеков С. (Қазақстан) [11]	Integration of Case Study and Digital Technologies in Physics Teaching Through the Medium of a Foreign Language (2020)	Кейс-әдіс цифрлық технологиялармен және ағылшын тілінде оқытумен біріктірілді. «Оптика» бөлімінде компьютерлік модельдер қолданылды, нәтижесінде студенттердің шығармашылық құзыреттері артты.
Herreid C.F. (АҚШ)	Case Studies in Science – A Novel Method of Science Education (1994)	Жаратылыстану пәндерінде кейс-әдісті қолданудың алғашқы жүйелі зерттеулерінің бірі. Нақты жағдайларды талдаудың сын тұрғысынан ойлауды дамытудағы рөлі атап көрсетілді.
Prince M. (АҚШ)	Does Active Learning Work? A Review of the Research (2004)	Белсенді оқытуға арналған зерттеулерге шолу. Кейс-әдісті қоса алғанда, белсенді тәсілдер студенттердің қызығушылығы мен үлгерімін арттыратыны дәлелденді.

Кейс әдісінің кезеңдері. 9-сыныпқа арналған кейс тапсырмалар. Қазіргі заманғы зерттеулер мен әдістемелер кейс әдісімен жұмыс істеу мына кезеңдерді орындаған кезде тиімді болады деп санайды:

1-сурет. Кейс әдісінің кезеңдері

1. **Назар аударатын мәселе табу.** Мұғалім оқушыларға зерттелетін физикалық заңға байланысты нақты өмірлік жағдайды ұсынады. Іс нақты контекстті және ой толғауға және сұрақ қоюға итермелейтін қайшылықтарды қамтуы керек.

2. **Кейс шарттарын талдау.** Оқушылар белгілі деректерді, физикалық шамаларды бөлектеп, бірінші шешімді жасайды. Бұл аналитикалық тәсіл абсрактілі ұғымдардан мәселені практикалық түсіндіруге көшуге көмектеседі.

3. **Шешімдерді іздеу.** Істі шешу кезеңінде оқушылар физикалық заңды қолданады және жағдайды модельдейді. Шешім бір немесе бірнеше ықтимал әрекеттер курсын қамтуы мүмкін. Жоспарлау барысында модельдер, ықтимал проблемаларды шешу және алдын алу жолдары ұсынылады.

4. **Шешім нұсқаларын талқылау.** Жұмыс шағын топтарда ұйымдастырылады, онда оқушылар гипотезалармен бөліседі, шешімдерін талдайды және дәлелдейді. Мұғалім өз кезегінде фасилитатор қызметін атқарып, пікірталасқа бағыт-бағдар беріп, ойдың дер кезінде жеткізілуін қадағалайды.

5. **Қорытындылау.** Қорытынды кезеңде мұғалім жалпы ғылыми қорытынды жасайды, физикалық заңды тұжырымдайды және кейспен жұмыс тәжірибесін қорытындылайды.

Кейс әдісі арқылы 9-сынып физика тарауларына тапсырмалар құрастырылды. Әр кейс тапсырма нақты өмірдегі жағдайлармен тығыз байланысты. Сол үшін де оқушылардың қызығушылығын оятып, физиканы оқуға деген ынтасын ашады.

Тақырып: Бірқалыпты қозғалыс

Жол полициясының қызметкері жылдамдықты асырған жүргізушіні тоқтатады. Екеуінің арасында әңгіме өрбиді. Жүргізуші жылдамдық асырылғанымен келіспейді. Ол 2 сағатта небәрі 60 км жүргенін айтып, демек қозғалыс жылдамдығы 30 км/сағ болғанын дәлелдейді. Көрсетілетін құралдар: спидометр, радар, жүрілген қашықтық есептегіш.

Сұрақтар:

- Бұл жағдайда кім дұрыс?
- Кейіпкерлер қандай жылдамдықтар туралы сөз етіп отыр?
- Жылдамдықты анықтау үшін қандай құралдар қолданылды?
- Осы кейске сүйене отырып, өзіңізге үй тапсырмасын (немесе сыныптағы тапсырманы) құрастырыңыз.

2-сурет. Бірқалыпты қозғалыс тақырыбына арналған кейске иллюстрация

Тақырып: Импульстің сақталу заңы

Космос кемесінің ұшырылуы бейнефрагмент арқылы көрсетіледі.

Сұрақтар:

- Видеокейсте қандай оқиға көрсетілген?
- Бұл оқиғаның негізінде қандай физикалық құбылыс жатыр?
- Видеоны көргенде қандай ерекшеліктерді байқадыңыз?
- Осы кейске сүйене отырып, өзіңізге үй тапсырмасын (немесе сыныптағы тапсырманы) құрастырыңыз.

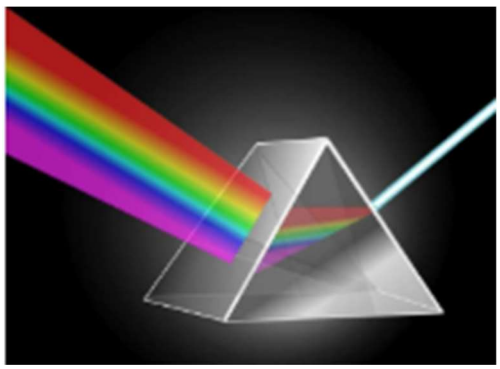
3-сурет. Ғарыш кемесінің ұшырылу сәті

Тақырып: Дисперсия

Аристотель түстердің пайда болуын былайша түсіндірген: жарық призма арқылы өткенде қараңғылықпен араласып, түрлі түске боялады. Аз ғана қараңғылық қосылса – қызыл түс, көп мөлшерде болса – күлгін түс шығады. Бұл теория ұзақ уақыт ғылымда үстем болды. Алайда өз тәжірибелерін жалғастыра отырып, Исаак Ньютон оны оңай жоққа шығарды. Ол призмаға қызыл жарықты бағыттады, ал ол өткенде ...

Сұрақтар:

- Жарық түсін өзгертті ме?
- Жаңа түстер пайда болды ма?
- Призма ақ жарықты «бояй ма», әлде оның құрамындағы қарапайым түстерге ажырата ма?



4-сурет. Дисперсия тақырыбына арналған кейске иллюстрация

Тақырып: Электромагниттік индукция

А. Куприннің «Тост» әңгімесінен үзінді: *XXII ғасырдың ең ұлы идеясы жүзеге асырылды: Жер шарын алып электромагнит катушкасына айналдыру үшін оны полюстен полюске дейін болат сыммен орады ... Магнит өрісі бүкіл фабрикалар мен зауыттарды іске қосты, барлық үйлерді жарықтандырды, жылытып тұрды. Көмір қажет болмай қалды ...*

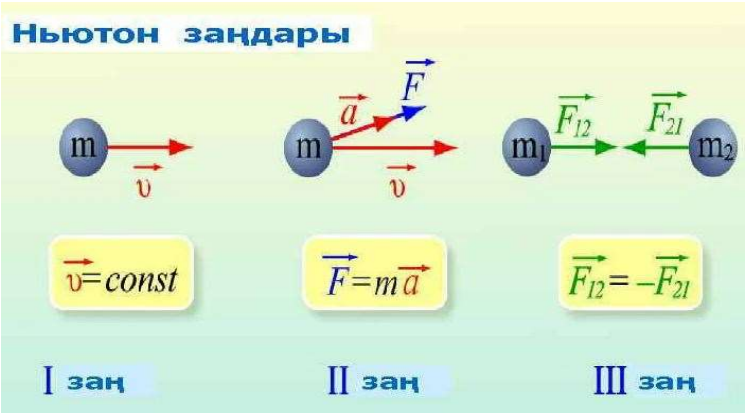
Сұрақтар:

- Автор сипаттаған жоба не себепті іске аспайды?
- Жердің магнит өрісі шынымен фабрикаларды, үйлерді энергиямен қамтамасыз ете ала ма?
- Мұндай жағдайдың жүзеге асуы мүмкін бе?

5-сурет. Электромагниттік индукция тақырыбына арналған кейске иллюстрация

Тақырып: Динамика

Әңгімелесушіңіз: «Біздің механика бойынша барлық біліміміз табиғатты дұрыс бейнелемейді, себебі біз өзіміз күш, масса, үдеу деген ұғымдарды енгіздік. Ал табиғатта күш те, масса да, үдеу де өздігінен жоқ» деп айтса, оған не дер едіңіз?



6-сурет. Ньютон заңдарының иллюстрациясы

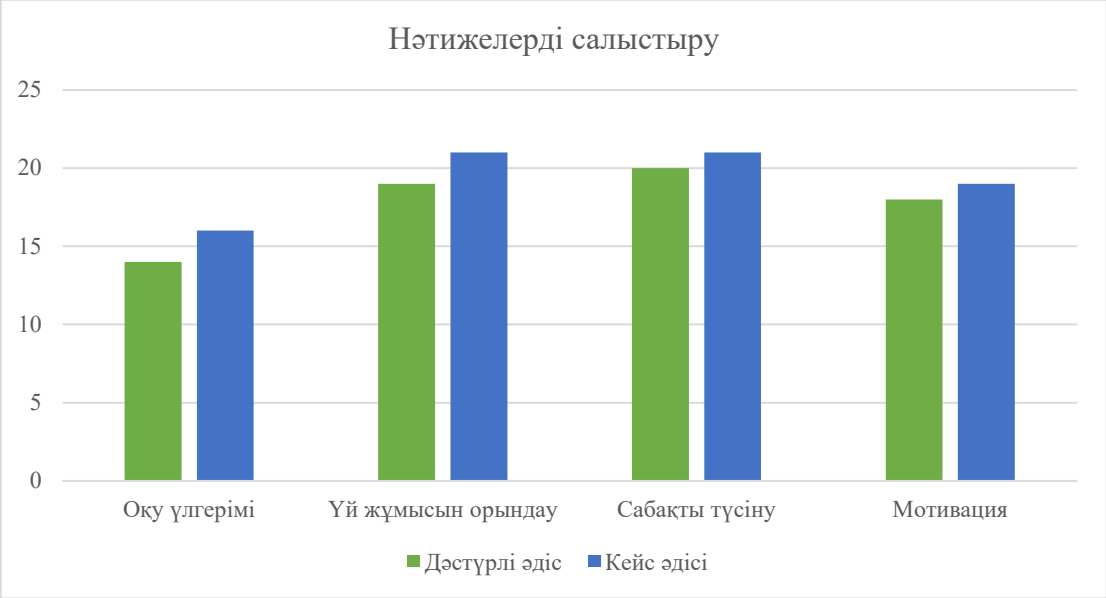
Сұрақтар:

- Физика заңдары (әсіресе механика заңдары) оларды ашпай тұрып табиғатта бар болды ма?
- «Масса», «күш», «үдеу» ұғымдарына анықтама беріңіз.
- Қарсы пікірді жоққа шығару үшін қандай дәлелдер келтірер едіңіз?

Зерттеу нәтижелері. Алынған теориялық база негізінде Алматы қаласының №59 мектебінде 9 «А» мен 9 «Ә» сыныптарында эксперимент жүргізілді. Екі сыныпта да 25 оқушыдан бар, білім сапасы 78%-ды құраған. Сыныптар сәйкесінше бақылау және эксперименттік топтарына бөлінді. Бақылау тобында сабақтар дәстүрлі әдіспен өткізілсе, эксперименттік топта кейс әдісін қолдану арқылы өткізілді. Екі әдісті салыстыру сабақ барысында алған баллдар арқылы, кері байланыс парағы мен үй жұмысын орындап келу сияқты критерийлар арқылы салыстырылды. Нәтижесінде сабақ барысында 8-10 балл арасында бағаланғандар бақылау тобында 14, ал эксперименттік топта 16 болды. Үй жұмысын орындап келген оқушылар санында да айырмашылық болды. Сабақ соңында алынып отырған кері байланыс парағы нәтижесінде сабақты түсіну деңгейі мен физика пәнін

оқуға деген мотивациясы артқанын да байқадық. Салыстырмалы нәтижелер төмендегі 1-диаграмма көрсетілген.

1-диаграмма. Екі топтың нәтижелерін оқу үлгерімі, үй жұмысын орындау, сабақты түсіну, мотивация бойынша талдаулар



Қорытынды. Жүргізілген зерттеу кейс әдісін жалпы білім беретін мектептерде физиканы оқытуда тиімді қолдануға болатынын көрсетті. Бақылау және эксперименттік топтардың салыстырмалы талдауы сабақтағы белсенділік деңгейінде, үй тапсырмасын орындауда, жаңа материалды түсіну дәрежесінде айтарлықтай айырмашылықтар бар екенін көрсетті. Эксперименттік топта оқушылардың пәнге деген қызығушылықтары артып, оқуға деген ынталары артқан.

Әдістеменің ерекшелігі – оқылатын физикалық заңдылықтарды өмірлік жағдайлармен байланыстыруға мүмкіндік береді, бұл материалды түсінуді жеңілдетеді және оқытудың практикалық тұсын күшейтеді. Топтық жұмыс, пікірталасқа қатысу мектеп оқушыларының коммуникативті және аналитикалық қабілеттерін дамытады, өз пікірін дәлелдей білуді қалыптастырады.

Қорытындылай келе, физиканы оқытуда кейс әдісін жүйелі түрде енгізу білім сапасын арттыруға, оқушылардың функционалдық сауаттылығын дамытуға, болашақ кәсіби қызметінде сұранысқа ие құзыреттіліктерді қалыптастыруға ықпал етеді.

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Pathways and Practices of Digitalization of Cadre Personnel Archives in Local Universities

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Abstract: Within the "Digital China" strategy, the digitalization of cadre personnel archives in local universities is vital for modernizing educational governance. This paper examines its necessity, pathways, and practices through policy review and case analysis. Findings show both progress and challenges, including limited resources, lack of standards, and security risks. The study argues that institutional innovation, technological application, and service efficiency should guide digitalization, offering support for governance modernization and practical experience for other universities.

Keywords: Local universities; cadre personnel archives; digital construction; smart campus; educational governance modernization

Literature Review

In recent years, the digitalization of personnel archives in higher education has gained attention. Lei Xiaohui (2022) stressed the need for standardization and information sharing to improve efficiency [1, p. 48]. Liao Lixiang (2021) argued that digital construction is key for modernization and human resource management [2, p. 34]. Yu Yanyan (2022) highlighted better data use, while Sun Ningning (2023) emphasized balancing design and security [3, p. 57]. International studies focus on big data and AI applications [4, p. 7681]. Yet, systematic, context-specific research for local universities is still lacking.

Methodology

Research Design

This study adopts a qualitative research approach, combining literature analysis with case studies to systematically examine the digitalization of cadre personnel archives in local universities. First, relevant policy documents issued at the national level and by educational authorities are reviewed to analyze the policy orientation and top-level design guiding archival digitalization. Second, representative cases from local universities are selected, with particular attention paid to their initiatives and achievements in areas such as technology application, institutional construction, and management mechanisms[5, p. 44].

The research design draws upon both policy documents and academic findings as theoretical foundations, and integrates them with comparative analyses of practical cases. This approach helps to reveal common challenges as well as differentiated pathways in the process of archival digital transformation in local universities. To ensure systematic analysis, the study incorporates theoretical frameworks related to modern educational governance and smart campus development[5, p. 45]. These frameworks provide a lens for evaluating how the digitalization of personnel archives contributes to the improvement of human resource management and the modernization of educational governance in higher education institutions.

Overall, the research design emphasizes the integration of theory and practice. By synthesizing policy insights, academic perspectives, and case-based evidence, the study aims to propose feasible strategies and pathways for advancing the digitalization of cadre personnel archives in local universities[6, p. 71].

Data Collection and Analysis Methods

The data for this study were primarily collected through a combination of literature review and case analysis. First, relevant research results on the digitalization of university archives over the past decade were retrieved from CNKI, Wanfang Database, and international academic journal platforms. These covered areas such as policy interpretation, technological application, management models, and security measures, providing the theoretical foundation for the study [7, p. 61]. Second, several local universities were selected as case objects, with a focus on their specific practices in the digitalization of cadre personnel archives, including document scanning, information system development, data standardization, and security protection.

For data analysis, content analysis was employed to systematically sort and synthesize policy documents and research literature, summarizing current academic consensus and divergences. At the same time, comparative analysis was applied to different institutional practices in order to extract common experiences and identify unique challenges. Building on this, the study further integrated the theoretical frameworks of educational governance modernization and smart campus development [8, p. 012347]. to explore the impact of archival digitalization on personnel management and governance efficiency in local universities. This analytical approach provides a solid foundation for proposing feasible pathways and policy recommendations.

Research Framework

The framework of this study consists of three levels. The first level is the policy and theoretical foundation, which focuses on the national Digital China strategy, official documents on archival digitalization issued by the Ministry of Education, and the concept of smart campus construction [3, p. 59]. These provide the macro-level policy background and theoretical basis for the digitalization of cadre personnel archives in local universities.

The second level is the analysis of practical pathways, which examines representative cases from local universities and summarizes their implementation steps. These include the digitization of paper-based archives, the development of information system platforms, the establishment of data standards and security management, and the integration of archival systems with internal human resource management platforms [9, p. 1239].

The third level is the study of problems and countermeasures, focusing on the challenges local universities face, such as limited resource allocation, inadequate technical support, underdeveloped institutional mechanisms, and risks to information security. Based on this, optimization strategies are proposed.

Overall, the framework reflects a logical progression of policy orientation—practical exploration—problem identification—pathway optimization. It aims to highlight the value and mechanisms through which personnel archive digitalization contributes to the modernization of educational governance, thus producing findings with practical significance and guidance [10, p. 114].

Key Findings and Practical Insights

Key Findings: Strong Policy Guidance but Uneven Local Implementation

The national *Digital China* strategy and the Ministry of Education's related documents have provided clear direction and institutional support for archival digitalization. Most local universities have incorporated the digitalization of cadre personnel archives into their development plans and established dedicated offices to oversee implementation. However, variations in regional economic development, funding capacity, and technological foundations have led to significant disparities in progress and quality [5, p. 43].Some universities have made notable advances in platform construction and data integration, while others remain at the stage of basic scanning and information entry, without achieving efficient sharing or in-depth utilization..

Key Findings: Technological Applications Achieve Breakthroughs but Lack Deep Integration

With the introduction of big data, cloud computing, and artificial intelligence, the management

of cadre personnel archives in universities is gradually shifting from traditional paper-based methods to digital and intelligent approaches. For instance, some institutions have built digital archival management platforms that enable online inquiry and circulation, thereby improving administrative efficiency. Nevertheless, the deep application of technology remains limited. Many systems stop at digitization and storage, without advancing toward data mining, intelligent analysis, or decision-support functions [4, p. 7682]. As a result, the potential of archival resources to enhance human resource management and support strategic decision-making is not fully realized.

Key Findings: Prominent Security Risks with Inadequate Protection Mechanisms

Data security has emerged as a widespread concern during the process of digitalization. Since cadre personnel archives contain highly sensitive information, any leakage could seriously affect both organizational management and individual privacy. Although most universities have adopted measures such as identity authentication, access control, and data backup, their overall security frameworks remain incomplete. Some institutions rely excessively on third-party platforms and lack long-term maintenance or emergency response mechanisms [4, p. 7680]. Moreover, issues in data transmission, cross-departmental sharing, and remote access create additional vulnerabilities, undermining the credibility and stability of archival management.

Practical Insight

The digitalization of cadre personnel archives in local universities must be rooted in national strategies while aligned with the institutions' own development realities. Universities should formulate clear implementation plans and development roadmaps, supported by cross-departmental coordination mechanisms that integrate archives with personnel, finance, and information technology functions. At the same time, universities need to establish sound rules and regulations to clarify responsibilities, operational standards, and monitoring and evaluation systems. This ensures stronger institutional enforcement and long-term sustainability.

Technology serves as the core driver of archival digitalization. Local universities should adopt appropriate technological pathways tailored to their specific conditions [11, p. 80]. On one hand, emphasis should be placed on standardizing the digitization process to ensure data integrity and traceability. On the other hand, the application of big data and artificial intelligence should be promoted to achieve intelligent search, trend analysis, and decision-support functions [6, p. 71]. Furthermore, universities should integrate archival information systems with smart campus platforms and digital personnel systems, thereby creating unified databases and management platforms that enhance the overall utilization value of archival data.

Since cadre personnel archives involve both personal privacy and organizational security, a comprehensive and multi-layered protection system is essential. Universities should implement strict security standards across all stages—data collection, storage, transmission, and use—by applying encryption technologies, blockchain verification, and multi-factor authentication. Dedicated archival security management units should be established, along with emergency response mechanisms and regular risk assessments, to continuously improve the security and stability of digital archival systems [4, p. 7684].

The ultimate purpose of archival digitalization is not mere "storage," but enhancing its application value. Universities should strengthen the in-depth development of archival data to expand its use in cadre selection, faculty evaluation, professional title review, performance management, and strategic decision-making. For instance, analyzing historical archival data can reveal patterns of cadre development, providing references for future talent training and selection. Similarly, tracking faculty personnel archives dynamically can help optimize performance evaluation systems and promote professional growth [8, p. 012351]. By transforming archives into actionable resources, digitalization efforts can truly contribute to the modernization of educational governance.

In advancing archival digitalization, local universities should adopt models suited to their

regional economic levels, institutional size, and information infrastructure [7, p. 65]. Economically stronger universities may experiment with big data analysis platforms and AI-driven archival management systems, whereas institutions with weaker foundations should begin with basic digitization of paper archives, followed by gradual platform building and data integration. A step-by-step, context-sensitive approach helps raise overall construction levels while avoiding resource waste and inefficiencies caused by rigidly replicating external models [5, p. 52].

Discussion

The digitalization of cadre personnel archives is both a technological trend and a key step for local universities to strengthen governance [2, p. 35]. This process reflects the interaction of technology, institutions, and culture.

Technology offers new tools—big data, cloud computing, and AI enable faster storage and retrieval. Yet, without proper rules, these benefits remain limited. Institutional design is therefore essential: it must ensure compliance, balance openness with security, and promote system integration [1, p. 48]. Where institutions are weak, data silos and "information islands" appear, reducing effectiveness.

Cultural awareness is another challenge. Archives are often viewed as secondary work, leading to low utilization. In reality, they are vital for cadre selection, faculty evaluation, and strategic decisions. Without a shift in mindset, digitalization risks staying symbolic.

To succeed, universities need systemic thinking. Strategic planning and policy support should guide the process, while standardization and integration improve technology use. At the same time, fostering archival awareness and user participation is crucial. Only through the joint role of technology, institutions, and culture can digital archives truly support modern educational governance [1, p. 49].

Conclusion and Policy Recommendations

The study of digitalizing cadre personnel archives in local universities shows that it is not merely a technical upgrade of archival management, but an integral part of modernizing university governance [12, p. 29]. Digitalization has enhanced the efficiency of archive utilization, improved the scientific basis of personnel decision-making, and promoted transparency in educational governance. However, common challenges—such as limited resources, lack of standards, incomplete institutional frameworks, and security risks—still constrain its effectiveness.

Based on these findings, several policy recommendations are proposed. First, strengthen top-level design: local universities should formulate digitalization plans aligned with the national "Digital China" strategy, with clear goals, tasks, and pathways [4, p. 7685]. Second, increase resource investment: funding, personnel, and technical support must be guaranteed, particularly through introducing specialized professionals to advance professionalized and digitalized archival management. Third, improve institutional systems: unified data standards and security regulations should be established, clarifying processes, permissions, and responsibilities while enabling cross-departmental sharing and coordination. Fourth, promote technological integration: archival systems should be interconnected with personnel management, research, and smart campus platforms to develop a data-driven human resource governance model [11, p. 84]. Fifth, foster a supportive cultural environment: universities should strengthen recognition of the value of digital archives among cadres and faculty, enhancing usage through training and awareness initiatives so that archives effectively serve talent development and strategic decision-making.

In conclusion, digitalizing cadre personnel archives in local universities is a systemic project that requires not only technological innovation but also institutional guidance and cultural support. Through multi-stakeholder collaboration and continuous optimization, sustainable development in archival management can be achieved, thereby providing strong support for the modernization of educational governance [9, p. 1243].

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Les mots composés en français

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Comme son nom l'indique, un nom composé est un nom qui est composé de deux mots ou plus. Ces mots, généralement unis par un trait d'union, forment un nouveau mot doté d'un nouveau sens : amour-propre (ego), cul-blanc (nom d'oiseau), sur-le-champ (immédiatement).
Un mot composé est une juxtaposition de deux lexèmes libres permettant d'en former un troisième qui soit un lemme (« mot ») à part entière et dont le sens ne se laisse pas forcément deviner par celui des deux constituants. Ainsi, un *garde-fou* est, en français, un lemme indépendant de *garde* et de *fou* dont le sens de « balustrade de protection sur un pont, près d'un fossé, empêchant de tomber » ne peut être deviné.
Ainsi, un mot composé étant un lemme à part entière, il est recensé par les dictionnaires, ce qui permet de le distinguer d'un syntagme (*petit-lait* est un mot composé synonyme de *lactosérum*, pas *petit chat*). Dans les langues à accent tonique[réf. nécessaire], les mots composés peuvent subir l'univerbation, ce qui permet aussi de les distinguer.

On vient de voir que, d'après la perspective adoptée dans ce livre, on classe parmi les mots composés les unités à deux termes qui sont principalement nominales, parfois adjectivales et même verbales (bébé-éprouvette, aigre-doux...), et les unités à trois formes qui sont uniquement nominales (pomme de terre, chemin de fer,machin à coudre....)

Les mots composés peuvent d'origine savante, d'origine mixte ou d'origine entiérement françaises.Contrairement à beaucoup d'autres langues qui forment leurs termes techniques et scientifiques nouveaux à partir d'élément existant dans la langue, le français favorise la composition par emprunts aux langues anciennes. Dans ce cas, on parle de ,, composition savante''. Les composés savants sont souvent crées par la fusion de bases grecques ou latines qui ne constituent en général pas des unités lexicales autonomes (sauf en cas d'abréviation,comme pour géo ou litho) : les éléments *hémo et philie de hémophilie ,* par exemple, ne se trouvent que dans des composés savants comme *hémogramme et pédophilie.*

La spécificité de la composition savante tient à l'emploi presque exclusif d'éléments empruntes directement au latin et au grec et à une formation qui tend à respecter les règles de la composition dans ces deux langues. Cependant, il existe aussi des composés savants qui contiennent un élément faisant partie du vocabulaire courant : par exemple, *sensible* dans *hipersensible, tension* dans *hypotension,etc.*

Les éléments latins servant en composition savante sont moins fréquents que les éléments grecs. La première partie de ces composés se termine généralement par la voyelle de transition-t :

insecticide
viticole
calorifère
frigorifique
fumivore

Les éléments grecs sont extrêmement nombreux, surtout dans les domaines scientifiques. La voyelle de transition -o relie habituellement les deux éléments :

bibliophile
cosmonaute

cleptomane
homéopathie
néologisme

Il existe aussi des composés *hybrides* formés d'un élément latin et d'un élément grec :

Automobile (*auto* du gr. autos ,,soi-même, lui – même'' + *mobile* du latin. mobilis ,,qui se meut''.)

Homosexuel (*homo* du gr. Homos ,,semblablie, le même + *sexuel* du bas lat.sexualis).

Ou dans lesquels l'un des deux éléments est français ou peut être considéré comme tel :

antidater
archiplein
extra-fin
juxtaposer
minijupe
ultra- chic

Parfois, deux composés synonymes l'un du latin, l'autre du grec,comme juxtaposition et parataxe. Il y a des éléments qui peuvent se placer uniquement au début (acro - dans acrobate) ou à la fin des mots composés (- *mane* dans mythomane, mégalomane),alors que beaucoup peuvent,selon le mot, occuper les deux positions **:**

phonographe / telephone
podologie / gastéropodé
pédiatrie / orthopédie

On trouve des composés parmi les substantifs, les adjectifs, les verbes, les adverbes et les mots-outils.

Le groupe des substantifs composés est le plus nombreux. Les modèles essentiels sont les suivants :

1. Composés formés par apposition de deux substantifs liés par un trait d'union. Ce modèle (*substantif + substantif*) est très productif de nos jours : avion-cargo, avion-citerne, balai-brosse, bateau-mouche, bateau-feu (ou bateau-phare), bateau-pilote, café-bar, café-concert, café-crème, café-restaurant, camion-citerne, camion-grue, chien-loup, chou-fleur, député-maire, ingénieur-électricien, plateau-repas, poids-plume, porte-fenêtre, roman-fleuve, tissu-éponge, wagon-lit, wagon-restaurant, etc.

2. *Substantif + préposition + substantif* : arc-en-ciel, boule-de-neige (arbuste à fleurs blanches en pompons), croc-en-jambe, eau-de-vie, gueule-de-loup, etc.

3. *Adjectif + substantif* ou bien *substantif + adjectif* : bas-relief, basse-cour, belle-fille, belle-mère, blanc-bec, bonhomme, court-circuit, court-métrage, gentilhomme, grand-duc, grand-père, long-métrage, plafond, plateforme (ou plate-forme), petit-fils, rouge-gorge ; amour-propre, cerf-volant, coffre-fort, etc.

4. *Adverbe + substantif* ou bien *préposition + substantif* : arrière-cour, arrière-garde, arrière-pensée, arrière-plan, arrière-saison, avant-garde, avant-propos, avant-scène, plus-value, presqu'île ; contrepoison, sans-emploi, sans-façon, sans-parti, sous-équipement, sous-marin, sous-officier, sous-peuplement, etc.

5. *Verbe + substantif* :C'est le modèle le plus répandu : aide-mémoire, abat-jour, brise-glace, cache-col, casse-noisette, chasse-neige, chauffe-bain, compte-gouttes, couvre-feu, couvre-lit, cure-dent, essuie-mains, garde-boue, garde-malade, gratte-ciel, lance-missile, lave-vaisselle, ouvre-boîte, pare-brise (ou parebrise), pare-chocs (ou parechoc), passe-temps, perce-neige,

porte-avions, porte-bagages, porte-cigares, porte-drapeau, porte-parole, pousse-café, presse-purée, tire-bouchon (ou tirebouchon), vide-ordures, etc.

Il existe un grand nombre de substantifs composés formés à partir des radicaux d'origine savante, grecque ou latine : agronomie, dictaphone, magnétophone, lexicologie, télescope, radiographie, etc. La composition savante est si bien assimilée en français qu'on emploie souvent à titre d'éléments composants des mots français qui s'ajoutent aux radicaux d'origine grecque ou latine : aérogare, autoroute, bureaucratie, électrochoc, hydravion, radioactivité, radiodiffuseur, téléachat, téléspectateur, téléviseur, etc.

Les adjectifs composés se forment d'après les modèles suivants :

1.Adjectif + adjectif : Le linguiste français Henri Mittérand trouve qu'il existe « deux types, identiques par la nature des composants (adjectif + adjectif), mais distincts par leur rapport grammatical interne ». Tantôt les deux adjectifs sont coordonnés (aigre-doux, douce-amère, sourd-muet), tantôt l'un joue par rapport à l'autre le rôle d'un adverbe (clairsemé, court-vêtu, mi-amusé, mi-clos, mi-sérieux, etc.).

Nombre d'adjectifs formés d'après ce modèle sont de formation savante et se rapportent à la terminologie technique et politique : anglo-américain, électrochimique, électromagnétique, franco-italien, radioactif, radiographique, radiologique, politico-militaire, politico-social, socio-culturel, thermocollant, thermodynamique, thermonucléaire, etc.

2. *Adverbe + adjectif* : bienheureux, malheureux, malpropre, malveillant, bienveillant, bien-aimé, bien-séant, etc.

3. *Adjectif + participe* : clairvoyant, dernier-né, mort-né, nouveau-né, etc.

La composition n'est pas propre aux verbes, aux adverbes et aux mots-outils. Citons quelques exemples :

4.Verbes composés : *colporter*, *culbuter*, *maintenir*, *maltraiter*, *saupoudrer*, qui sont des survivances de l'ancien français et ne sont composés que sur le plan diachronique.

5.Adverbes composés : au-dessous, au-dessus, auparavant, aussitôt, autrefois, beaucoup, bientôt, cependant, longtemps, maintenant, par-devant, toujours, toutefois, vis-à-vis, etc.

6.Mots-outils composés (conjonctions et préposition) : puisque, quoique, depuis, hormis, parmi, etc.

L'usage des mots composés est consacré par le dictionnaire. Les formations peuvent être diverses : juxtaposition de deux noms (chou - fleur), de deux noms reliés par une conjoncton de cordination (va- et – vient) ou nom (*laisser - aller*), de deux noms reliés par une préposition (clin – d'œil)...

Une certaine variété des mots composés français utilise des emprunts aux langues anciennes qui sont à la base de notre culture, le latin et le grec. Les langues voisines, comme l'allemand, ne connaissent pas ce procédé de formation, ce qui pose des problèmes de traduction. Ce sont des mots dits « savants », médicaux, techniques, scientifiques, philosophiques, etc., qui se forment ainsi. La composition savante (appelée aussi interfixation) se définit donc comme la juxtaposition de deux radicaux (au moins) d'origine latine ou grecque, avec addition éventuelle d'un suffixe (*-ie / -iste*), qui donnera la catégorie, le genre, et permettra de faire par exemple le tri entre la spécialité et le spécialiste (*biologie / biologiste)*

Certains de ces éléments sont habituellement utilisés au début ou à la fin du mot (ex : *-mane* à la fin : *mélomane / mythomane / mégalomane* ; idem : *anti- / archi-* au début), ce qui donne l'impression qu'ils entrent dans la construction normale des mots dérivés, mais il ne s'agit pas de dérivation, puisqu'on peut les trouver à l'autre bout :

cinéphile / philosophe, philatélie
téléphone / phonographe.

Et encore il y a le nom composé qui est écrit en un seul mot, il n'y a pas de difficulté particulière, la marque du pluriel se met à la fin du nom :
Un gendarme → des gendarmes
Exceptions :
Un monsieur → des messieurs
Madame → Mesdames
Un bonhomme → des bonshommes
On a vu au début de cette parti sur la composition que, seules les unités à deux termes principalement nominales, parfois adjectivales et même verbales,ainsi que les unités à trois termes uniquement nominales sont rangées parmi les mots composés. Les unités figées complexes faisant partie des autres catégories grammaticales (adverbes,prépositions, conjonctions, interjections) et les formes lexicalisées comportant plus de trois éléments (vendre la mèche, qu'en – dira – t- on, à pas de loup, tout à coup...) sont classées parmi les locutions.Toutes ces unités complexes, qui sont inscrites comme unités figées dans le code de la mémoire.

IMPACT OF NATIVE SPEAKER TEACHERS ON STUDENTS' MOTIVATION IN LEARNING FOREIGN LANGUAGES

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Abstract. The article considers the issue of the influence of a native language teacher on the motivation of students learning a foreign language. The analysis of the concept of motivation, its types, various recognized theories of motivation is presented. The article describes in detail the author's experience of co teaching Kazakh students with American foreign language teachers. The article includes findings of this practice and the corresponding conclusions based on the observation and surveying students. Experience of co working with an American teacher on the full semester course "English folklore and methods of its use in English lessons" 10 years ago and experience working with an American teacher in the second semester of the 2020-2021 academic year on the course "Foreign language for specific purposes" allowed author to carry out the necessary analysis on the problem under study. The author examines various aspects of interaction between native speakers and Kazakhstani students: assessment, mentality, attitude to learning. The results showed not only a positive influence of native speakers on student motivation, this influence can also be neutral. The analysis of this experience can be useful for increasing the students' motivation in the process of co-teaching foreign languages.

Key words: co-teaching, motivation, native speakers, teaching foreign languages, American teachers, Kazakhstani students, author's experience, observation.

Motivation is undoubtedly a very significant factor for succeeding in learning a foreign language. So many books have been devoted to and various researches have been done related to its role and place in foreign language studying. Nonetheless, we will make one more attempt to investigate it in connection to the presence or absence of a native speaker in the educational process.

In psychology, motivation refers to the initiation, direction, intensity, and persistence of behavior. Motivation is a temporal and dynamic state that should not be confused with personality or emotion. It involves having the desire and willingness to do something. A motivated person can be reaching for a long-term goal such as becoming an experienced teacher or a more short-term aim like learning certain foreign word [1]. The Cambridge dictionary defines motivation simply as the need or reason for doing something, enthusiasm for doing something [2]. We are inclined to accept this definition for it is not stodgy and overloaded and it shows how students should feel while learning, i.e. they should feel enthusiastic on the one hand and they should reasonably realize their need in it.

There have been developed a number of motivation theories like behavioral, cognitive, psychoanalytic theories, humanistic theories, and others. Perhaps the most widely accepted and popular one is Maslow's theory called "hierarchy of human needs" [3].

The aim of our research has been discovering the impact of native speaker's involvement in the educational process on the students' motivation in learning a foreign language. In the research we have used the methods of observation and survey, namely we observed students' behavior and psychological condition during lessons with and without native speaker teacher and

we orally surveyed and discussed with students their feelings, emotions and opinion concerning the issue.

It is usually considered natural and efficient for increasing students' motivation to communicate with native speakers. However, we would not be so point-blank. Our experience of co-teaching with Americans does not always prove the above statement. The experience we had fourteen years ago is more likely to contradict the statement. Our co-teacher was an American university teacher and the course was English folklore, it included lectures, seminars, midterms and an examination. Sixty 3rd year students took the course. The American teacher was very fair, strict and impartial. Kazakhstani students participated rather actively in the classes, most of them attended all classes, took notes of the lectures and tries to do their best in discussions at the seminars. However, majority of them found the course material rather hard to comprehend and learn. Consequently, a number of students were not able to progress as well as they thought they would do even though they did not miss classes.

We would point out two main problems that arouse in this educational situation: 1) identifying and recognizing learning goals on the part of students and on the part of the American teacher; 2) the assessment issue. As for the first problem, based on our observing and talking to students we can state that the American teacher identified and recognized the students' learning goal as acquiring knowledge of English folklore and developing skills of its effective applying at English lessons. Whereas the students understood their aim as completing all prescribed tasks and finishing the course successfully. We will not ascertain the fact that all the students taking the course followed the above mentioned goal but half of them were likely to do so, for we could observe that for them completing the course with good points prevailed over developing necessary skills. The second issue that arouse contradictions turned out to be the assessment. The American teacher was very objective, impartial and just in his assessing strategy. Although he did his best to get along well with our students and make friends with them, he kept being impartial and strict in evaluating them. Our Kazakhstani students seemed to be inclined to hope for better marks due to the native speaker's good attitude to them. Being a co teacher and realizing the Asian culture and mentality I was aware of and anticipated this kind of expectations on both parts, however I did hope for the best. The highest tension occurred when the time of final exam test came. Some of the students (nearly one third of the total number) made an attempt to cheat during the final test; the American teacher was firm and dismissed them immediately he saw their misconduct saying they had failed the exam. They came up to me outside the exam room and implored of giving them the chance to retake the test without letting my co teacher know it. I was not going to accomplish a deal with students-cheaters, so they felt hurt. There appeared a psychological internal conflict between the American teacher and Kazakhstani students; the conflict concerned the assessment.

Another experience was 2020-2021 academic year. One semester long we had an American teacher who was teaching online using zoom platform due to Covid-19 pandemic. This time my co-teacher was a very pleasant middle-aged woman. She has a Master's degree in TESOL and is a very experienced competent teacher. The class was general English; the content included various issues of vocabulary, grammar, phonetics: simile, epithet, metaphor, idioms, black history, parts of speech, pronunciation of minimal pairs, reading techniques (skimming, scanning), etc. I conducted lessons in the morning according to regular time-table and she had classes with the same students twice a week in the evening due to the huge time gap between California and Kazakhstan, she worked online from the USA. One group of 18 third year students participated in the project. The chairperson of the English and German languages department, the project coordinator and me (being the co-teacher and the group curator) discussed in advance with the students the responsibility of their participation in the project. Most of them, i.e. two third demonstrated willingness and readiness to have classes with the native speaker teacher though

at a rather uncomfortable time for them. However, when the classes started only 8-9 students attended the classes on the regular basis. Others often missed the classes making some excuses or announcing some reasons for being unable to attend. The students who missed the classes rather often were the ones who were uninterested at the very beginning. So we can say that the opportunity of studying with a native speaker teacher does not motivate all learners. However, it concerns the aspect of motivation only; some students who were not successful during the previous two years of studying due to their low level of English and\or psychological and communicative barriers got much more interested and involved in developing their communicative skills. For instance, one student did not study well at the first two courses, she missed classes, did not do the assignments, did not understand the material and did not take part in discussions. She explained her misbehavior by her groupmates' higher level of English and their mocking at her inability to speak well. This year she has become a little more active and engaged in the educational process, she tried to communicate with the native speaker and she seemed to enjoy it especially when she was alone with the teacher and no other students present. She could pleasantly discuss with the American teacher topics from her own life experience like her brother's barbershop and her part time job there, her family problems and her being busy because of the necessity to look after her little nephews, etc. the American teacher was impressed by her eagerness to talk. The other student talked openly about his political views and shared his opinion concerning the politics, economics and social policy in his home country. The third student discussed the differences in educational aspects in the American and Kazakhstani systems, he was confirmed he was right and assured the teacher. They did not share so openly and they were not so active in our classes (I mean without the native speaker).

Conclusion

Having thoroughly observed and carefully polled the students involved in the recent project and having taken into consideration the experience of co-teaching fourteen years ago we have come to the following findings and can make the following conclusions:

1) One third of the students, i.e. 6 students did not want to participate in the interesting English classes prepared and delivered by the American teacher. Therefore, studying with a native speaker teacher does not always motivate all foreign language learners; some students who do not possess intrinsic motivation do not get more internally motivated just because their teacher is a native speaker, their motivation remains the same external and low.

2) Two thirds of the students actively participated in the classes, they were engaged in the lessons, demonstrated increased initiation of, and persistence in activities. Thus, the students who were primarily internally motivated at least to some extent have increased their motivation greatly at classes with the American teacher; their effort and energy have increased, they have enhanced cognitive processing. All of these have led to their improved performance: they feel more confident in spontaneous communication with the native speaker, they develop critical thinking and creativity skills, they seem to demonstrate direct behavior toward particular goals.

The summary of our observation and survey can state that native speakers as FL teachers can significantly increase motivation of those learners who have at least some kind of motivation before studying with them. However, we cannot absolutely assert the fact that native speakers as FL teachers

can and will highly motivate those learners who did not have before or currently do not have any intrinsic motivation; it can occur but not in every case.

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Economic Sciences

Дифференциация государственных программ, направленных на использование транзитных возможностей Казахстана

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Аннотация: несмотря на постоянное популяризацию историко-культурных *ценностей о Шелковом пути, программа, имеющая показатели экономической направленности, была реализована Правительством Казахстана в 2006 году, как региональная программа, как республиканский проект. Наряду с казахстанскими инициативами по созданию транзитного коридора, возрождение в контексте китайской программы как Нового Шелкового пути представляет новую модель развития для различных отраслей экономики. В исследовании статьи был проведен контент-анализ программ, связанных с активизацией деятельности Казахстана как транзитного коридора, проанализированы проведенные мероприятия.*

Ключевые слова: *транзитный коридор, государственные программы, Новый Шелковый путь, автодороги, инфраструктура.*

Президент РК Н.Назарбаев на совещании Совета иностранных инвесторов в Астане в 2012 году представил масштабный проект «Новый Шелковый путь», в рамках которого Казахстан расширил свою транзитную деятельность на территории Центральной Азии. Проект утвержден распоряжением Премьер-Министра РК от 25 декабря 2012 года №231 [1].

В качестве следующего шага в этом направлении был подписан План сотрудничества между Правительством Республики Казахстан и Правительством Китайской Народной Республики по сопряжению новой экономической политики «Нұрлы жол» и строительства «Экономического пояса Шелкового пути» [2].

Предполагаемое расширение Евразийского сухопутного моста включает строительство железнодорожных путей из трансконтинентальных линий в Иран, Индию, Мьянму, Таиланд, Пакистан, Непал, Афганистан и Малайзию, Юго-Восточную Азию и другие регионы Закавказья (Азербайджан, Грузия). Маршрут включает тоннель Мармарай под проливом Босфор, паромную переправу через Каспийское море (Азербайджан-Иран-Туркменистан-Казахстан) и коридор Север-Юг. Организация Объединенных Наций предложила дальнейшее расширение Евразийского сухопутного моста, включая проект Трансазиатской железной дороги (на самом деле он существует в 2 вариантах). В целях развития инфраструктурных проектов в странах вдоль Нового Шелкового пути и Морского Шелкового пути и содействия реализации китайской продукции в декабре 2014 года был создан инвестиционный фонд Шелкового пути.

Новый Шелковый путь (а также Евразийский сухопутный мост) — концепция новой евразийской (в перспективе — межконтинентальной) транспортной системы, продвигаемой Китаем в сотрудничестве с Китаем, Казахстаном, Россией и другими странами для перемещения грузов и пассажиров из Китая в европейские страны. Транспортный маршрут включает трансконтинентальную железную дорогу — Транссибирскую магистраль через Россию и второй Евразийский континентальный мост через Казахстан. По самому длинному в мире грузовому железнодорожному маршруту из Китая в Германию поезда ходят 15 дней, что в 2 раза быстрее, чем по морскому маршруту через Суэцкий канал.

Из порта Ляньюнган с собственным терминалом Казахстана контейнеры загружаются на поезд, а следующая остановка отправляется на станции Алашанькоу или Хоргос. В казахстанских частях постов Достык или Алтынколь грузится контейнерный поезд. Далее, в порту Актау, грузится в Пором и отправляется в Баку. Через Грузию отправляется в Украину и Южную Европу. Если требуется срочная доставка, транспорт загружается до аэропорта или отправляется через Кызылорду и Мангистау в Туркменистан и Иран [3].

В качестве следующего преимущества можно отметить, что проект «Один пояс – один путь» создает условия для использования транзитных возможностей страны. Деятельность в качестве транзитного коридора для Казахстана, расположенного в центре евразийского континента, ведет к экономической эффективности. Одним из проявлений этого является строительство «шоссе Западный Китай – Западная Европа» и открытие «сухого порта Хоргос», тем самым проход товаров через нашу страну, произведенных в Европе и Западной Азии.

Проект «Западная Европа - Западный Китай» основан на модернизированной торгово-логистической транзитно-транспортной системе, отличающейся от прежней ценности Шелкового пути и придающей приоритет экономическим отношениям. Новый проект выполняет роль службы транзитного коридора, оснащенного современными передовыми технологиями. Возрождение Шелкового пути в 21 веке также может быть использовано как средство сохранения стабильности во внешней политике государств Средней Азии и в их экономически безопасном развитии. При этом в Стратегии «Казахстан 2050» подчеркивается важность внутренней региональной интеграции в решении социально-экономических проблем, устранении конфликтов, оптимальном сужении водно-энергетических узлов и предотвращении других конфронтаций. При этом в Концепции внешней политики РК Центральная Азия отражена в числе приоритетных стратегических направлений первой категории во внешней политике Казахстана. Это также говорит о намерении нашей республики процветать в соседних государствах. При этом транспортировка товаров через Казахстан вызывает двусторонний интерес. Например, грузоперевозки до Турции через Сухой порт составляют 16 суток. Особенно скоропортящиеся товары перевозятся по этому маршруту через Казахстан. Этот маршрут является самым быстрым судоходным путем по сравнению с морем. Высокоэффективны терминалы сухих портов Алтынколь, Достык, оснащенные товаропроводящим техническим оборудованием. Специальная зона Хоргос также оборудована различными помещениями для хранения контейнеров и даже приспособлениями для ремонта рефрежираторов [3].

АО «НК Қазақстан темір жолы» и китайская логистическая компания «Сианьский сухопутный мост» также запустили новые маршруты грузовых поездов. Город Сиань стоял у истоков Великого Шелкового пути, население которого сегодня составляет 10 млн. человек. один из крупнейших городов Китая с численностью населения [4].

В рамках принятой в 2014 году программы «Нұрлы жол» реализованы проекты реконструкции, строительства железнодорожных линий на территории Республики. В 2014 году в китайском порту Ляньюньган был построен и начал работать логистический

терминал с объединением Казахстана с Китаем. С 2020 года грузоперевозки через казахстанский участок нового Шелкового пути, начиная с Восточных ворот «Хоргос» и заканчивая Каспийским морем, планируется превысить 10 млн тонн. Тем самым возникает необходимость формирования развитой национальной транспортно-логистической инфраструктуры и ее интеграции в международную транспортную систему. В качестве инициативы комплексных мероприятий в развитии транспортно-логистической отрасли Казахстана можно отметить Международный транспортно-логистический бизнес-форум «Новый Шелковый путь», который проводится в рамках ежегодного Астанинского экономического форума. Традиционно на площадке Евразийского континента традиционно собираются представители Востока и Запада, которые сотрудничают в направлении экономической интеграции и международных связей, предлагают решения по вопросам и строят планы на будущее. Мировые транспортные учреждения, грузоперевозки, логисты и эксперты, аналитики в рамках данного форума проведут комплексную работу по вопросам обустройства транспортного коридора Нового Шелкового пути, который сможет конкурировать с морскими маршрутами. На сегодняшний день государства-участники проекта осуществляют грузоперевозки по трем направлениям:

- Из внутренних провинций Восточного побережья Китая через Казахстан и Россию в страны Европы и Евросоюза;
- Через коридор «ТРАСЕКА» государствам Центральной Азии;
- В страны Кавказа, Ирана, Турции через Каспийское и Черное моря [5].

Кроме того, в государственной программе инфраструктурного развития «Нұрлы жол» на 2015-2019 годы, утвержденной Постановлением Правительства РК от 30 июля 2018 года № 470, акцент сделан на развитие инфраструктуры туризма. В разделе программы «развитие индустриальной инфраструктуры и инфраструктуры туризма» определены следующие меры:

- Введение 72-часовых транзитных виз в международных аэропортах страны. Транзитный потенциал необходимо использовать для развития туризма. Для определенных стран доступ должен быть облегчен только при наличии авиабилета и визы следующего пункта назначения. А также за счет развития программ «stopover holiday» - краткосрочных экскурсий для транзитных пассажиров авиакомпаний;
- Введение упрощенного порядка получения виз для организованных туристических групп с основных рынков Ирана, Индии, Таиланда;
- Разработка новых перспективных туристских продуктов.

Будет налажено строительство нефтегазопроводов, развитие придорожного сервиса. Кроме того, реализуемая в стране программа «Нұрлы жол» тесно связана с проектом «Один пояс – один путь». По итогам реализации государственной программы построено и реконструировано порядка 3 тыс. км автодорог республиканского значения. Из них: Западная Европа-Западный Китай – 527 км, Центр — Юг – 324 км, Центр — Восток – 795 км, Капшагай — Талдыкорган – 160 км, Астана – Петропавловск — граница РФ – 177 км, Уральск-Каменка-100 км, Актобе-Атырау-Астрахань- 42 км, Талдыкорган — Усть – Каменогорск-20 км, Калбатау-Майкапшагай-18 км, Бейнеу — Актау-382 км, Жетыбай-Жанаозен-73 км, Бейнеу-Акжигит-85 км, Щучинск – Зеренда — 80 км, Таскескен-Бахты-80 км, юго-западный круг Астаны-34 км, Сатпаевский круг — 15 км, Павлодар – Омск — 59 км, мост через реку Тобол-3 км [6].

По итогам завершения программы доля автодорог республиканского значения в хорошем и удовлетворительном состоянии доведена до 88%, местных дорог-до 71%. Отремонтировано 10 тысяч километров дорог республиканского значения и 15 тысяч километров дорог местного значения. В рамках реализации программы «Нұрлы жол» увеличена протяженность 4-полосных автодорог I и II категорий (до 8,2 тыс. км). Реализован

мегапроект по реконструкции Международной автомобильной магистрали «Западная Европа – Западный Китай», которая служит основным транспортным коридором в Центральной Азии, соединяющим Восток и Запад. Также в рамках программы при строительстве автодорог впервые использован механизм государственно-частного партнерства, начат переход от дорогостоящего капитального ремонта к более экономичному методу холодного ресайклинга.

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ASSESSMENT METHODS OF FINANCIAL STABILITY IN COMMERCIAL BANKS

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Abstract

Financial stability in commercial banks is a cornerstone of overall economic health and resilience. The increasing complexity of financial markets, regulatory changes, and evolving risk environments have intensified the need for robust and multidimensional approaches to assess banks' financial stability. This article analyzes the primary quantitative and qualitative methods used to evaluate the financial soundness of commercial banks, including ratio analysis, stress testing, the CAMELS framework, and advanced risk management models. The study draws on international practices and empirical research, highlighting the strengths and limitations of each method. The findings suggest that a combination of traditional and advanced assessment tools, backed by regulatory oversight and internal governance, is crucial for ensuring long-term financial stability in the banking sector.

Keywords: financial stability, commercial banks, assessment methods, CAMELS, stress testing, risk management

Introduction

Commercial banks play a vital role in the functioning of financial systems by channeling savings into productive investments, facilitating payments, and supporting economic activity. The stability of these institutions directly impacts public confidence, capital flows, and macroeconomic stability [9]. In recent decades, episodes of banking crises—triggered by factors such as poor risk management, asset quality deterioration, and macroeconomic shocks—have underscored the importance of systematically assessing banks' financial stability [15].

Assessing financial stability involves evaluating a bank's ability to absorb losses, maintain adequate liquidity, and withstand adverse economic conditions [14]. The development of comprehensive assessment methodologies has therefore become a critical priority for both regulators and banking institutions [2]. This paper reviews the main methods used to appraise the financial stability of commercial banks, their applications, and their implications for financial sector governance.

Research

1. Ratio Analysis

Ratio analysis remains one of the most widely used quantitative tools for evaluating the financial health of commercial banks. Key ratios include:

Capital Adequacy Ratio (CAR): Measures the bank's capital in relation to its risk-weighted assets, reflecting its capacity to absorb potential losses [7].

Liquidity Ratios: Such as the Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), gauge the bank's ability to meet short-term and long-term obligations.

Asset Quality Ratios: Non-performing loan ratios (NPL) and loan loss provisions signal the credit risk and overall quality of the loan portfolio.

Profitability Ratios: Return on Assets (ROA) and Return on Equity (ROE) assess the bank's earning power relative to its assets and equity [12].
Leverage Ratio: Indicates the proportion of debt used in the bank's capital structure [13].
Ratio analysis provides an accessible and standardized way to benchmark financial performance across institutions and over time [1]. However, it may oversimplify complex risk profiles and is sensitive to accounting conventions [6].

2. The CAMELS Framework

The CAMELS rating system is a comprehensive supervisory tool developed by U.S. regulators and adopted worldwide. It evaluates banks across six domains:
Capital Adequacy
Asset Quality
Management Quality
Earnings
Liquidity
Sensitivity to Market Risk

Regulators assign a composite score based on both quantitative ratios and qualitative assessments [11]. The CAMELS approach allows for a nuanced assessment of a bank's risk profile and governance but may suffer from subjectivity and information asymmetry [19].

3. Stress Testing

Stress testing has become an essential element in the toolkit for assessing financial stability, especially after the global financial crisis of 2007-2008 [5]. Stress tests simulate the impact of adverse scenarios—such as economic downturns, interest rate shocks, or liquidity crises—on banks' balance sheets and income statements[16].
Macroeconomic Stress Testing: Models the effects of GDP contraction, unemployment spikes, or exchange rate volatility [13], [17].
Reverse Stress Testing: Identifies scenarios that would render a bank insolvent, thereby exposing vulnerabilities [14].

Stress testing helps banks and regulators identify capital shortfalls, liquidity gaps, and risk concentrations [3]. However, the reliability of stress tests depends on the accuracy of underlying assumptions, scenario design, and data quality [20].

4. Advanced Risk Management Models

Modern banks employ sophisticated models to quantify and manage risk:
Value-at-Risk (VaR): Estimates the maximum potential loss over a given time period at a specified confidence level.
Credit Risk Models: Such as the Internal Ratings-Based (IRB) approach under Basel II/III, use statistical techniques to estimate the probability of default and loss given default [7].
Liquidity Risk Models: Employ cash flow projections and scenario analysis to ensure funding adequacy.
While these models enhance risk measurement and capital allocation, they may underestimate tail risks and are susceptible to model risk [8].

5. Qualitative Assessment and Governance

Beyond quantitative metrics, qualitative assessment of governance, risk culture, and management practices is vital for financial stability [18]. Effective boards, internal controls, and compliance systems can mitigate operational and reputational risks. Regulators may conduct on-site inspections and interviews to supplement their evaluations.

6. International and Regional Practices

United States and European Union: Both jurisdictions have robust supervisory regimes, including regular stress tests and public disclosure of results [10].

Emerging Markets: Many developing countries are strengthening regulatory capacity and adopting global best practices in financial stability assessment [21].

Challenges and Future Directions

Despite progress, several challenges persist:

Data Quality and Transparency: Reliable, granular data is essential for accurate assessment.

Model Risk and Complexity: Overreliance on complex models may obscure underlying vulnerabilities.

Rapid Technological Change: Fintech innovations and cyber risks require continuous adaptation of assessment frameworks.

Systemic Risk: Interconnectedness among banks and non-bank financial institutions can amplify shocks [14].

Future research and policy should focus on integrating traditional metrics with real-time analytics, enhancing cross-border regulatory cooperation, and fostering a culture of proactive risk management [4].

Conclusion

Assessing the financial stability of commercial banks requires a multidimensional approach encompassing ratio analysis, the CAMELS framework, stress testing, advanced risk models, and qualitative assessments. Each method has unique strengths and limitations; their combined use offers a more comprehensive view of bank health and resilience. Continued regulatory vigilance, technological innovation, and strong internal governance are essential to safeguarding the financial stability of commercial banks in an increasingly complex environment.

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SECURITE ALIMENTAIRE ET CHANGEMENT CLIMATIQUE A MADAGASCAR : ENJEUX, MANIFESTATIONS ET MESURES D'ADAPTATION

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Résumé

Cet article examine les manifestations du changement climatique sur la sécurité alimentaire à Madagascar, ainsi que les mesures et stratégies d'adaptation mises en place ou envisagées. Le changement climatique constitue l'un des principaux défis pour la sécurité alimentaire à Madagascar. Il se manifeste par des sécheresses récurrentes dans le sud, des cyclones destructeurs et une variabilité pluviométrique accrue. Ces phénomènes affectent directement la disponibilité des denrées agricoles, l'accès économique des ménages, la diversité alimentaire et la stabilité des marchés. En mobilisant les approches économiques (loi de l'offre et de la demande, théorie des capabilités d'Amartya Sen, économie institutionnelle et keynésienne), cette étude met en évidence les impacts théoriques du climat sur les quatre piliers de la sécurité alimentaire. Des mesures d'adaptation, telles que le développement de l'irrigation, la diversification agricole, la gestion des risques climatiques et la régulation des marché, sont proposées pour renforcer la résilience du pays.

Mots clés : Sécurité alimentaire, changement climatique, Madagascar, mesures d'adaptation, résilience

Introduction

La sécurité alimentaire est définie par la FAO comme l'accès de toutes les personnes à une nourriture suffisante, saine et nutritive à tout moment. Madagascar, dont plus de 90% de la population vit sous le seuil de 3,10 USD/ jour, dépend largement d'une agriculture pluviale vulnérable, en particulier dans le Grand Sud, zones fréquemment frappées par sécheresses et cyclones (PAM 2023). En 2022, environ 33% de la population, soit 8,8 millions de personnes, souffraient d'insécurité alimentaire, dont plus de 2,2 millions en situation d'urgence dans les régions du Grand Sud et Sud-Est (librairie IMF Friends of Madagascar Development 2023). Cette situation alerte sur l'urgence d'une transition vers une agriculture plus résistante au climat. Ainsi, la combinaison d'événements extrêmes (cyclones, sécheresses, inondations) et de vulnérabilités structurelles (pauvreté, faible infrastructure, dépendance au riz) aggrave l'insécurité alimentaire. L'objectif de cet article est d'examiner les manifestations du changement climatique sur la sécurité alimentaire à Madagascar, ainsi que les mesures et stratégies d'adaptation mises en place ou envisagées.

Manifestations des impacts du changement climatique

- Sécheresse extrême (2021-2022) : consécutivement à deux années de pluies très en-dessous de la moyenne, le sud a connu la pire sécheresse depuis 40 ans (Androy, Anosy, Atsimo-Andrefana).
- Cyclones tropicaux (Batsirai, Emnati en 2022), entrainant la famille et des crises nutritionnelles sévères.
- Insécurité alimentaire aiguë : selon IPC info, plus de 1 million de personnes sont concernées par une insécurité alimentaire sévère (IPC 3+) entre juillet et septembre 2023, avec 458 000 enfants risquant la malnutrition sévère (SAM) ou modérée (MAM).
- Accès à l'eau potable : seulement 22% de la population à accès à une source d'eau potable gérée de manière sûre, aggravant les risques sanitaires (Food Systems Dashboard)
- Malnutrition persistant : le retard de croissance (stunting) touche plus de 40% des enfants, et la malnutrition aiguë est estimée à 8% (library IMF)
- Alimentation déséquilibrée : 94% de la population ne peut pas se permettre un régime alimentaire sain, avec une disponibilité végétale très faible (38,5g/jour) selon Madagascar FCSI Indicators –Food Systems Dashboard.

Approche théorique économique de la sécurité alimentaire

1. Disponibilité alimentaire (approche néoclassique)
   La sécurité alimentaire est d'abord liée à la capacité nationale de produire. A Madagascar, la dépendance aux cultures pluviales fragilise la disponibilité alimentaire face aux aléas climatiques.
2. Accès économique (théorie des capabilités – Amartya Sen)
   Amartya Sen (Prix Nobel 1998) démontre que la famine survient non seulement par manque de nourriture, mais surtout par l'inaccessibilité économique (pouvoir d'achat limité, chômage, pauvreté).
   Exemple malgache : même si le riz est disponible sur les marchés, les ménages pauvres ne peuvent pas toujours l'acheter.
3. Stabilité et utilisation (approche institutionnelle et développement durable)
   La sécurité alimentaire doit être stable dans le temps et intégrer des aspects nutritionnels. Cela implique des politiques de stockages, de régulation des marchés, d'infrastructures de transport et de systèmes d'irrigation adaptés.

Discussion : mesures et stratégies d'adaptation

1. Mesures institutionnelles et politiques
   - Renforcement des politiques agricoles : l'Etat malgache doit prioriser la sécurité alimentaire dans les politiques publiques, notamment à travers une meilleure planification agricole intégrant le risque climatique.
   - Amélioration de la gouvernance locale : décentralisation des prises de décision afin que les collectivités puissent adapter leurs stratégies aux réalités locales.
   - Partenariats internationaux : coopération accrue avec la FAO, le PAM, la Banque Mondiale et l'Union Africaine pour financer des programmes de résilience alimentaire

2. Mesures techniques et agricoles
   - Développement de l'agro écologie et de l'agriculture durable : promotion de techniques agricoles adaptées au climat (semences résistantes à la sécheresse, rotation des cultures agroforesterie).

- Systèmes d'irrigation résilients : construction de micro-barrages, réhabilitation des canaux et collecte des eaux de pluie pour réduire la dépendance à la pluie.
- Diversification de la production : introduction de cultures tolérantes à la sécheresse (sorgho, manioc, patate douce) afin de réduire la vulnérabilité des ménages.

3. Mesures économiques et sociales
    - Soutien aux petits exploitants agricoles : subventions, crédits agricoles adaptés et formation en gestion durable.
    - Renforcement des filets sociaux : mise en place de systèmes de protection sociale pour les ménages les plus vulnérables (aides alimentaires, transferts monétaires)
    - Promotion de la sécurité nutritionnelle : campagnes de sensibilisation à l'équilibre alimentaire et à l'utilisation des produits locaux.
4. Mesures environnementales
    - Reboisement et restauration des terres dégradées : lutte contre la déforestation et gestion durable des sols pour améliorer la productivité
    - Protection des bassins versants : prévention de l'érosion et amélioration de la gestion des ressources en eau.
    - Renforcement de la biodiversité agricole : conservation des semences locales adaptées aux conditions climatiques.
5. Stratégies d'adaptation communautaires
    - Approche participative : implication des communautés rurales dans la planification et la mise en œuvre des projets agricoles et environnementaux.
    - Savoirs traditionnels et innovations locales : valorisations des pratiques paysannes de résiliences face aux chocs climatiques.
    - Renforcement des coopératives et associations paysannes : pour mutualiser les ressources et faciliter l'accès aux marchés.

Tableau 1 : impacts identifiés et mesures d'adaptation pour la sécurité alimentaire face au changement climatique à Madagascar.

Impacts identifiés	Mesure d'adaptation	Acteurs impliqués
Sécheresses extrêmes	Introduction de cultures résistantes à la sécheresse, irrigation	Agriculteurs, ONG, Etat
Cyclones et inondations	Aménagements anti-érosion, infrastructures de stockage sécurisée	Etat, Collectivités
Insécurité alimentaire aiguë	Filets sociaux, aide alimentaire, renforcement du marché local	Gouvernement, bailleurs
Malnutrition infantile	Nutrition ciblée, prévention de la malnutrition	ONG, Etat
Accès à l'eau potable	Forages, protection de bassins versants, infrastructures hydrauliques	Communautés locales, ONG
Baisse de rendements	Techniques agroforestières, diversification des cultures	Paysans, instituts de recherche

Tableau 2. Impacts théoriques du changement climatique

Pilier de la sécurité alimentaire	Impact climatique	Théorie économique associée	Conséquence à Madagascar
Disponibilité (production)	Sécheresses, inondations, cyclones réduisent les récoltes et la productivité agricoles	Théorie néoclassique (loi de l'offre et de la demande) : baisse de l'offre entraine hausse des prix	Difficulté à atteindre l'autosuffisance alimentaire, augmentation des importations de riz
Accès (pouvoir d'achat)	Perte de revenus agricoles, destruction de bétail et de cultures	Théorie des cabablités d'Amartya Sen (entitlements) : famine= incapacité économique à accéder à la nourriture	Les ménages pauvres, surtout dans le Sud, ne peuvent acheter les denrées de base malgré leur disponibilité relative.
Utilisation (nutrition)	Réduction de la diversité alimentaire, recours à des produits de substitution moins nutritifs	Approche institutionnelle et nutritionnelle : capital humain et services de santé déterminent l'utilisation efficace des aliments	Hausse de la malnutrition chronique (retard de croissance, maladies liées à la sous-alimentation)
Stabilité (durabilité)	Variabilité accrue (sécheresses alternées avec cyclones), absence de stockage et régulation	Théorie keynésienne (rôle stabilisateur de l'Etat) et développement durable	Instabilité structurelle des marchés et insécurité alimentaire récurrente dans les zones vulnérables

Conclusion

Le changement climatique accentue les fragilités structurelles de Madagascar en compromettant les quatre piliers de la sécurité alimentaire. L'approche théorique permet de mieux comprendre les mécanismes économiques et sociaux sous-jacents, et d'identifier les leviers d'action. Pour renforcer la résilience alimentaire, Madagascar doit conjuguer des stratégies locales (semences résistantes, diversification) et nationales (politiques de stockage, subvention, régulation des marchés). Une coopération internationale et régionale est également essentielle pour soutenir les efforts d'adaptation

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ЭВОЛЮЦИЯ КОРПОРАТИВНОГО КРЕДИТОВАНИЯ: СОВРЕМЕННЫЕ ТЕНДЕНЦИИ И ВЫЗОВЫ ДЛЯ БАНКОВСКОЙ СИСТЕМЫ КАЗАХСТАНА

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Аннотация: *В статье рассматриваются ключевые тенденции и вызовы, сопровождающие эволюцию корпоративного кредитования в банковской системе Казахстана в последние годы. Особое внимание уделено анализу структуры кредитного портфеля, динамике процентных ставок, а также качеству активов банков. Установлено, что несмотря на общее улучшение показателей кредитного риска, наблюдается смещение приоритетов в сторону розничного кредитования, что ограничивает инвестиционный потенциал банковского сектора. Сделан вывод о необходимости усиления роли банков в поддержке корпоративного сектора, особенно в промышленности и сегменте МСБ, для обеспечения устойчивого экономического роста.*

Ключевые слова: *корпоративное кредитование, банковская система, Казахстан, кредитный портфель, проблемная задолженность, потребительские ссуды, кредитные риски, финансирование бизнеса.*

Annotation: *The article examines the key trends and challenges accompanying the evolution of corporate lending in the banking system of Kazakhstan in recent years. Special attention is paid to the analysis of the loan portfolio structure, the dynamics of interest rates, as well as the quality of banks' assets. It was found that despite the overall improvement in credit risk indicators, there is a shift in priorities towards retail lending, which limits the investment potential of the banking sector. It is concluded that it is necessary to strengthen the role of banks in supporting the corporate sector, especially in industry and the SME segment, in order to ensure sustainable economic growth.*

Keywords: *corporate lending, banking system, Kazakhstan, loan portfolio, non-performing loans, consumer credit, credit risks, business financing.*

Введение

За последние десятилетия банковский сектор Казахстана прочно утвердился как ключевой элемент национальной экономики. Он стал основой финансовой системы страны и важным источником поддержки экономического роста и стабильности. Пройдя через периоды экономических потрясений, включая мировой финансовый кризис 2008 года, казахстанские банки смогли восстановиться и укрепить свою устойчивость. Эти учреждения с честью выдержали и более поздние вызовы, такие как пандемия COVID-19 и геополитическая нестабильность [1].

Одним из заметных достижений сектора стало успешное внедрение финансовых технологий и цифровизация. Сегодня банковская система Казахстана считается одним из лидеров в области инноваций и информационных технологий, опережая многие другие сферы экономики страны. Тем не менее, несмотря на очевидный прогресс, остаются серьезные вопросы к эффективности участия банков в общем экономическом развитии.

Ключевые макроэкономические показатели, отражающие вовлеченность банковского сектора в экономику, указывают на существенное отставание от уровня развитых, а зачастую и развивающихся стран. Доля банковских активов, объем кредитования и депозитов по отношению к валовому внутреннему продукту остаются сравнительно низкими. Особенно тревожной тенденцией является сокращение объемов корпоративного кредитования, которое уже не первый год демонстрирует устойчивый спад. Эта проблема была отмечена и в Послании Президента народу Казахстана в сентябре 2023 года.

Причины столь низкой активности банков в кредитовании бизнеса лежат глубоко в структуре национальной экономики. Системные дисбалансы и фундаментальные слабости мешают банкам активно участвовать в финансировании реального сектора.

Проведенное исследование и его методика. В исследовании использовался комплексный подход, основанный на анализе количественных и качественных данных. Применялись методы экономико-статистического анализа с целью выявления динамики ключевых показателей банковского кредитования, включая сравнительный анализ по секторам и видам заемщиков. Для оценки текущих тенденций и выявления факторов, сдерживающих рост корпоративного кредитования, использовались элементы контент-анализа отчетов банков, обзоров международных организаций и официальных выступлений представителей государственных органов.

Анализ структуры кредитного портфеля казахстанских банков показывает устойчивое преобладание потребительского кредитования, доля которого в период с 1 января 2022 года по 1 января 2024 года увеличилась с 29% до 35%. Существенный рост в данном сегменте в 2023 году был обусловлен активным распространением механизмов рассрочки, а также регулярными маркетинговыми кампаниями со стороны крупнейших банков [2].

Увеличение доступности и привлекательности потребительских продуктов привело к усилению обеспокоенности в обществе и органах власти по поводу уровня закредитованности населения. В этой связи был инициирован законопроект, направленный на ужесточение условий предоставления потребительских займов. Структура валового кредитного портфеля БВУ РК показана на рисунке 1.

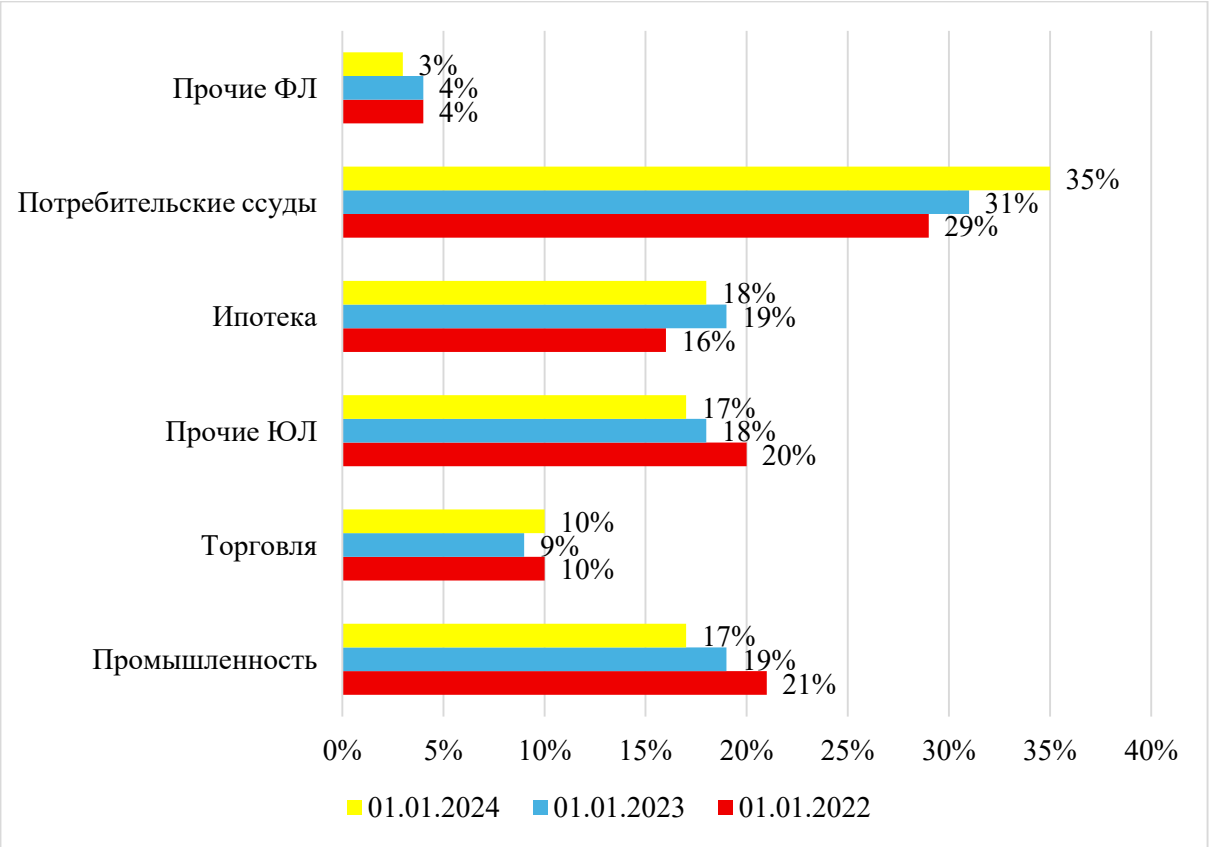

Рисунок 1. Структура валового кредитного портфеля БВУ РК [2]

В корпоративном сегменте основная масса кредитов продолжает концентрироваться в промышленности. Однако за анализируемый двухлетний период наблюдается снижение ее удельного веса в совокупном объеме корпоративного кредитования с 21% до 17%, что может свидетельствовать о сдержанности банков в финансировании реального сектора либо о снижении инвестиционной активности со стороны промышленных предприятий. При этом другие сектора экономики демонстрируют относительную стабильность в структуре валового кредитного портфеля [3].

Динамика процентных ставок также претерпела изменения: если в течение 2022 года кредиты юридическим лицам предоставлялись на условиях более низкой процентной ставки по сравнению с физическими лицами, то к началу 2024 года наблюдается их фактическое выравнивание. Кроме того, после снижения доли валютных кредитов в 2022 году с 13% до 8%, в последующий год зафиксирован рост этого показателя до уровня 10% на начало 2024 года, что может быть связано с изменением валютных предпочтений заемщиков и изменениями в макроэкономической конъюнктуре [4].

В 2023 году темпы роста проблемной задолженности замедлились, увеличившись лишь на 6% по сравнению с 22% годом ранее. Это произошло на фоне существенного расширения совокупного кредитного портфеля, объем которого вырос на 23%. В результате удельный вес проблемной задолженности в общем объеме кредитов снизился с 3,4% до 2,9%, что указывает на улучшение качества активов банковского сектора [5].

Качество кредитного портфеля БВУ РК показано на рисунке 2.

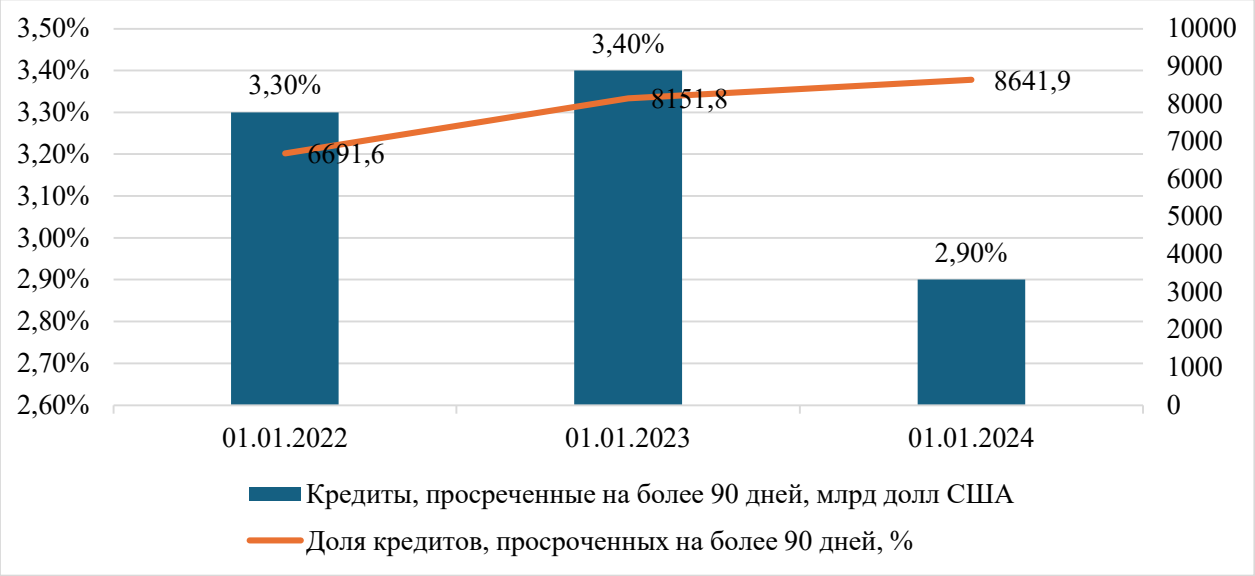

Рисунок 2. Качество кредитного портфеля БВУ РК [2]

Объем резервов по кредитам, просроченным более чем на 90 дней, остается стабильно высоким, удерживаясь на уровне около 76%, что свидетельствует о взвешенной политике управления кредитными рисками. При этом структура проблемных активов продолжает демонстрировать доминирование розничного сегмента: около 67% общего объема просроченной задолженности приходится на ссуды, выданные физическим лицам. В течение года объем просроченной задолженности свыше 90 дней в этом сегменте увеличился на 16%, тогда как по корпоративным заемщикам отмечено снижение аналогичного показателя на 10%.

Указанная динамика отражает различия в поведении заемщиков и чувствительности к макроэкономическим условиям, а также подчеркивает необходимость адаптации стратегий управления рисками с учетом специфики клиентских категорий.

Результаты исследования.

Результаты проведенного исследования подтверждают наличие устойчивой тенденции смещения приоритетов банковского сектора Казахстана в сторону розничного кредитования, что проявляется в увеличении доли потребительских ссуд в кредитном портфеле и высокой активности банков в продвижении соответствующих продуктов. При этом корпоративный сегмент, особенно промышленность, демонстрирует снижение удельного веса в общем объеме кредитования, несмотря на важность данного направления для долгосрочного экономического роста. Анализ процентных ставок свидетельствует о сокращении дифференциации условий кредитования между физическими и юридическими лицами, а также о стабилизации стоимости заимствований на фоне выравнивания рыночных условий.

Качество кредитного портфеля в целом улучшилось, что выражается в снижении доли проблемной задолженности при одновременном росте объема кредитования. Однако сохраняется высокая концентрация просроченных обязательств в сегменте физических лиц, что указывает на потенциальные риски, связанные с закредитованностью населения и уязвимостью розничного портфеля к макроэкономическим шокам. Несмотря на это, банки демонстрируют устойчивую политику резервирования, что способствует сдерживанию системных рисков.

Вывод

Текущая модель развития банковского сектора характеризуется дисбалансом в структуре кредитования, с ориентацией преимущественно на розничный сегмент при недостаточном внимании к потребностям корпоративного сектора. Такая ситуация ограничивает потенциал банков как источника инвестиций в экономику и требует пересмотра стратегических приоритетов кредитной политики. Повышение роли банков в финансировании бизнеса, особенно малого и среднего предпринимательства, представляется необходимым условием для устойчивого экономического роста. В этом контексте важно совершенствовать институциональные условия, снижать кредитные риски, а также усиливать стимулы для расширения корпоративного кредитования, особенно в ключевых отраслях экономики.

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Philological Sciences

МУЛЬТИЛІНГВІЗМ У ФРАНКОМОВНІЙ РЕКЛАМІ (НА МАТЕРІАЛАХ ФРАНКОМОВНИХ МУЛЬТИЛІНГВІСТИЧНИХ ОНЛАЙН-ПОВІДОМЛЕНЬ)

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Стаття присвячена детальному аналізу мультилінгвізму у франкомовній рекламі, що розглядається як інструмент культурного обміну, подолання мовних бар'єрів та ефективної комунікації в епоху глобалізації. Було проаналізовано понад 100 автентичних рекламних повідомлень, зібраних із різних онлайн-джерел. Особливу увагу приділено функціональному навантаженню кожної мови, залученої в мультилінгвістичний контекст, а також регіональних мов. Робота детально розкриває вплив економічних та соціокультурних факторів на вибір мов у рекламних кампаніях, а також їхній вплив на мовну політику Франції. Представлені практичні приклади демонструють, як використання кількох мов не лише відображає сучасні процеси культурного обміну, але й слугує ефективним інструментом для позиціонування міжнародних брендів та завоювання нових ринків.

Ключові слова: *франкомовна реклама, мультилінгвізм, мультилінгвістичні рекламні повідомлення, використання кількох мов, функції мов, фактори вибору мов.*

Постановка проблеми

В епоху інтенсивної глобалізації та цифрових технологій, коли інформація та товари вільно перетинають кордони, реклама виходить за рамки простих комерційних повідомлень, стаючи важливим елементом міжкультурної комунікації. Збільшення кількості людей, які володіють кількома мовами, робить мультилінгвізм у рекламі не просто трендом, а стратегічною необхідністю. Це явище є відображенням сучасних реалій, де мовні бар'єри поступово стираються, а культурний обмін стає невід'ємною частиною повсякденного життя. Преставлена робота виходить за рамки поверхневого аналізу та заглиблюється у функціональне навантаження кожної мови, що використовується в рекламних повідомленнях, а також у фактори, що впливають на цей вибір. Дослідження мультилінгвізму у франкомовній рекламі дозволяє зрозуміти, як компанії адаптують свої маркетингові

стратегії до різних аудиторій, демонструючи повагу до культурних особливостей та прагнучи створити емоційний зв'язок зі споживачем.

Метою цієї наукової роботи є комплексний аналіз лексичної та граматичної структури мультилінгвістичних рекламних слоганів та повідомлень, а також виявлення функцій, які виконують різні мови (англійська, офіційні державні мови, регіональні мови, автохтонні мови колишніх колоній) у франкомовних рекламних текстах.

Для досягнення поставленої мети було визначено наступні завдання: вивчити та систематизувати наукові джерела, що стосуються мультилінгвізму в контексті реклами та міжкультурної комунікації; зібрати та систематизувати корпус автентичних франкомовних мультилінгвістичних рекламних повідомлень з онлайн-джерел; провести детальний аналіз обраного рекламного матеріалу, ідентифікуючи функції та роль кожної іноземної мови у загальному рекламному тексті; визначити та класифікувати соціокультурні, економічні та лінгвістичні фактори, що впливають на вибір мов при створенні рекламних матеріалів; виявити особливості використання інших мов у франкомовній рекламі та узагальнити отримані дані.

У рамках даного дослідження нами особисто було зібрано та проаналізовано корпус із понад 100 рекламних текстів. Джерела пошуку включали офіційні сайти французьких та міжнародних компаній, сторінки брендів у соціальних мережах (Facebook, Instagram), а також рекламні банери та відеоролики на YouTube, орієнтовані на франкомовну аудиторію, які ми власноруч класифікували за видом реклами (слоган, текст, оголошення), залученими мовами, та проаналізувала їх функціональне навантаження. Така систематизація дозволила не лише підтвердити теоретичні положення, а й виявити неочевидні тенденції у використанні мультилінгвізму. Ключовим етапом моєї роботи стало виявлення та аналіз конкретних функцій, які виконує кожна мова в контексті рекламного повідомлення, що надало роботі практичної цінності.

Серед інших методів дослідження застосовувалась універсальна модель мультилінгвізму, запропонована Панасенком Є.О., яка дозволила створити мультилінгвістичний квадрат франкомовної реклами, що є нашою авторською розробкою. За допомогою цього квадрату прояви мультилінгвізму було розставлено в певний логічний порядок, який перетворився у цілісну систему чотирьох основних категорії використання у франкомовній рекламі інших мов.

Виклад основного матеріалу. Мовна політика Франції в цілому має на меті захист французької мови, зокрема через Закон Тубона, що зобов’язує використовувати французьку у публічній сфері, але сучасний світ впевнено змінюється під впливом глобалізації, стираючи кордони не лише між економіками, але й між культурами, сприяючи їхньому взаємопроникненню, і Франція не є винятком в цьому процесі. Тому зараз багато уваги приділяється проблемам збереження регіональних мов як елементу культурної спадщини, де реклама відіграє роль індикатора балансу між єдністю та різноманіттям. Використання державних, регіональних та автохтонних мов у рекламних кампаніях відображає тенденцію до культурної відкритості, що поєднує традиції з глобальними процесами.

Аналіз зібраного матеріалу рекламних повідомлень дозволив виявити кілька ключових функцій, які виконують іноземні мови у франкомовній рекламі. Спостереження за вживанням англійської мови у якості як державної офіційної мови франкомовних країн, так і мови Інтернет-комунікацій та інформаційних технологій, дозволило зрозуміти, що вживання англійських слів у рекламі робить її більш сучасною і більш привабливою, особливо для молодого франкомовного покоління. Наприклад, слоган з реклами смарт-годинника від відомого бренду звучить як «Le meilleur de la tech, made in France». У цьому випадку англійська фраза «made in France» не тільки підкреслює французьке походження продукту, але й використовує універсально зрозуміле маркування, що робить його привабливим для

міжнародної аудиторії. Або реклама парфуму, що містить слоган «L'essence de la liberté, live your life», де фраза «live your life» не просто перекладається як «живи своїм життям», а й несе в собі емоційний заряд, що асоціюється з динамічністю, самореалізацією та міжнародними трендами.

Аналіз використання державних офіційних мов дозволив виявити наявність у багатьох рекламних афішах суміші французької мови з державними, рівнозначного перекладу на іншу державну мову для цільової аудиторії, яка не є плюрілінгвістичною, та міжлінгвістичного впливу таких мов на французьку, що відображується зокрема в граматичних конструкціях, притаманних германським мовам. Слоган «Le goût du vrai latte macchiato» використовує італійську назву напою, щоб підкреслити його автентичність та італійське походження, викликаючи асоціації з якістю та традиціями, а слоган «La pêche aux chansons Liedelfang» розрахован на плюрілінгвістичну швейцарську публіку, завдяки чому в ньому використовується суміш двох державних мов - французької і німецької одночасно.

Вивчення реклами із регіональними мовами, яких у європейський частині Франції наличується двадцять чотири, показало наявність «мовної суміші», неперекладених повідомлень, якщо вони легкі для розуміння, зокрема у соціальній рекламі або рекламі культурних акцій, а також використання двомовних покажчиків, що підкреслює важливість регіональної мови, яка в цьому випадку використовується на рівні з французькою, що є єдиною державною мовою Франції. Також було з’ясовано, що у рекламних афішах не робиться дослівний переклад інформації, тексти адаптуються під користувачів - носіїв різних регіональних мов окремо, як-от приклад рекламного повідомлення, що складається з французької частини: «Notre cidre, c'est l'âme de la Bretagne.» (Наш сидр — це душа Бретані) та бретонської «Evit ur yalc'had, plijout a ra d'an holl» (Для повного щастя, він до вподоби всім).

Дослідження різноманіття корінних мов колишніх колоній французької імперії, яке також знайшло своє відображення у мультилінгвістичній рекламі, дозволило зрозуміти, що порядок використання мов залежить від того, на яку аудиторію вони орієнтовані. Якщо йдеться, у першу чергу, про населення метрополії, першим друкується текст французькою мовою, якщо на місцевих жителів, то автохтонною. Ці мови рідко використовуються в широкій рекламі, але їх наявність вказує на глибокий культурний зв'язок та прагнення охопити специфічну діаспорну аудиторію, особливо в галузях, де ця аудиторія має значну вагу (наприклад, продукти харчування, косметика), що демонструє повагу до культурного розмаїття і допомагає встановити довіру подібно тексту реклами «OÙ FÉ PA LE POIS (Все просто) Des grains gadyamb, en 5 minutes évidemment ! (Зерна гад'ямб, звісно, за 5 хвилин!)

Висновки. Результати цього дослідження мають широкі сфери застосування, які виходять за межі академічної дискусії. Маркетингові агентства можуть використовувати наші висновки для розробки ефективних мультилінгвістичних рекламних кампаній, адаптованих до конкретних ринків. Розуміння функціонального навантаження кожної мови дозволяє не просто перекладати слогани, а створювати емоційно насичені та культурно релевантні повідомлення. Компанії, які планують вийти на франкомовний ринок, можуть використовувати отримані дані про використання мов у рекламі для кращого позиціонування свого бренду, що допоможе уникнути культурних помилок та створити більш привабливий для споживача імідж. Преставлене дослідження також вносить вклад у розуміння того, як глобалізація та цифрові технології впливають на мовну еволюцію. Воно демонструє, що мультилінгвізм - це не хаотичне змішування, а структурований процес, який підпорядковується певним функціональним закономірностям. Отримані езультати, між іншім, можуть бути використані в навчальних програмах з французької мови, маркетингу та міжкультурної комунікації. Аналіз автентичних прикладів допоможе студентам краще зрозуміти сучасні тенденції у використанні мови та її роль у суспільстві.

Проведене дослідження підтверджує, що мультилінгвізм у франкомовній рекламі є динамічним і багатогранним явищем, що не лише відображає сучасні процеси культурного обміну, а й виступає як потужний інструмент для досягнення комерційних та соціальних цілей і як важлива частка сучасної комунікації, що потребує подальшого глибокого аналізу та культурної чутливості. Розроблений «мультилінгвістичний квадрат франкомовної реклами» систематизує основні напрями використання інших мов і може стати підґрунтям для подальших досліджень у сфері соціолінгвістики та рекламознавства.

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MULTILINGUALISM IN FRENCH-LANGUAGE ADVERTISING (BASED ON FRENCH-LANGUAGE MULTILINGUAL ONLINE MESSAGES)

The article is dedicated to a detailed analysis of multilingualism in French-language advertising, which is viewed as an instrument for cultural exchange, overcoming language barriers, and effective communication in the era of globalization. Over 100 authentic advertising messages from various online sources were analyzed. The study focuses on the functional load of each language involved in the multilingual context, including regional languages. The work also explores the impact of economic and socio-cultural factors on the choice of languages in advertising campaigns and their influence on France's language policy. Practical examples show how using multiple languages not only reflects modern cultural exchange but also serves as an effective tool for positioning international brands and conquering new markets.
***Key words**: French-language advertising, multilingualism, multilingual advertising messages, use of multiple languages, functions of languages, factors influencing language choice*

Biological Sciences

Үй жағдайында өсірілетін өсімдіктерге сыртқы факторлардың әсері: күн сәулесі, температура және дыбыс

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Жұмыстың өзектілігі: Үй жағдайында өсірілетін мәдени өсімдіктердің өсуіне қолайлы жағдай жасайтын факторды анықтау.

Зерттеу нысаны: Үй жағдайында өсірілген Қарапайым жалбыз(Mentha spicata *L.)*, Қолшатырлы сүттіген (Молочайка зонтичная -Euphorbia umbrella *L.*), Етті хойя(Мясистая Хойя- Hoya Carnosa) өсімдіктері;

Мақсаты: Үй жағдайында өсірілетін мәдени өсімдіктерге әсер ететін факторлар: күн сәулесі, температура және дыбыстың әсерін анықтау.

Міндеттері:

1. Таңдалып алынған өсімдіктерге қолайлы жағдай жасау арқылы өсіру
2. Таңдалып алынған өсімдіктерге температура, күн сәулесі және дыбыс әсерін анықтау

Үй жағдайында өсірілетін өсімдіктер — бұл адамдардың үйінде немесе басқа жабық кеңістікте өсіруге бейімделген өсімдіктер. Олар жарықтың жетіспеушілігіне, температураның тұрақсыздығына және ылғалдың төмен болуына төзімді болып келеді. Мұндай өсімдіктердің күтімі жеңіл, көлемі шағын немесе орташа болады.

Үйде өсіруге ыңғайлы өсімдіктер түрлері:

- Кактус пен суккуленттер (алоэ, эхеверия) – жарық пен сирек суаруға төзімді;
- Гүлді өсімдіктер (фиалка, спатифиллум, кливия) – сәндік мақсатта;
- Пальмалар мен лианалар – кең жарық бөлмелерге;
- Асханалық өсімдіктер (аскөк, лавр жапырағы, қызанақ) – күн көзі бар терезе маңына;
- Жапырақты өсімдіктер (фикус, монстера, хлорофитум) – көлеңкеге де төзімді.

Үй өсімдіктері мен дала өсімдіктерінің айырмашылығы:

Сипаттамасы	Үй өсімдіктері	Дала өсімдіктері
Өсу ортасы	Жабық кеңістік, тұрақты жағдай қажет	Табиғи ортада, ауа райына бейімделген
Жарыққа қатысы	Жартылай көлеңкеге төзімді	Күн сәулесін жақсы көреді
Температура	18–24°C аралығында өседі	Ыстық не суыққа төзімді
Суару мен күтім	Жиі суаруды және бақылауды талап етеді	Табиғи жауын-шашынмен дамиды
Шығу тегі	Селекция арқылы алынған	Табиғи жолмен таралған

Зерттеуге алынған үй өсімдіктеріне қысқаша сипаттама:

1. **Қарапайым жалбыз (Mentha spicata)**
   - **Жарық:** Жартылай көлеңке
   - **Суару:** Топырақты үнемі ылғал ұстау
   - **Температура:** Орташа, суыққа төзімді
   - **Таксономия:** Ерінгүлділер тұқымдасы
2. **Қолшатырлы сүттіген (Euphorbia umbrella)**
   - **Жарық:** Жақсы жарық, бірақ тікелей күннен қорғайды
   - **Суару:** Топырақ құрғаған соң суару
   - **Температура:** 15–18°C
   - **Таксономия:** Сүттігендер тұқымдасы
3. **Етті хойя (Hoya carnosa)**
   - **Жарық:** Жартылай көлеңке
   - **Суару:** Құрғағаннан кейін ғана суару
   - **Температура:** 18–24°C
   - **Таксономия:** Қатпарлығүлділер тұқымдасы

Үй өсімдіктері – адамға экологиялық, психологиялық және эстетикалық пайда әкелетін тіршілік иелері. Оларды дұрыс таңдап, жағдайына сәйкес күтіп-баптау арқылы ұзақ уақыт бойы әдемі әрі пайдалы жасыл кеңістік қалыптастыруға болады. Әр өсімдіктің жарық, суару, топырақ және температура талаптары әртүрлі екенін ескеру – сәтті күтімнің кілті .[1-5]

1. Өсімдіктерге сыртқы орта фактоларының әсері

1.1 Жарықтың әсері

Жарық — өсімдіктердің өсуі мен дамуы үшін ең маңызды фактор, себебі ол фотосинтез процесіне тікелей қатысады. Фотосинез арқылы өсімдіктер энергия алып, тіршілік процестерін қамтамасыз етеді. Жарық жетіспеген жағдайда өсімдік әлсіреп, жапырақтары сарғайып, өсуі баяулайды. Жарық табиғи (күн сәулесі) және жасанды (LED немесе люминесцентті лампалар) болып бөлінеді. Сонымен қатар, жарықтың ұзақтығы мен қарқындылығы әр өсімдікке әртүрлі әсер етеді — кейбіреулері көп жарықта, ал басқалары көлеңкеде жақсы өседі.[6,7]

1.2 Температура әсері

Температура өсімдіктердің өсуі мен физиологиялық процестеріне тікелей әсер етеді. Ол фотосинтез, тыныс алу, су сіңіру, гүлдеу және жеміс беру қарқындылығын анықтайды. Ең қолайлы температура — 15–30°C аралығы, ал тым суық не ыстық жағдайларда бұл процестер баяулап немесе тоқтап қалуы мүмкін. Жоғары температурада су тез буланып, өсімдік ылғал тапшылығына ұшырауы мүмкін. Ал төмен температурада су аз буланады, бірақ қатты суықта жасушалар зақымданады. Температураның күрт өзгеруі өсімдіктің өсуін баяулатып,

ауруларға төзімділігін төмендетеді. Әр өсімдіктің өзіне тән қолайлы температуралық режимі болады.[8,9]

1.3 Дыбыстың әсері

Дыбыстың өсімдіктерге әсері — тербеліс арқылы жүзеге асатын қызықты құбылыс. Өсімдіктер дыбысты естімесе де, ауадағы немесе топырақтағы тербелістерді сезіп, оған физиологиялық жауап береді. Дыбыс тербелістері өсімдіктің жасушаларында биохимиялық процестерді белсендіруі мүмкін, мысалы, өсу гормондарының бөлінуін арттырады. Классикалық музыка мен табиғи дыбыстар өсімдіктің өсуін ынталандыратыны анықталған. Ал керісінше, қатты шу немесе жиілігі жоғары дыбыстар өсімдікті күйзеліске ұшыратып, өсуін тежейді. Жоғары жиіліктегі дыбыстар пайдалы да, зиянды да әсер етуі мүмкін — бұл дыбыстың қарқындылығы мен ұзақтығына байланысты. Дыбыс тамыр жүйесінің бағытталуына және жапырақтардың қозғалысына да әсер етуі ықтимал. Жалпы, дыбыстық орта өсімдіктің тіршілік ету жағдайына ықпал етеді. Сондықтан пайдалы дыбыс толқындарын қолдану өсімдіктердің өсіп-жетілуіне жағымды әсер етуі мүмкін. [10-14]

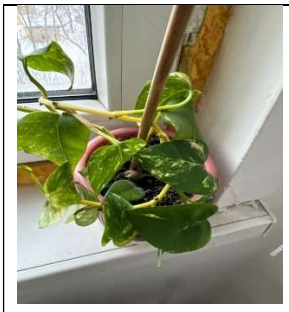
2. Зерттеу бөлімі

2.1 Зерттеу барысында пайдаланылған құралдар.

2025 жылғы 17 қаңтар мен 29 ақпан аралығында біз үй жағдайында өсірілген үш өсімдік түріне — Қарапайым жалбыз (Mentha spicata), Қолшатырлы сүттіген (Euphorbia umbrella) және Етті хойя (Hoya Carnosa) — күн сәулесі, температура және дыбыс сияқты сыртқы факторлардың әсерін зерттедік. Алғашқы өлшемдер 17 ақпанда алынды. Зерттеу үшін люксометр, смарт сағаттағы дыбыс өлшегіш және цифрлық термометр қолдандық. Люксометр жарық қарқындылығын люкс бірлігімен өлшейді және өсімдіктердің жарыққа қажеттілігін бағалауға мүмкіндік береді. Дыбыс деңгейін смарт сағаттағы арнайы қосымша арқылы өлшеп, оны дБ (децибел) бірлігінде белгіледік. Ал температураны цифрлық термометрмен өлшедік, ол ауа температурасын Цельсий шкаласымен дәл көрсетті. Осы құралдардың көмегімен біз сыртқы факторлардың өсімдіктердің дамуына әсерін бақыладық.

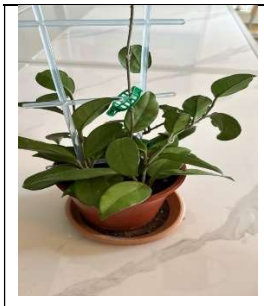
2.2 Зерттеу барысы

17.01.25 күні алғашқы зерттеу барысында өсімдіктердің жағдайы нашар болды: жапырақтары солып, топырағы құрғақ, түсі бозарған. Олар орналасқан университеттегі кабинет салқын және жарық жеткіліксіз еді. Температура -7°C, жарық деңгейі 169.7 люкс, ал дыбыс ырғағы 34 дБ болды. Суару барлық өсімдіктерге орта есеппен 8-9 күнде бір рет жүргізілді. Экспериментке дейінгі өсімдіктердің сыртқы көрінісі фото арқылы тіркелді.(1,2,3-суреттер)

		
1-сурет. Етті хойя(Мясистая Хойя- Hoya Carnosa)	2-сурет. Қолшатырлы сүттіген (Молочайка зонтичная-Euphorbia umbrella *L.*)	3-сурет. Қарапайым жалбыз (Mentha spicata)

29.01.25 күні өсімдіктер жылы әрі жарығы мол жерге ауыстырылды, ал дыбыс деңгейі өзгеріссіз қалды. Температура 15–20°C, жарық мөлшері 676 люкс болды. Хойяның жапырақтарындағы дақтар азайып, сабақтары жасылдана бастады, Молочайка зонтичный жапырақтары 4–5 см көтерілді, ал жалбыздың өсуі жақсарды.

14.02.25 күні өсімдіктердің орны өзгертілмей, тек жарық мөлшері 731 люксқа дейін арттырылды және дыбыс деңгейі сабақтардың басталуына байланысты 58–71 дБ аралығында болды. Температура 20°C шамасында сақталды, ал суару бұрынғыдай тұрақты қалды. Хойя өсімдігінің жағдайы толықтай жақсарып, жапырақтары қалыңдап, дақтар жойылды. Сабақтары жасылданып, тіке көтерілді. Молочайка зонтичный өсімдігі де толықтай қалпына келіп, жапырақтары қанық жасыл түске еніп, бойын тіктей бастады. Жалбыздың сарғайған жапырақтары жазылып, өзі орташа өлшемнен биік өсе бастады. Барлық өсімдіктердің жағдайы біршама жақсарғаны анық байқалды. (4,5,6-суреттер)

		
4-сурет. Етті хойя(Мясистая Хойя-Hoya Carnosa)	5-сурет. Қолшатырлы сүттіген (Молочайка зонтичная -Euphorbia umbrella *L.*)	6-сурет. Қарапайым жалбыз (Mentha spicata)

Өсімдіктің жақсы өсуі үшін суару, жарық, температура және дыбыс деңгейі маңызды рөл атқарады. Суару өсімдіктің тіршілігін қамтамасыз етсе, жарық фотосинтез процесі арқылы энергия береді. Температура өсімдіктің дамуына тікелей әсер етіп, оның өсу қарқынын реттейді. Шу деңгейі тым жоғары болса, өсімдіктердің өсуі баяулап, стресс жағдайы туындауы мүмкін. Сондықтан әр факторды дұрыс бақылау өсімдіктің сау әрі қарқынды өсуіне ықпал етеді.

Қорытынды

Зерттеу жұмысы барысында біз үй жағдайында өсірілген Хойя (Hoya carnosa), Молочайка зонтичный (Euphorbia umbellata) және Жалбыз (Mentha spicata) өсімдіктеріне қолайлы орта жағдайларын анықтадық. Әр өсімдік түрінің жарыққа, температураға және дыбыс деңгейіне деген қажеттіліктері әртүрлі екенін байқадық. Хойя үшін ең қолайлы температура 18–24°C аралығында болып, жарық мөлшері 1000–3000 люкс болуы тиіс, ал дыбыс деңгейі 30–50 дБ тыныштықта болғаны дұрыс. Молочайка зонтичный өсімдігі үшін 18–25°C температура, 3000–5000 люкс жарық және 60 дБ-дан аспайтын дыбыс қолайлы. Жалбызға 18–22°C температура, 1500–3000 люкс жарық қажет, ал дыбыс деңгейі 50–70 дБ аралығында болғаны дұрыс, алайда қатты шу теріс әсер етеді.

Зерттеу басында 17.01.2025 күні алынған алғашқы деректер бойынша өсімдіктер салқын (7°C), жарығы төмен (1256 люкс), тыныш бөлмеде орналасқан, бұл олардың солып, жапырақтарының сарғаюына әкелді. Кейін олар жылы жерге ауыстырылып, температура 20°C, жарық деңгейі 1600–2000 люкс, дыбыс шамамен 60–70 дБ болды. Осы өзгерістерден кейін өсімдіктердің өсуі қалпына келіп, жапырақтары жасарып, жалпы жағдайы жақсарды.

Бұл тәжірибе өсімдіктердің өсуі мен дамуы үшін сыртқы орта факторларының үйлесімділігі аса маңызды екенін дәлелдейді. Температура өсімдіктің физиологиялық процестеріне тікелей әсер етеді, ал жарық фотосинтез арқылы энергия көзі болып табылады. Дыбыс деңгейі өсімдіктерге аз зерттелгенімен, ол да биохимиялық процестерге ықпал етуі мүмкін. Қорытындылай келе, өсімдіктерді өсіру барысында жарық, температура, дыбыс және суару режимі бір-бірімен теңгерімді болуы қажет. Осындай үйлесімді орта өсімдіктердің сау, белсенді өсуін қамтамасыз етеді.

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Novel Multicomponent Anticancer Combinations and Their Potentiation with Copper Oxide Nanoparticles: Selective Cytotoxicity Against A549 Cells

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Abstract
The development of selective and less toxic anticancer therapies remains a significant challenge in oncology. In this study, four novel multicomponent anticancer combinations were evaluated

against human lung cancer A549 cells and compared with normal human dermal fibroblasts (NHDF). Cell proliferation and cytotoxicity were assessed using MTT assay, while apoptosis induction was evaluated via Annexin V-FITC/PI flow cytometry. Results demonstrated that all four combinations exerted marked cytotoxicity in A549 cells with limited effects on NHDF, in contrast to standard chemotherapeutics cisplatin and gemcitabine, which showed higher toxicity towards normal cells. Among the tested agents, sample 1 exhibited the most potent anticancer effect with the highest safety index. Furthermore, potentiation with copper oxide (CuO) nanoparticles significantly enhanced cytotoxicity and apoptotic induction, indicating a synergistic interaction and improved selectivity. These findings suggest that the tested combinations, particularly when formulated with CuO nanoparticles, represent promising candidates for further preclinical evaluation as safe and effective anticancer therapeutics.

Introduction

Lung cancer represents one of the most pressing global health challenges, accounting for nearly 1.8 million deaths annually, and continues to be the most lethal form of cancer worldwide (Bray et al., 2021). Among lung cancer subtypes, non-small cell lung cancer (NSCLC) constitutes approximately 85% of all diagnosed cases, with adenocarcinoma, squamous cell carcinoma, and large-cell carcinoma being the predominant histological forms (Travis et al., 2015). Despite improvements in diagnosis and treatment, the 5-year survival rate for advanced NSCLC remains below 20%, highlighting the need for innovative therapeutic strategies (Herbst et al., 2018).

Limitations of Conventional Chemotherapy

Platinum-based doublet therapy, particularly cisplatin combined with gemcitabine, has long been the standard of care in NSCLC (Ohe et al., 2020). However, its utility is severely constrained by systemic toxicities such as nephrotoxicity, neurotoxicity, and myelosuppression (Florea & Büsselberg, 2011). Additionally, tumor resistance mechanisms—including enhanced DNA repair, efflux pump overexpression, and apoptotic evasion—often diminish long-term efficacy (Galluzzi et al., 2012). These limitations have driven extensive research into alternative therapeutic modalities that maintain efficacy while reducing collateral damage to healthy tissue.

Evolution of Combination Therapies

The concept of drug combinations in oncology is not new; it was initially developed to overcome resistance and exploit complementary mechanisms of action (Chou, 2010). Modern multicomponent drug formulations, however, go beyond conventional combinations by rationally designing synergistic mixtures that target multiple hallmarks of cancer simultaneously. Such strategies can reduce effective doses of individual drugs, thereby limiting toxicity, and may also lower the probability of resistance development (Al-Lazikani et al., 2012). Recent advances in computational drug design and systems biology have enabled more precise selection of synergistic agents, enhancing the translational potential of combination approaches (Bulusu et al., 2021).

Targeting Cancer Selectively

One of the greatest challenges in cancer therapy is achieving selectivity: the ability to eradicate malignant cells while preserving normal tissues. Unlike conventional chemotherapeutics, which often act indiscriminately on rapidly dividing cells, multicomponent regimens may be tailored to exploit cancer-specific vulnerabilities such as aberrant signaling pathways, altered redox homeostasis, or defective DNA repair mechanisms (Hanahan & Weinberg, 2011). For example, combining drugs that simultaneously induce oxidative stress and inhibit antioxidant defenses may create lethal synthetic interactions in cancer cells that do not occur in normal counterparts (Trachootham et al., 2009).

Role of Apoptosis in Anticancer Strategies

Apoptosis, or programmed cell death, remains a central mechanism of action for most chemotherapeutics. Cancer cells frequently evade apoptosis through dysregulation of Bcl-2 family proteins, caspase signaling, and p53 activity (Elmore, 2007). Strategies that restore apoptotic

sensitivity—either through direct mitochondrial pathway activation or death receptor modulation—are crucial for effective treatment. Combination therapies that integrate apoptotic inducers with agents that impair compensatory survival signaling may offer particularly potent outcomes (Fulda, 2015).

Nanomedicine as a Transformative Tool

In parallel with advances in drug design, nanotechnology has revolutionized cancer therapy by enabling controlled and targeted drug delivery. Nanoparticles can accumulate preferentially in tumors via the enhanced permeability and retention (EPR) effect, thereby reducing systemic toxicity (Maeda et al., 2013). Moreover, nanoscale carriers allow co-delivery of multiple drugs, protecting labile compounds from degradation and facilitating synchronized release at the tumor site (Shi et al., 2017).

Among the wide range of nanomaterials explored, metal oxide nanoparticles have attracted considerable attention due to their unique physicochemical properties and inherent bioactivity. Copper oxide (CuO) nanoparticles, in particular, demonstrate direct cytotoxic effects via reactive oxygen species (ROS) generation and mitochondrial dysfunction, making them promising adjuncts in cancer treatment (Siddique et al., 2020). Importantly, CuO nanoparticles may synergize with chemotherapeutic agents by amplifying oxidative stress and apoptosis in malignant cells (Sankar et al., 2014; Giri at al., 2023; Bushira at al., 2023).

Rational Integration of Multicomponent Therapy with Nanoparticles

Integrating nanotechnology with rationally designed drug combinations represents a frontier in cancer therapy. Nanoparticles not only improve drug pharmacokinetics and biodistribution but may also contribute to direct cytotoxicity, creating opportunities for super-additive interactions (Torchilin, 2014). Moreover, nanoparticle-based delivery systems can be engineered for stimuli-responsive release, targeting the acidic tumor microenvironment or exploiting enzymatic activity unique to cancer tissues (Zhu & Chen, 2019).

Recent preclinical studies demonstrate that combining conventional chemotherapeutics with nanoparticles results in enhanced tumor regression and reduced systemic toxicity (Gupta et al., 2019). Furthermore, advances in surface modification allow nanoparticles to be functionalized with ligands for active targeting, such as antibodies or peptides, thereby increasing selectivity for malignant cells (Peer et al., 2020).

Relevance of A549 and NHDF Cell Models

The A549 lung adenocarcinoma cell line is one of the most widely used in vitro models for NSCLC research due to its stable growth characteristics and resemblance to human disease (Giard et al., 1973). Meanwhile, NHDF cells serve as an important control for assessing toxicity in non-cancerous human tissue, allowing evaluation of the therapeutic index. Comparing cytotoxicity across these two models provides valuable insights into the selectivity and safety of novel anticancer agents.

Rationale for the Present Study

In light of the challenges posed by conventional chemotherapy and the emerging opportunities in multicomponent and nanoparticle-assisted therapy, this study sought to evaluate four novel anticancer combinations in A549 cells, with parallel testing in NHDF cells to assess selectivity. We further investigated whether potentiation with CuO nanoparticles could enhance the cytotoxic and apoptotic efficacy of the most active candidate while minimizing off-target effects. This integrative approach addresses the dual challenges of efficacy and safety, offering a promising direction for the development of next-generation NSCLC therapies.

Extended Introduction (Part II)

Molecular Pathogenesis of NSCLC

The molecular landscape of NSCLC is heterogeneous, involving a variety of genetic and epigenetic alterations. Mutations in epidermal growth factor receptor (EGFR), KRAS, and ALK translocations are among the most clinically relevant aberrations, driving uncontrolled proliferation and survival (Collisson et al., 2014). Beyond these canonical drivers, aberrations in tumor suppressor genes such as TP53, LKB1, and PTEN contribute to malignant progression and therapy resistance (Campbell et al., 2016). Epigenetic alterations, including promoter hypermethylation of tumor suppressor genes and histone modifications, also play critical roles in disease pathogenesis and therapeutic resistance (Gonzalez et al., 2018).

Mechanisms of Chemoresistance

Resistance to cisplatin and gemcitabine is a major clinical obstacle. Mechanisms include enhanced DNA damage repair, particularly via nucleotide excision repair (NER) pathways, increased efflux transporter activity (e.g., P-glycoprotein, MRP family), and detoxification through glutathione conjugation (Galluzzi et al., 2012). Cancer stem cells (CSCs) also contribute to resistance by maintaining self-renewal and surviving under chemotherapy-induced stress (Saygin et al., 2019). Multicomponent drug combinations that simultaneously target DNA repair, efflux, and CSC signaling pathways may offer a solution to overcoming this resistance.

Tumor Microenvironment and Stromal Interactions

The tumor microenvironment (TME) plays a crucial role in shaping tumor growth and therapeutic response. Hypoxia, a common feature in NSCLC, drives angiogenesis through hypoxia-inducible factors (HIFs) and promotes epithelial-to-mesenchymal transition (EMT), enhancing metastasis and drug resistance (Semenza, 2013). Cancer-associated fibroblasts (CAFs) and tumor-associated macrophages (TAMs) further contribute by secreting growth factors, cytokines, and extracellular matrix (ECM) components that protect tumor cells from drug-induced apoptosis (Quail & Joyce, 2013).

Angiogenesis and Immune Evasion

Angiogenesis, predominantly mediated by VEGF, sustains tumor growth and provides routes for metastatic dissemination. Anti-angiogenic agents have shown benefits, but resistance develops due to compensatory angiogenic pathways (Carmeliet & Jain, 2011). Simultaneously, NSCLC tumors evade immune destruction by expressing PD-L1, which binds PD-1 on T cells, suppressing immune surveillance (Topalian et al., 2015). While immune checkpoint inhibitors (ICIs) have revolutionized NSCLC treatment, not all patients respond, underscoring the need for complementary strategies.

Oxidative Stress as a Therapeutic Target

Cancer cells maintain higher basal levels of ROS than normal cells, which promotes genomic instability but also renders them vulnerable to further ROS insults (Trachootham et al., 2009). Agents that amplify ROS generation or inhibit antioxidant defenses (e.g., glutathione, thioredoxin systems) selectively kill malignant cells. CuO nanoparticles are particularly effective in this context, as they catalyze Fenton-like reactions that elevate intracellular ROS to cytotoxic levels (Siddique et al., 2020).

Apoptosis vs. Necroptosis in Cancer Therapy

While apoptosis is a canonical mechanism of chemotherapeutic action, resistant tumor cells may disable apoptotic signaling pathways. In such contexts, necroptosis—a regulated necrotic cell death pathway mediated by RIPK1, RIPK3, and MLKL—represents an alternative therapeutic mechanism (Newton & Manning, 2016). Designing multicomponent regimens that exploit both apoptotic and necroptotic pathways could maximize tumor cell death while preventing escape mechanisms.

Nanocarrier Engineering for Cancer Therapy

Nanoparticle-based delivery platforms offer several advantages, including increased solubility of hydrophobic drugs, protection from enzymatic degradation, and tumor-targeted accumulation. Polymeric nanoparticles, liposomes, dendrimers, and inorganic nanoparticles each possess unique advantages (Shi et al., 2017). Surface functionalization with antibodies, peptides, or aptamers enhances active targeting, while stimuli-responsive systems allow triggered release in response to pH, enzymes, or redox gradients in the TME (Zhu & Chen, 2019).

Copper Oxide Nanoparticles in NSCLC Models

CuO nanoparticles possess inherent cytotoxicity due to ROS generation, mitochondrial damage, and induction of DNA strand breaks (Sankar et al., 2014). Studies have shown that CuO nanoparticles induce G2/M cell cycle arrest and potentiate apoptosis in NSCLC models (Applerot et al., 2012). Moreover, CuO nanoparticles can enhance the efficacy of existing chemotherapeutics by disrupting redox homeostasis and sensitizing resistant cancer cells (Siddique et al., 2020).

Translational and Clinical Perspectives

Despite encouraging preclinical findings, translation of nanomedicine and multicomponent therapies faces challenges including large-scale reproducibility, biocompatibility, and regulatory hurdles (Bobo et al., 2016). The immune system's recognition of nanoparticles and their clearance by the reticuloendothelial system remain critical limitations (Blanco et al., 2015). Nonetheless, the growing body of evidence supports the notion that rationally designed, nanoparticle-assisted multicomponent therapies may represent the next generation of precision oncology, particularly for difficult-to-treat cancers such as NSCLC.

Materials and Methods

Chemicals and Reagents

All chemicals and reagents used in this study were of analytical grade. Unless otherwise stated, reagents were procured from standard suppliers, including Merck (India), HiMedia (India), Invitrogen (India), SRL (India), and Sigma-Aldrich (USA). The fluorescent probe 2′,7′-dichlorodihydrofluorescein diacetate (DCFDA, Cat. #D6883, Sigma-Aldrich) was used for intracellular ROS detection. Fetal bovine serum (FBS, Cat. #16000044) was purchased from Gibco (USA). Dulbecco's Modified Eagle's Medium (DMEM) and Roswell Park Memorial Institute medium (RPMI-1640) were obtained from HiMedia (India). Antibiotics including penicillin (100 U/mL) and streptomycin (10 µg/mL) were added to culture media. Dimethyl sulfoxide (DMSO, ≥99.9% purity, Sigma-Aldrich) was used to dissolve MTT crystals. All solutions were prepared using sterile deionized water and filtered through 0.22 µm membranes before use.

Nanoparticle Synthesis and Characterization

Copper oxide (CuO) nanoparticles were synthesized using a chemical precipitation method, as described previously (Siddique et al., 2020), with slight modifications. Briefly, copper sulfate pentahydrate was dissolved in distilled water, followed by slow addition of sodium hydroxide under continuous stirring until black precipitates formed. The precipitates were collected, washed thrice with distilled water and ethanol, and dried at 60°C. The dried powder was calcined at 400°C for 2 h to obtain stable CuO nanoparticles.

Characterization of nanoparticles was performed using multiple techniques:

Particle size distribution and zeta potential were measured by dynamic light scattering (DLS; Malvern Zetasizer Nano ZS).

Morphology was assessed by transmission electron microscopy (TEM; JEOL 2100).

Crystallinity was confirmed by X-ray diffraction (XRD; Rigaku Ultima IV).

Surface chemistry was analyzed using Fourier-transform infrared spectroscopy (FTIR; Bruker Tensor 27).

Nanoparticles were sterilized by UV exposure before being dispersed in sterile phosphate-buffered saline (PBS) and sonicated for 15 min to avoid aggregation.

Cell Culture

Human lung adenocarcinoma cells (A549) and normal human dermal fibroblasts (NHDF) were purchased from the American Type Culture Collection (ATCC, USA). A549 cells were cultured in DMEM supplemented with 10% FBS, while NHDF cells were maintained in RPMI-1640 supplemented with 10% FBS. Both media were supplemented with 100 U/mL penicillin and 10 µg/mL streptomycin. Cultures were maintained at 37°C in a humidified incubator with 5% CO_2. Cells were sub-cultured at ~80% confluence using 0.25% trypsin-EDTA. Cell density and viability were routinely assessed by trypan blue exclusion using a hemocytometer.

Preparation of Treatment Solutions

Four experimental multicomponent anticancer combinations (samples 1–4) were prepared at stock concentrations of 10 mM in sterile PBS or DMSO (depending on solubility). Cisplatin (Sigma-Aldrich) and gemcitabine (Sigma-Aldrich) were used as reference drugs. Working dilutions were freshly prepared in culture media immediately before use. Final DMSO concentration in assays did not exceed 0.1% (v/v), a level that showed no cytotoxic effects in control experiments. For nanoparticle studies, CuO suspensions were mixed with the selected anticancer combination (sample 1) at varying concentrations, followed by 10 min of sonication to ensure homogeneity.

Cytotoxicity Assay (MTT)

Cell viability was assessed using the MTT assay, as described previously (Twentyman & Luscombe, 1987). Briefly, A549 and NHDF cells were seeded in 96-well plates at a density of 5×10^4 cells/well and allowed to adhere overnight. Cells were then treated with varying concentrations (0–500 µM) of test samples, reference drugs, or CuO-combined formulations for 48 h. After treatment, 20 µL of MTT reagent (5 mg/mL in PBS) was added to each well and incubated for 4 h at 37°C. The resulting formazan crystals were dissolved in 100 µL of DMSO per well, and absorbance was measured at 570 nm using a microplate reader (Bio-Rad iMark). Cell viability was expressed as a percentage relative to untreated controls. The IC_{50} value for each compound was calculated using nonlinear regression analysis (GraphPad Prism v9.0).

Apoptosis Assay (Annexin V-FITC/PI)

Apoptosis was quantified using an Annexin V-FITC/propidium iodide (PI) apoptosis detection kit (BD Biosciences, USA), following manufacturer instructions (Miller, 2004). A549 and NHDF cells were seeded in 6-well plates (1×10^6 cells/well) and treated with selected concentrations of test compounds, cisplatin, gemcitabine, or nanoparticle-enhanced formulations for 48 h. Following treatment, cells were harvested, washed twice with cold PBS, and resuspended in 100 µL of binding buffer. Cells were stained with 5 µL of Annexin V-FITC and 5 µL of PI and incubated at room temperature in the dark for 15 min. Data acquisition was performed on a BD FACSVersé flow cytometer, and analysis was conducted using FlowJo software (BD Biosciences). Early apoptotic (Annexin V+/PI–), late apoptotic (Annexin V+/PI+), and necrotic (Annexin V–/PI+) populations were quantified.

Intracellular ROS Measurement

Intracellular ROS levels were assessed using DCFDA staining. Cells were seeded in 6-well plates and treated as described above. Following treatment, cells were incubated with 10 µM DCFDA at 37°C for 30 min, washed with PBS, and analyzed by flow cytometry (excitation: 488 nm, emission: 530 nm). ROS levels were expressed as mean fluorescence intensity relative to untreated controls.

Statistical Analysis

All experiments were conducted in triplicate (n=3) and repeated at least twice independently. Data are presented as mean ± standard error of mean (SEM). Statistical significance was assessed using one-way ANOVA followed by Dunnett's multiple comparison test (GraphPad Prism v9.0). A p-value of <0.05 was considered statistically significant.

Results

Cytotoxicity of Multicomponent Combinations

To evaluate the anticancer potential of the four novel multicomponent formulations, cytotoxicity was first assessed using the MTT assay. All tested samples showed a dose-dependent inhibition of proliferation in A549 cells, while sparing normal NHDF cells to a significant extent.

Sample 1 was the most effective, reaching an IC_{50} of 56.82 ± 3.51 µM in A549 cells. In comparison, sample 2 displayed moderate cytotoxicity with an IC_{50} of 84.19 ± 2.89 µM, while samples 3 and 4 were less potent, with IC_{50} values of 225 ± 3.06 µM and 271 ± 2.65 µM, respectively. Importantly, none of the test compounds reached 50% lethality in NHDF cells at concentrations up to 700–900 µM, indicating a markedly improved therapeutic index relative to standard chemotherapeutics.

In contrast, cisplatin and gemcitabine exhibited significantly lower IC_{50} values in A549 cells (8.22 ± 2.05 µM and 6.26 ± 1.26 µM, respectively), confirming their potent cytotoxic activity. However, both drugs also demonstrated substantial toxicity in NHDF cells, with IC_{50} values of 26.39 ± 4.22 µM and 22.64 ± 3.72 µM, respectively. Calculation of the safety index (IS = LC_{50} NHDF / LC_{50} A549) showed that sample 1 achieved the highest IS value (≥12.3), outperforming both cisplatin (3.6) and gemcitabine (3.4). Samples 2–4 displayed intermediate IS values (≥8.3, ≥3.1, and ≥2.6, respectively).

$$IS = LC50_{NHDF} / LC50_{A549} \quad (1)$$

Experimental data of the ratio I for the test and reference sample sare given in Table 1.

Sample s	A.549	NHDF	I
1	56.82 ± 3.51	≥700	≥ 12.3
2	84.19 ± 2.89	≥700	≥ 8.3
3	225 ± 3.06	≥700	≥ 3.1
4	271±2.65	≥700	≥ 2.6
Gemcitabine	6.258 ± 1.26	22.64 ± 3.72	3.4
Cisplatin	8.22 ± 2.05	26.39 ± 4.22	3.6

Table 1. Comparative IC_{50} values and safety indices of test formulations versus reference drugs. Results of MTT assay of samples 1-4 in A549 (cancer cells), and NHDF cells (normal cell) using Cisplatin and Gemcetabine as a standard reference drugs. Each value represents mean ± SEM, n=3. One-way ANOVA was followed by Dunnett multiple comparison test.***(P<0.001) was interpreted as statistically significant, as compared with the control.

These findings strongly indicate that sample 1 possesses superior selectivity for malignant lung cancer cells, establishing it as the lead candidate for further mechanistic and nanoparticle-potentiation studies.

Apoptotic Induction by Multicomponent Combinations

To determine whether the observed cytotoxicity was mediated by apoptosis, Annexin V-FITC/PI dual staining followed by flow cytometry was performed. All four test samples induced apoptosis in A549 cells in a concentration-dependent manner, with a progressive shift from viable to early and late apoptotic cell populations.

Sample 1 exhibited the most pronounced apoptotic induction. Treatment with 25, 50, and 100 µM of sample 1 resulted in 37.88%, 68.89%, and 80.77% apoptotic cells, respectively, compared to 0.7% in untreated controls. In NHDF cells, the same concentrations caused minimal apoptosis (1.79%, 3.95%, and 12.43%, respectively), confirming preferential targeting of cancer cells.

Sample 2 also demonstrated strong apoptotic effects, with 40, 80, and 160 µM treatments yielding 49.83%, 51.83%, and 81.88% apoptosis in A549 cells. However, slightly higher toxicity was observed in NHDF cells relative to sample 1. Samples 3 and 4 induced apoptosis at higher

concentrations, with sample 3 reaching ~57% apoptosis only at 448 µM, while sample 4 achieved ~70% apoptosis at 540 µM.

By comparison, cisplatin (9 µM) and gemcitabine (16 µM) both induced apoptosis rates approaching 80% in A549 cells. However, this was accompanied by significant induction of apoptosis (~38%) in NHDF cells, underscoring their limited selectivity.

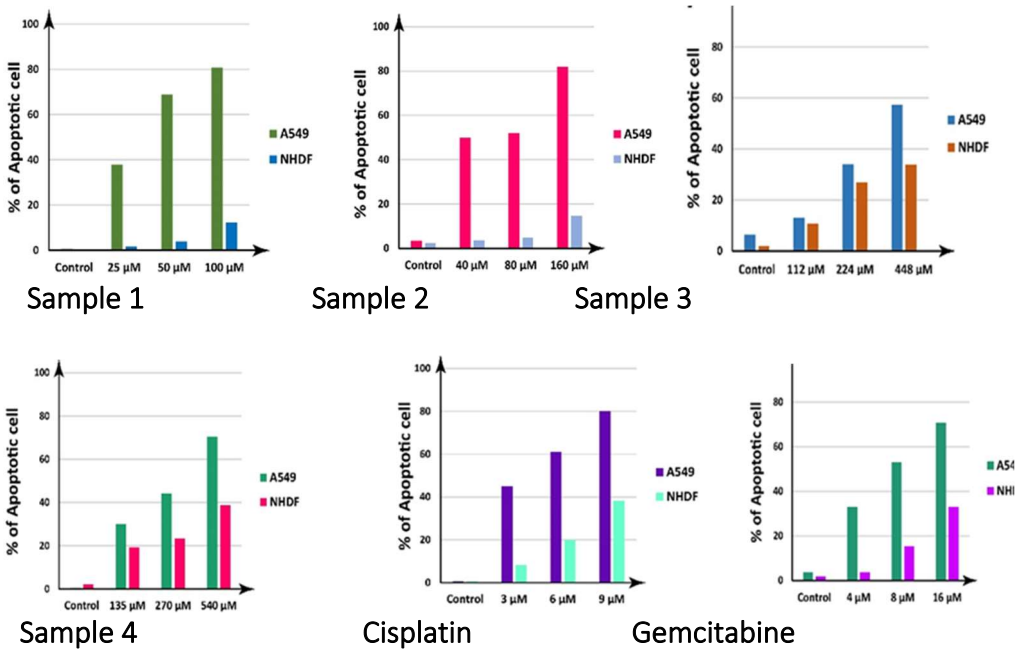

Figure 1. Annexin V-FITC/PI flow cytometric assay of samples 1 - 4, cisplatin and gemcetabine in A549 (cancer cells), and NHDF (normal cells).

Together, these results confirm that the anticancer activity of the new formulations is mediated by induction of programmed cell death, with sample 1 achieving a favorable balance of efficacy and safety.

Potentiation with CuO Nanoparticles

To further enhance the anticancer effects, sample 1 was formulated with copper oxide (CuO) nanoparticles at four different concentrations. MTT assays revealed that the combination significantly reduced IC_{50} values in A549 cells compared to sample 1 alone. For example, sample 1-1 exhibited an IC_{50} of 132.3 ± 4.23 ng, with negligible effects on NHDF cells (LC_{50} ≥ 2.16 ± 0.39 µg). Other formulations (1-2, 1-3, 1-4) displayed similar trends, with safety indices ranging from 4.8 to 16.3. These values were markedly higher than those observed for cisplatin and gemcitabine, whose IS values were 4.1 and 4.2, respectively.

Annexin V-FITC/PI analysis confirmed that CuO-potentiated formulations induced robust apoptosis in A549 cells at lower concentrations than sample 1 alone. Apoptotic rates of >70% were observed even at mid-range doses, whereas NHDF cells remained largely unaffected.

Sample s	A.549, ng	NHDF, µg	Is
1-1	132.3 ± 4.23	2.16 ± 0.39	16.3
1-2	180 ± 2.33	2.23 ± 0.22	12.4
1-3	120.56 ± 2.25	1.96 ± 0.29	5.1
1-4	380.79 ± 3.35	1.83 ± 0,35	4.8
Cisplatin	340.61 ± 5.39	1.41 ± 0.18	4.1
Gemcitabine	320.11 ± 5.33	1.33 ± 0.26	4.2

Table 2. Results of MTT testing of four samples potentiated with copper oxide nanoparticles in comparison with cisplatin and gemcitabine

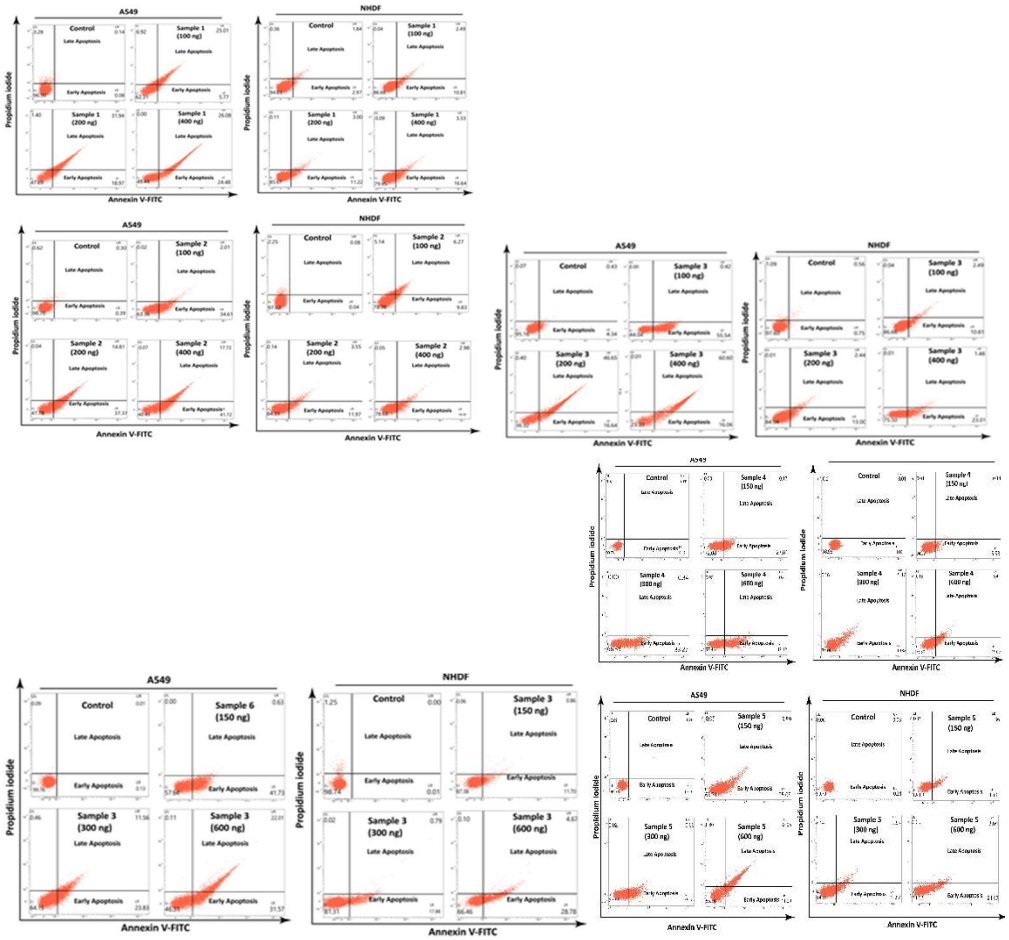

Figure 2. Results of the AnnexynV-FITZ/PI testing of the four newly developed combinations, cisplatin and gemcitabine potentiated with copper oxide nanoparticles.

These results strongly suggest that incorporation of CuO nanoparticles enhances intracellular delivery and synergistically amplifies the cytotoxic and apoptotic properties of the novel formulation.

Intracellular ROS Generation

Since CuO nanoparticles are known to exert cytotoxicity through ROS production, intracellular ROS levels were quantified using DCFDA staining. Treatment with sample 1 alone modestly increased ROS in A549 cells in a dose-dependent manner, while NHDF cells exhibited minimal ROS elevation. When CuO nanoparticles were incorporated, ROS levels rose significantly in A549 cells, correlating with the enhanced apoptotic response. In contrast, NHDF cells maintained near-baseline ROS levels, confirming selective oxidative stress induction in cancer cells.

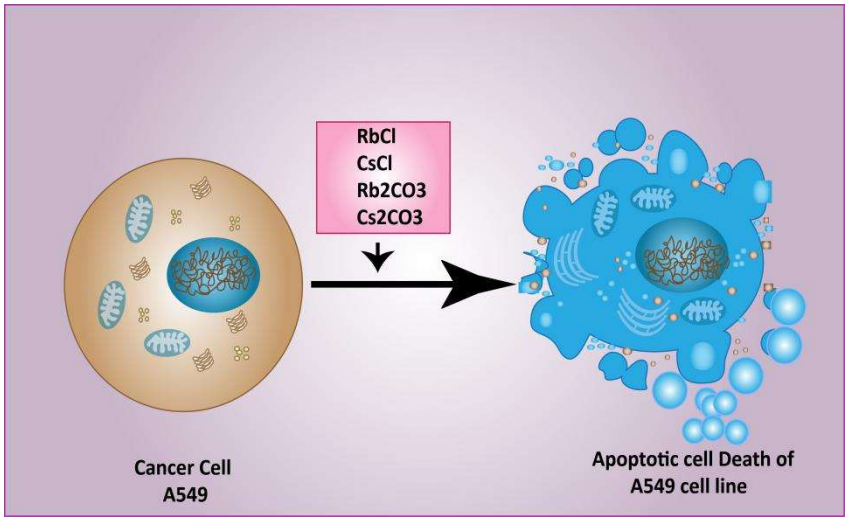

Figure 3. Intracellular ROS generation in A549 and NHDF cells treated with sample 1

alone, CuO-potentiated sample 1, and reference drugs.

Summary of Findings

Multicomponent cytotoxicity: All four samples inhibited A549 proliferation, with sample 1 showing the strongest effect and highest safety index.

Apoptotic mechanism: Flow cytometry demonstrated dose-dependent apoptosis induction, with minimal effects in NHDF cells compared to cisplatin and gemcitabine.

Nanoparticle potentiation: CuO incorporation significantly enhanced cytotoxic and apoptotic effects of sample 1, improving the safety index beyond standard chemotherapeutics.

ROS dependence: The enhanced efficacy of nanoparticle-potentiated formulations was linked to increased ROS generation in cancer cells, confirming a mechanistic contribution of oxidative stress.

Discussion

Selectivity of Multicomponent Formulations

The present study demonstrates that the tested multicomponent anticancer combinations display selective cytotoxicity towards A549 lung adenocarcinoma cells while exerting minimal effects on normal NHDF fibroblasts. Among these, sample 1 emerged as the most promising candidate, with an IC_{50} of 56.82 µM and a safety index ≥12.3, significantly outperforming standard chemotherapeutics cisplatin and gemcitabine. This observation supports the hypothesis that rationally designed multicomponent therapies may achieve enhanced selectivity by targeting cancer-specific vulnerabilities while sparing healthy tissues (Al-Lazikani et al., 2012).

Unlike conventional agents that act broadly on proliferating cells, the multicomponent formulations likely exert a multifaceted mode of action, involving oxidative stress modulation, apoptosis induction, and disruption of key signaling pathways. This multi-targeted profile may explain the improved therapeutic window observed in vitro.

Apoptotic Mechanisms and Implications

Apoptosis remains the cornerstone of anticancer strategies. Flow cytometry revealed that all tested samples induced apoptosis in a concentration-dependent manner, with sample 1 achieving >80% apoptosis at 100 µM in A549 cells. Importantly, apoptosis in NHDF cells remained minimal, highlighting preferential targeting.

This finding is consistent with prior studies showing that lung cancer cells harbor intrinsic vulnerabilities in apoptotic regulation, including Bcl-2 family protein imbalance and p53 dysfunction (Youle & Strasser, 2008). Restoration or induction of apoptosis in NSCLC is therefore a critical therapeutic goal (Fulda, 2015). Compared with cisplatin and gemcitabine, which triggered substantial apoptosis in both malignant and normal fibroblast cells, the selective apoptotic profile of the new formulations underscores their clinical promise.

Role of Oxidative Stress and ROS Modulation

One mechanistic contributor to the selective cytotoxicity of sample 1 may be oxidative stress. Cancer cells exist in a state of elevated basal ROS, which promotes genomic instability yet simultaneously creates a therapeutic vulnerability (Trachootham et al., 2009). Agents that increase ROS levels beyond the threshold of tolerance preferentially induce apoptosis in malignant cells while sparing normal counterparts.

Our observation that CuO nanoparticle incorporation further elevated ROS generation in A549 cells while maintaining baseline ROS in NHDF cells provides strong mechanistic evidence of ROS-mediated selectivity. This aligns with reports that CuO nanoparticles generate intracellular ROS via Fenton-like redox cycling, leading to mitochondrial dysfunction and DNA damage (Siddique et al., 2020; Sankar et al., 2014).

Potentiation by Copper Oxide Nanoparticles

The incorporation of CuO nanoparticles markedly enhanced the cytotoxic and apoptotic effects of sample 1, increasing the safety index up to 16.3, well above standard drugs. This potentiation likely

reflects a dual contribution: (i) direct ROS-mediated cytotoxicity of CuO nanoparticles and (ii) improved delivery, uptake, and intracellular accumulation of the multicomponent formulation.

Nanoparticle-based delivery has been widely shown to improve drug solubility, prolong circulation time, and promote tumor accumulation via the enhanced permeability and retention (EPR) effect (Maeda et al., 2013). Moreover, metallic nanoparticles such as CuO possess inherent cytotoxicity that synergizes with co-delivered agents (Applerot et al., 2012). In our study, these synergistic interactions clearly amplified both cytotoxic and apoptotic effects, consistent with the super-additive outcomes reported in prior nanomedicine research (Shi et al., 2017).

Comparison with Conventional Chemotherapy

Standard chemotherapeutics remain effective in NSCLC but are plagued by systemic toxicity and resistance. Cisplatin and gemcitabine demonstrated strong activity in A549 cells in our assays, but at the cost of high NHDF apoptosis (~38%), reflecting their well-known off-target toxicity (Florea & Büsselberg, 2011). In contrast, sample 1 and its CuO-enhanced formulation achieved similar or higher levels of tumor apoptosis with markedly reduced toxicity in normal cells.

This differential response underscores a key advantage of the new formulations: by integrating multiple agents into a synergistic cocktail, they achieve effective tumor cell killing without the indiscriminate damage associated with monotherapies. This feature is particularly valuable in lung cancer, where comorbidities and frailty often limit patient tolerance to intensive chemotherapy (Herbst et al., 2018).

Relevance to NSCLC Therapeutics Landscape

The current therapeutic landscape for NSCLC has evolved rapidly, with targeted therapies (EGFR, ALK, ROS1 inhibitors) and immune checkpoint inhibitors (anti-PD-1/PD-L1) transforming clinical outcomes in subsets of patients (Topalian et al., 2015; Collisson et al., 2014). However, resistance inevitably develops, and many patients lack actionable mutations or fail to respond to immunotherapy (Campbell et al., 2016). Thus, chemotherapy remains indispensable in frontline and salvage settings.

Our findings suggest that multicomponent and nanoparticle-assisted strategies could provide a middle ground between conventional chemotherapy and precision medicine approaches. By combining multiple agents into rationally designed formulations and enhancing delivery via nanotechnology, it may be possible to achieve durable efficacy in a broader range of patients while minimizing toxicity.

Potential Mechanisms of Resistance and How They May Be Overcome

Resistance to chemotherapy often arises from enhanced DNA repair, drug efflux, and apoptotic evasion (Galluzzi et al., 2012). Multicomponent formulations may circumvent these mechanisms by targeting multiple pathways simultaneously. For instance, combining agents that both induce oxidative stress and inhibit antioxidant defenses may overwhelm cancer cells' adaptive capacity (Trachootham et al., 2009). Similarly, nanoparticle delivery can bypass efflux pumps by enabling endocytotic uptake, thereby increasing intracellular drug accumulation (Blanco et al., 2015).

Translational Challenges and Considerations

While the preclinical findings are highly encouraging, translation to clinical application requires addressing several hurdles. Nanoparticle stability, large-scale reproducibility, biodistribution, and long-term toxicity remain areas of concern (Bobo et al., 2016). Regulatory pathways for nanoparticle-based drugs are also evolving, requiring rigorous demonstration of safety, consistency, and efficacy.

Another challenge is inter-patient heterogeneity in tumor biology and microenvironment, which may influence nanoparticle uptake and therapeutic response. Personalized nanoparticle formulations or combination regimens tailored to molecular subtypes of NSCLC may represent a future direction (Bulusu et al., 2021).

Future Directions

Future research should focus on validating these findings in vivo, using xenograft and syngeneic lung cancer models to evaluate pharmacokinetics, biodistribution, and tumor selectivity. Assessing systemic toxicity, especially potential hepatic and renal accumulation of CuO nanoparticles, will be critical. Moreover, combining multicomponent/nanoparticle formulations with immunotherapies may yield additive benefits by promoting immunogenic cell death and enhancing antitumor immunity (Galluzzi et al., 2017).

Finally, clinical translation may benefit from nanoparticle surface functionalization with tumor-targeting ligands (e.g., antibodies against EGFR or PD-L1) to maximize selectivity and efficacy (Peer et al., 2020).

Conclusion

This study highlights the potential of rationally designed multicomponent anticancer combinations as selective and effective treatments for NSCLC. Among the tested agents, sample 1 exhibited superior anticancer activity, inducing robust apoptosis in A549 cells while sparing NHDF fibroblasts. Incorporation of CuO nanoparticles further enhanced efficacy and selectivity, confirming the synergistic potential of nanotechnology-based delivery.

These findings align with and extend prior reports on the role of combination therapy and nanomedicine in overcoming the limitations of conventional chemotherapy. While further in vivo and clinical studies are warranted, the results strongly support continued development of multicomponent, nanoparticle-potentiated regimens as next-generation therapies for lung cancer.

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Philosophical Sciences

FROM JASPERS TO NIETZSCHE: PHILOSOPHY OF EXISTENCE IN VISUAL REPRESENTATION

Petra Cepková
Barbora Kováčová

Abstract
The study explores the connections between the philosophy of existence and documentary photography. It draws on the concepts of prominent thinkers such as Karl Jaspers, Martin Heidegger, Gilles Deleuze, Friedrich Nietzsche, Emmanuel Levinas, Roland Barthes and Susan Sontag. It analyses how their ideas translate into the visual medium. Documentary photography is understood here not only as an aesthetic record, but above all as a space of confrontation with borderline situations, an ethical appeal, and a visual testimony to human dignity and vulnerability. In the text, the authors address the issues of altruism and egoism in social relations and their visualisation through the photographic image, which oscillates between an aesthetic reception and a call for engagement. The final section presents the possibility of linking documentary photography with action art as a strategy of social participation and reflection.

Keywords:
Philosophy of existence, visual imagery, documentary photography

Introduction

The philosophy of existence offers a valuable framework through which to analyse the power and effect of the photographic image. The thought of authors such as Karl Jaspers, Martin Heidegger, Friedrich Nietzsche, Gilles Deleuze, Emmanuel Levinas and Roland Barthes opens up diverse perspectives on questions of being, suffering, ethics and identity. Their concepts allow us to see photography not only as an aesthetic artefact, but above all as a medium of confrontation - whether with borderline situations, with the otherness of the other, or with one's own finitude. Reflections on altruism and egoism take on special significance in this context, revealing the complex motives of human behaviour and their visual reflections in social space. Documentary photography here acts as a medium that oscillates between aesthetic reception and ethical appeal, and can stimulate not only individual reflection but also wider social engagement. The aim of the text is therefore to show how philosophical concepts of existence and ethics intersect with the practice of documentary photography, and to highlight its potential as a tool for knowledge, reflection and social change.

From Jaspers to Nietzsche

Karl Jaspers elaborated the concept of borderline situations (*Grenzsituationen*), which represent the inevitable experiences of life-death, suffering, guilt and loneliness - that every human being must confront (Jaspers, 1938). These moments create a space for authentic existence and self-knowledge. In documentary photography, for example, images depicting abandoned children in asylums evoke precisely these borderline situations - they become an invitation for the viewer to

reflect on his or her own existence and social responsibility.
In *Being and Time* (1927), Martin Heidegger introduced the concept of *Dasein* to describe human being as being-in-the-world. Heidegger's analysis emphasises that human existence is always temporally and situationally bounded, with anxiety and confrontation with death being central to understanding one's own being (Heidegger, 2008). Documentary photography, which depicts moments of anxiety, loneliness or abandonment, can therefore act as a visual appeal to the awareness of the finitude of life.
Gilles Deleuze, in works such as *Difference and Repetition* (1968) or *What is Philosophy?* (Deleuze & Guattari, 1994) emphasise being as a dynamic process of becoming. His philosophy shatters traditional, fixed identities and emphasises the constant creation of self and world. In the context of documentary photography, this means that the people depicted are not just 'fixed objects' but subjects in motion - evolving, changing and experiencing different life stories.
Friedrich Nietzsche criticised the static nature of moral and social norms and promoted the idea of constantly transcending oneself and creating one's own values (Nietzsche, 1883-1885). His concept of the will to power and the ideal of *the Übermensch* encourage the search for inner strength despite suffering and chaos. Documentary photography, which often depicts marginalised individuals, can thus be seen as a visual testimony to the power and persistence of human dignity.
Emmanuel Levinas stresses the primacy of ethics over ontology in his philosophy. For him, the encounter with the Other - especially through the face - is the fundamental experience that commits us to responsibility (Levinas, 1961). Documentary photography, which often captures the immediate gaze of the sitter, can thus be interpreted as an ethical appeal. The gaze of an institutionalised child or the face of a person suffering from poverty becomes a memento that confronts the viewer with his or her own obligation to another.
Roland Barthes, in his publication *Camera Lucida* (1980), distinguishes between *the studium,* the general cultural interest - and the *punctum*, the point that personally affects the viewer, "pierces" him. Documentary photography has the potential to create such a *punctum* because it awakens a deeply existential response in the details - the hand gesture, the eye gaze or the environment. In this way, photography becomes a medium that can link individual experience to universal questions of being. Susan Sontag, in her work *On Photography* (1977), draws attention to the ambivalence of the photographic image. On the one hand, photography can humanise and evoke compassion, but on the other hand, it can also aestheticise suffering and thus neutralise its impact. In the context of a philosophy of existence, it is therefore important to examine whether documentary images lead to an authentic understanding of the other or whether they become mere 'consumption' of the other's suffering.

Motivations for human behaviour and existence

Questions of the motivation of human behaviour - whether one is primarily egoistic or altruistic - are fundamental to an understanding of social relations and solidarity. In his book *The Selfish Gene* (1976/2018), Richard Dawkins explains that even altruistic behaviour can have an evolutionary basis. Phenomena such as *kin selection* or reciprocity allow even behaviour that at first glance appears altruistic to become advantageous in terms of gene survival and reproduction. From this point of view, altruism is not the opposite of egoism, but a subtle form of it that, in the long run, strengthens group cooperation and survival.
Adam Smith, in *The Wealth of Nations* (1776/1977), pointed out that individuals pursuing self-interest can contribute indirectly to the common good through the 'invisible hand of the market'. But already in his lesser-known work *The Theory of Moral Sentiments* (1759), he pointed out that morality, empathy and justice are essential for sustainable social relations. The combination of self-interest and the moral dimension shows that man is a being capable of acting not only out

of calculation but also out of authentic solidarity.

In the context of documentary photography, these theoretical frameworks take concrete form. Photography that reveals social inequalities, poverty or marginalised groups (Rassu Nagy, 2018) functions not only as a mirror of reality but also as an appeal for social participation. As Susan Sontag points out in *On Photography* (1977), images of suffering have the power to evoke empathy, but they also carry the risk of aestheticising or dulling the viewer's sensibilities. It is therefore the responsibility of both photographer and recipient to ensure that the image is not merely an object of passive consumption, but a trigger for social engagement.

Documentary photography thus oscillates between the egoistic enjoyment of the aesthetic perception of the image and the altruistic imperative to act. By depicting the faces of people on the margins of society, their everyday struggles and vulnerabilities, it creates a space (Rassu Nagy, 2018) where philosophical questions of altruism and egoism are translated into concrete ethical decisions. Photography becomes a tool for social participation - inviting the viewer to reflect not only on their own place in the world, but also on their responsibility towards others.

Conclusion

Reflection on documentary photography shows that this medium cannot be understood as a passive record of reality. Combined with philosophical concepts of existence, ethics and social participation, it becomes an active tool that mediates the experience of borderline situations and raises questions of responsibility, solidarity and human dignity. The photograph visualizes the tension between egoism and altruism, between aesthetic pleasure and ethical appeal, leading the viewer to reflect on his or her existence and on the social structures that shape the lives of the subjects depicted. In conjunction with action art, an even wider space for dynamic expression and social engagement is opened up, whereby documentary photography transcends the boundaries of the artistic medium and takes on the character of a vehicle for social change.

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Роль ноонаук у порятунку людства і перспективи нооархеології

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Анотація. *Доведено факт перебування людства в стані розпачу і неспроможності обрати шлях порятунку та відвернення небезпек традиційних і консієнтальних війн. Нагадано про досліджені нами три світові меганоореволюції. Вони рятують людство через використання екологічно ідеальних ноонаук і ноотехнологій. Стаття пояснює поняття «нооархеології» як молодої точної науки, що формує правильне уявлення про прадавнє минуле і разом з нооісторією розпочала рятувати людство від океану міфів і свідомої брехні про появу і розвиток народів. Ми пропонуємо ноонауки для вирішення національних і глобальних проблем.*

Ключові слова: *криза людства, три ноореволюції, засоби порятунку, ноонауки і ноотехнології, нооархеологія як точна наука, її використання*

Korsak K., Korsak Y. **The role of noosciences in saving humanity and the prospects of nooarchaeology**

Abstract. *The fact that humanity is in a state of despair and inability to choose the path of salvation and avert the dangers of traditional and conscientious wars is proven. We recall the three world meganoorevolutions studied by us. They save humanity through the use of ecologically ideal noosciences and nootechnologies (wisesciences & wisetechnologies). The article explains the concept of "nooarchaeology" as a young exact science that forms the correct idea of the ancient past and, together with noohistory, began to save humanity from the ocean of myths and deliberate lies about the emergence and development of peoples. We offer noosciences to solve national and global problems.*

Keywords: *crisis of humanity, three noorevolutions, means of salvation, noosciences and nootechnologies, nooarchaeology as an exact science, its use*

1.Вступ

Сьогодні понад вісім мільярдів подвійно розумних Homo (надалі — HSS) перебувають не просто у кризі, а в тотальному розпачі. Всі відомі нам твори зарубіжних футурологів та рішення наднаціональних форумів, конгресів, конференцій і великих зібрань керівників держав, провідних політологів, економістів, філософів, журналістів й представників багатьох наук констатують рух людства до загибелі у формі «Колапсу-XXI», складають переліки і рейтинги загроз, закликають до єдності та боротьби з ними, але обмежуються пропозиціями збільшувати національні парки, берегти тропічні ліси й розвивати «позеленіння» без вказівки на існування екологічно ідеальних ноотехнологій як шляху до порятунку на їх основі. Вже чверть століття ми поширюємо нооінформацію, але не досягли визнання її існування і правдивості (виняток — позиція НАН України, яка оприлюднила нашу статтю [1]). Нам банально не вірять у те, що можливі процеси, які надають людям потрібне для якісного

життєзабезпечення й одночасно виліковують довкілля від індустріальних та інших пошкоджень.

Ми оприлюднили сотні матеріалів з детальними поясненнями рятівних ноонаук і ноотехнологій. Остання публікація містить пропозицію поняття «***нооекономіка***» і детально пояснює використання у ній наявних і перспективних ноонаук і ноотехнологій [2]. Наш подальший текст продовжує розпочате там дослідження у напрямі використання можливостей нової точної науки, яку пропонуємо називати «***нооархеологія***», що має великий потенціал для вирішення найскладніших проблем людства.

Мета, завдання, методологія, джерела, результати. **Мета** полягає не тільки у поясненні факту перебування людства у розпачі та безнадії через відмову від використання ноотермінів та у переконаності в неможливості створення екологічно ідеальних ноопроцесів, а й у створенні ноосхеми еволюції і прогресу HSS.

Завдання ми вбачаємо в пропозиції нового наукового поняття «***нооархеології***» як молодої та перспективної точної науки, що зростає у XXI ст. на основі досягнень багатьох природничих наук в ізотопних та інших методах вимірювання віку артефактів разом з секвенуванням (дешифруванням) ДНК та інших білків їх органічної складової.

У **методології** ми спираємося на всі відомі досягнення наших попередників, насамперед — на пораду історика-француза Ф. Броделя (1902-1985) аналізувати розвиток великих систем на основі всіх знань HSS, а не однієї чи двох академічних наук.

Нашими ***джерелами*** є багато тисяч новітніх творів, адже постійно на відомих мовах і в доступній інформації відстежуємо головні наукові відкриття й технологічні інновації. Наші досягнення легко розшукати в Інтернеті. Концентровано їх містить створена нами нооенциклопедія **Nooglossary** ([3; 4] та інші) з сотнями «ноотермінів з майбутнього».

У своїх сподіваннях щодо **результатів** появи цієї статті ми не чекаємо негайного успіху та «світової слави», адже історія наук свідчить про початкове відторгнення й повільність сприйняття і поширення тих світоглядних і виробничих інновацій, **що набагато випереджають свій час**.

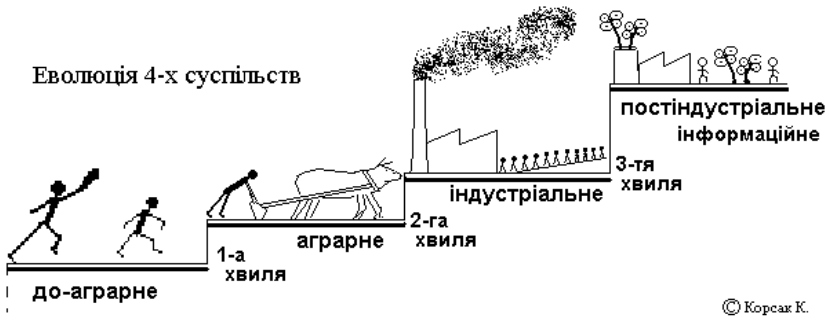

Рис. 1. Е. Тоффлер відтворює еволюцію людства як зміну трьох цивілізаційних хвиль

Набагато точнішими (на думку студентів) виявилися створені нами схеми еволюції людства з врахуванням новітніх наукових досягнень — світових, українських і власних. Запропонуємо найновішу — рис. 2.

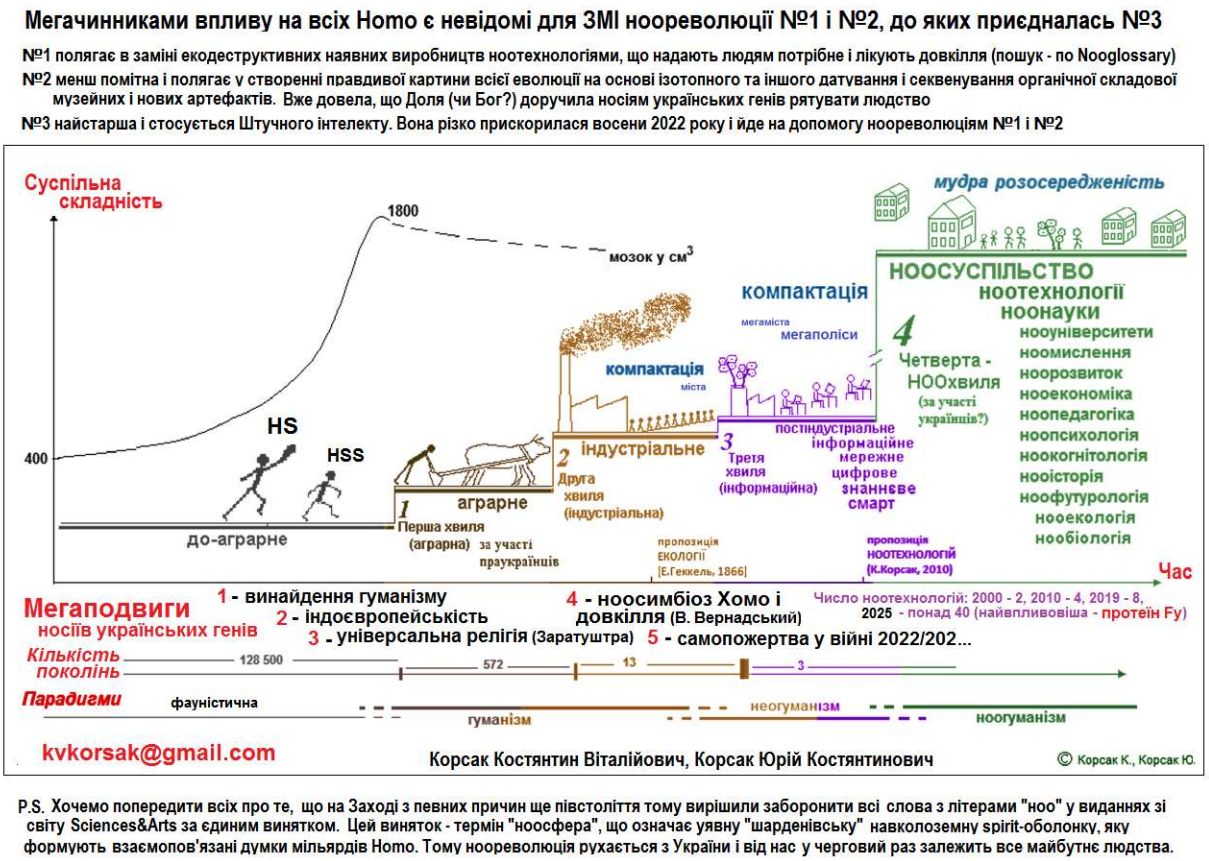

Рис. 2. Правдива схема еволюції HSS з нооінформацією для психозахисту українців (серпень 2025 року)

Феноменальною відмінністю ноотехнології від усіх відомих інших є те, що вони не порушують природні процеси й надають людям все потрібне разом з усуненням індустріальних пошкоджень біосфери. З групи понад 40 відомих нам ноотехнологій позицію №1 ми віддаємо бактеріальній ноотехнології з назвою «***протеїн Fy***», що у найближчі роки цілком спроможна назавжди ліквідувати і білковий голод, і все індустріальне тваринництво, яке дає змогу Homo щосекунди з'їдати приблизно 3400 теплокровних живих істот, багато з яких впізнають себе у дзеркалі (отже, можуть мати свідомість). Зникне також більша частина всього аграрного сектора економіки, яке обслуговує тваринництво.

Загалом кількість нових ноотехнологій зростає практично щомісяця, хоч їх не визнають офіційно, не включають в державні плани і не скеровують значні ресурси на їх цілеспрямований розвиток. Але ми лишаємося оптимістами і переконані в тому, що в найближчі роки вони, а не «боротьба з глобальним потеплінням», стане світовим пріоритетом. Твердження про його страшну шкідливість є міфом.

Закінчуючи цей підрозділ, запрошуємо читачів звернути увагу на верхнє частину рис. 2, на якому акцентовано чергове наше значне відкриття — доведення розвитку на планеті у новому столітті трьох грандіозних «**мегаореволюцій**» — **виробничої** (**№1**), **гуманітарної** (**№2**) і **вдосконалення Штучного інтелекту** (**№3**). Сукупно вони вже розпочали змінювати «*абсолютно все*». Зробимо наголос на тому, що головну роль у порятунку людства від Колапсу-XXI відіграє «економічна» ноореволюція №1, а в її межах — поширення бактеріальної ноотехнології «протеїн Fy» та інших подібних.

Але поза матеріальним виробництвом існує грандіозна за обсягом знань і значення «гуманітарна сфера» — сукупність багатьох гуманітарних наук, світоглядних і релігійних уявлень, колективних та особистих цінностей і моральних переконань, мов і мистецтв та

всього іншого, чим HSS вирізняється серед інших істот у біосфері. Реально майбутнє людства залежатиме не тільки від матеріального життєзабезпечення на основі біологічних та інших ноотехнологій, а й від поведінки мільярдів людей всіх народів і племен.

Тому ми пропонуємо звернути особливу увагу на успіхи нооархеології, що спроможна допомогти усвідомленню і вирішенню політичних, релігійних та інших проблем і суперечностей.

3. Розкопки в Гебеклі-Тепе — початок революції в археології

Сукупність новітніх знань, які ми пропонуємо називати «***нооархеологією***», є наслідком багатьох відкриттів у точних науках та втілення їх у вимірювальній апаратурі. Її використання дало змогу ізотопними та кількома іншими методами отримувати порівняно точні дані про вік археологічних артефактів разом з секвенуванням (дешифруванням) ДНК та інших білкових сполук в їх біологічних складових. Хоч ізотопні виміри розпочалися ще в XX ст., але пропонуємо початком народження нооархеології вважати 2010-й, коли швед Сванте Паабо дешифрував геном неандертальців.

Ми вважаємо цю дату і успіх С. Паабо початком революції в археології, початком перетворення її в точну науку як джерело надійних — аналогічно до законів фізики — знань про Prehistory, правди про походження народів і націй, культур і релігій.

Проведемо аналогію між науковими революціями у фізиці й археології. У першій головна наукова революція розпочалася в 1896 році й зумовили формування знань про квантовий світ, атоми, їх складові елементи, структури найменших частинок тощо. Тієї весни француз А. Беккерель (1852-1908) у процесі вивчення випромінювання з різних об’єктів відкрив явище радіоактивності урану й інших важких елементів. Активна праця зумовила появу серії статей, що спонукали приєднання до досліджень багатьох науковців світу. Вони мали наслідком відкриття ядра, електронних оболонок, ядерної енергії і великого світу квантових явищ, які неможливо було пояснити на основі класичної механіки і всіх математичних досягнень.

Наголосимо на тому, що ніхто не заперечив дослідів А. Беккереля, не звинуватив у шарлатанстві чи у спробах «наукового фантазування». Його досліди кожен міг повторити ще раз, провести точніші спостереження й отримати кращі результати.

А от в археології все сталося інакше, хоч початок революції був аналогічним — у 1996 р. археолог-німець К. Шмідт (1953-2014) почав досліджувати «аномальний» горб Гебеклі-Тепе у Східній Туреччині. Практично одразу він виявив у ньому мегалітичні конструкції кільцевої форми, які він спершу називав «огорожами» й детально описував у своїх публікаціях ([6] та ін.). Схематичне відтворення «огорож» наведено на рис. 3 разом з вказівкою на територіальне розташування Гебеклі-Тепе.

Рис. 3. Загальні дані про горб Гебеклі-Тепе й конструкцію Кільцевих мегалітичних арен (КМА) на ньому

Отримані матеріали без зволікань були скеровані в лабораторії для визначення віку знахідок ізотопними методами. Результати спричинили початок революції в археології й мали глобальні наслідки.

Виміри засвідчили, що перша Кільцева мегалітична арена (надалі — КМА) була споруджена приблизно 13 500 років тому в часи неоліту й за багато-багато сотень років до початку одомашнення злаків і дрібних копитних. Спершу практично ніхто не йняв віри тому, що вік КМА виявився таким великим і одразу заперечив всі усталені описи Стародавнього Світу з цивілізаціями у дельтах і заплавах великих рік півдня — Нілу, Тигра, Євфрату, Інду та інших.

Незадоволення відкриттям виявилося настільки активним, що на Заході прихильники класичних поглядів подали судовий позов з вимогою визнати результати К. Шмідта помилковими і заборонити їх поширення у системах освіти. Перевірки в різних лабораторіях підтвердили цей вік, а створений у ЗМІ ажіотаж викликав світову цікавість до Гебеклі-Тепе і сприяв інтенсифікації досліджень. Вони дали такі головні наслідки:

1] було помічено ще понад десять місць з КМА різних розмірів і досконалості на тих територіях, що охоплені мапою на рис. 3. Там відбуваються розкопки і керівники Туреччини вкладають кошти для приваблення потоків туристів у Гебеклі-Тепе й усі інші надстародавні місця життя майбутніх винахідників землеробства;

2] південніше Лівану розташовані землі, де сьогодні живуть євреї і палестинці. Там теж пройшло винайдення сільського господарства, але не помічено жодної Кільцевої мегалітичної арени. Всі виявлені КМА перебувають значно північніше на територіях появи наших генетичних пращурів, а також майбутніх європейських фермерів, курдів, вірмен і міноритарних народів.

Розкопки рукотворного горба Гебеклі-Тепе продовжуються й сьогодні, бо наші пращури за кілька тисяч років спромоглися нагромадити так багато великих каменів (мегалітів) різної форми разом зі ще більшою кількістю маленьких камінчиків і грунту, що археологам доведеться працювати ще багато років. Нещодавно вони розпочали копати західну частину горба і виявили рештки господарських і житлових споруд. А всі роки раніше науковці стверджували, що Гебеклі-Тепе було сакральним місцем для періодичних зібрань і святкувань мешканців сусідніх територій, що там ніхто й ніколи не жив постійно.

4. Досягнення нооархеології у доказах внеску наших пращурів у порятунок і прогрес HSS

Наведемо максимально стисло перелік відкриттів у нооархеології та нооісторії, що стосуються появи і життєдіяльності носіїв українських генів. Для цього нам потрібен авторський рис. 4, створений поєднанням інформації з багатьох джерел.

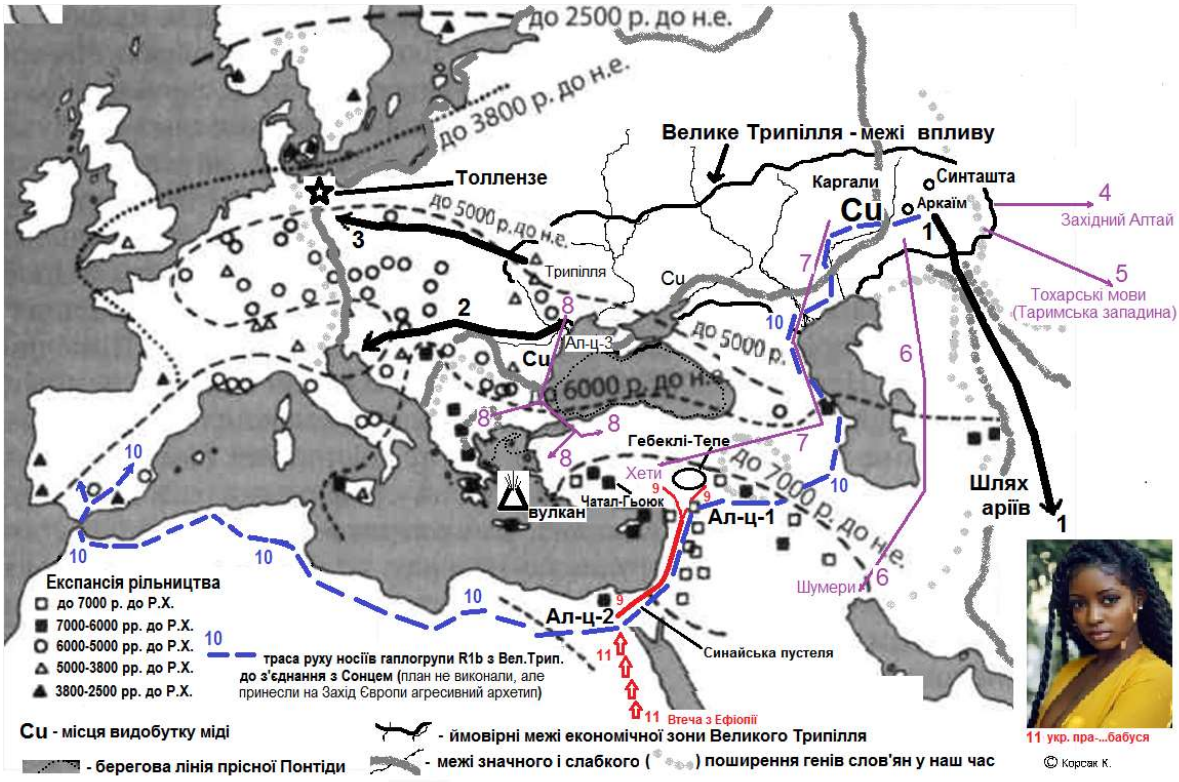

Рис. 4. Рух землеробства з Леванту й терени життєдіяльності носіїв українських генів

1). Світова наука вже нагромадила надійні докази того, що сучасні українці сформувалися поєднанням генів багатьох різних попередників, але загалом мають тільки два по-справжньому великих витоки. Перший виділився приблизно 60 000 років тому з інших племен на Ефіопському нагір'ї як ***напівпігмеї***. Чоловіча частина напівпігмеїв не спромоглася відігнати нападників від своїх практично ідеальних красунь. Тому вони по вказаній на рис. 4 трасі «11» намагалися врятуватися в дельті Нілу серед височенних очеретів. Шанс повного порятунку прийшов 50 000 років тому в часи перетворення Синайської пустелі в зелену саванну [7]. По трасі «9» відбулося поступове поширення майбутнього населення Східного Середземномор'я.

2). Після 35 000 років стабільних умов розпочалося закінчення останнього Льодовикового періоду. Тому з межі 14 тис. р. тому кліматичне збурення так погіршило умови життя, що різко зросла загроза канібалізму. Наші пращури перебували на ***пенепленах*** (детальне пояснення наукового значення цього поняття ми навели у статті [8]) — горбистих місцевостях з рештками давніх гір з різними корисними для праці і винахідництва речовинами (кременями, обсидіанами, рудами металів, самородками міді й інших металів, глинами всіх видів та ін.). Там росли однорічні злаки й інші рослини з великим насінням для збору яких прибували «жниварі» з різних племен. В інтервалах між дозріванням різних видів рослин вони мали час на «мозкові штурми» і пошуки шляхів захисту від загрози канібалізму. Висловимо гіпотезу, що шлях порятунку був знайдений у процесі дискусій — цілком згідно основній тезі Біблії — «Спочатку було Слово» [9].

Найімовірніше — наш геніальний пращур «Y» сформував світогляд про Вищі Сили для всіх періодичних та інших явищ свого довкілля, яким необхідно підпорядковуватися в усій щоденній діяльності. Як доказ цієї ідеї і засіб її переконливого поширення у громаді він придумав КМА (рис. 3). В центрі арени «Y» поставив чималі плоскі Т-подібні плити з різноманітним різьбленням, середня лінія між якими вказувала напрям на Полярну (тоді це був яскравий Сиріус) і давала змогу навіть у темряві орієнтуватися щодо інших сторін світу. Позначки на плитах навколо колової арени (на рис. 3 вони не вказані) в момент появи чи зникнення Сонця інформували про дату — тижні й навіть дні року. Науковці переконані, що КМА були неймовірно досконалими для тих часів «пригоризонтними обсерваторіями». Пізніше на цій основі споруджували Стоунхендж і його попередників, обсерваторію з глиняних конусів у Безводівці на півдні Чернігівщини ([10] та ін.), кільцеве південноуральське поселення Аркаїм з конусами з каміння по лінії горизонту, а також багато-багато чого іншого.

3). Керуючись порадою Ф. Броделя, ми звернулися до досягнень багатьох наук і пропонуємо чимало нових пояснень «загадок Гебеклі-Тепе». Прикладом може бути пояснення множинності різних КМА на горбі. Ми врахували всі відомі наукам дані про рух Землі. Для «феномену КМА» особливе значення має прецесія (рух по конусу) осі добового обертання Землі з періодом 26 000 років. Це зумовлює явище поступового зміщення «полярних» і втрату точності КМА. Наші пращури не рихтували старі конструкції, а будували нові зі старанним засипанням попередніх. Повага до пращурів та вдячність за їх піклування примушувала застосувати такий захист старих КМА від природних та інших пошкоджень. Ми детально аналізували нооархеологічні дані про еволюцію горба Гебеклі-Тепе і споруд на ньому в багатьох працях.

4). Головним досягненням будівельників КМА ми вважаємо ліквідацію канібалізму й винахід пратрипільського гуманізму як сукупності нового світогляду, моралі, поведінки і системи цінностей, що лишається позитивним зразком для всіх HSS і сьогодні. На Заході помилково вважають, що гуманізм утвердився тільки через кілька тисячоліть після появи перших КМА як наслідок великих стабільних селищ та розвиненого с/г. Ми не зустріли творів з акцентуванням гіпотетичної фігури генія-інноватора «Y» і не бачили пояснень переходу HSS від канібалізму до гуманізму як «***першого мегаподвигу пращурів***».

5). А доказів цього вичину нооархеологія надає чимало і швидко нарощує їх кількість. Поряд з розкопками КМА у різних точках Східної Туреччини центром загальної уваги стало вказане на рис. 4 поселення Чатал-Гьоюк. Задовго до Трої і досягнень Античності в ньому тисячі років панував «аграрний комунізм», спокій і безпека, любов до чистоти і якісної праці, тотальна рівність в усьому, відсутність не тільки убивств, а й крадіжок цінностей з безлічі усім відомих місць сховок, спільні розваги і т.д. Цей суспільний феномен став можливим через стандартність зайнятості усіх дорослих і відсутність можливості акумуляції значних багатств одним «лідером» чи його «бандою».

5). Дуже високі стандарти життя в подібних аграрних комунах неминуче викликали заздрість в усіх сусідів, більшість з яких дотримувалися старих світоглядних стереотипів. Ми пояснюємо зникнення цих комун не через внутрішню соціальну девіацію, а з причин посилення нападів ворогів. Тому пращури зруйнували житлові будівлі, акуратно присипали поверхню аж до появи на ній трави і кущів. Цим вони надійно приховали все від грабежів і плюндрування. Відсутність турецьких проток полегшила переселення аграріїв на Захід і Північ. Наші «африканські» невисокі пращури врешті досягли пенепленних чорноземних лісостепів України,. Там сталося несподіване і феноменально щасливе їх поєднання з другим генетичним «витоком» — удвічі важчими й потужними ***аріями***, що прийшли в Європу з Західного Алтаю по південних лісах. На основі взаємної симпатії назавжди поєдналися «жіноча й чоловіча досконалості», створивши рекордну для історії HSS Трипільську культуру. Пенеплени України були мало не безмежними і дали змогу нашим пращурам додати до

свого першого мегаподвигу ще більший за просторовим впливом — створення і/чи стимулювання всього того, що охоплюється повним значенням слова «***індоєвропейство***». Тут зупинимо виклад у сподіванні на високу обізнаність читачів, обмежившись вказівкою на те, що на межі 2016 і 2917 років провідний автор виявив докази перетворення правобережного Трипілля в колосальну економічну зону Великого Трипілля (ВТ) від Карпат і майже до Алтаю.

Технологічне лідерство наших пращурів у ВТ було таким великим, що купці-розвідники прибували для ознайомлення з ним з усіх усюд, вивчали нові для себе слова з гірництва, «кухонної металургії бронзи» на основі використання березового вугілля, а також всього іншого (конярства, колісного транспорту тощо). Фіолетові стрілки на рис. 4 вказують головні частини феноменального впливу Великого Трипілля на Євразію — від Атлантики аж до мегапустель Західного Китаю. Не війни і потоки крові зумовили «індоєвропейство», а мирне й некероване поширення «технологічного» лексикону зумовило спільність сотень мов індоєвропейської родини, існування відомих «списків Сводеша» і т.д. Ось незаперечний доказ — різниця звучання слова «береза» в сучасних мовах, зумовлена довжиною шляху від Аркаїма і Горного до дому «розвідників»: берёза — бяроза — beržas — bříza — brzoza — bedoll — betulla — bétula — birke — birch — bouleau — beith — bjørk... Французи так і не второпали нашу десяткову систему, тому й зараз їх держава «спирається на 20 пальців» і наше «вісімдесят» відтворює як «чотири рази по двадцять (quatre-vingts)». Ми запропонували «хмарнотегове» поширення спільних для індоєвропейської мовної родини слів від наших пращурів (це описано в [11]), яке позитивно сприйняли спілки лінгвістів України. Формування індоєвропейства було не тільки другим мегаподвигом носіїв українських генів, а й «1-им одуховленням людства».

6). Доведено, що 3150 років тому в Північній півкулі виникла надто сувора «вулканічна зими», створена виверженням егейського вулкану Санторині (вказано на рис. 4). Велике Трипілля розпалося назавжди. Населення східної частини ВТ переселилося на південь та схід. На заході вплив і гени пращурів досягли меридіану Берліна разом з початком значних змін у Середземномор'ї, де прибуття «генів і технологій степовиків» мало наслідком феноменальне піднесення Еллади (це правильна назва «Греції») до безперечного культурного і світоглядного лідера класичного «Стародавнього Світу», бази піднесення Риму до становища колосальної імперії.

7). Задовго до формування Еллади і розпаду ВТ по вказаній на рис. 4 синій лінії «10» до Південної Іспанії дісталися «ербіни» — носії Y-гаплогрупи R1b (наші пращури-арії мали R1a або її варіант R1a1a), які обрали агресивний варіант поведінки і світогляду, що був полярний до пратрипільського. З межі 5000 років тому вони поступово винищили фермерів-землеробів з усім їх гуманізмом й утвердили на Заході «атлантичну парадигму» з її геноцидами, війнами, спаленням жінок, атаками Сходу Європи і створенням колоній по всьому суходолу. Після низки невеликих геноцидних нападів на пращурів західних слов'ян у Центральній Європі ербіни здійснили мега-атаку для повного захоплення торгівельного бурштинового шляху від Балтики на Південь і поневолення слов'ян. Нападники були переконані в успіху, але зазнали на берегах болотистої річки Толлензе (вказано на рис. 4) такої поразки від лужичан та їх трипільських союзників, що припинили напади аж на 2000 років (детально все викладено у серії трьох наших статей [12]. Шкода, що не назавжди, що Європа й зараз поділена в культурі й архетипах поведінки на Захід і Схід, що союзники України спираються на надто різні системи цінностей.

5. Висновки і пропозиція використання нооархеології

Сучасна нооархеологія стрімко накопичує все новіші докази участі носіїв українських генів у порятунку людства від небезпек (список здійснених мегаподвигів наведений на рис.

2). Перебування українців у складі Російської і Радянської імперій мало наслідком їх повну «невідомість» у державах-лідерах світу. Там виникло і зберігається зараз помилкове переконання в тотожності двох народів, у відсутності української мови в родині слов'янських. Її вважали неістотною локальною говіркою і ніколи не згадували в світових енциклопедіях. Тому поява незалежної України в 1991 р. була шоком для Заходу (нас офіційно привітала тільки Польща !) і багато подій пізніше можна легко пояснити поєднанням «невідомості» з впливом вказаного вище поділу Європи на зони атлантичного і пратрипільського (гуманістичного) архетипів.

Слід визнати, що загалом антиукраїнська пропаганда як частина світової консцієнтальної війни набагато переважає своїм впливом все те, що керівники й науковці України пропонують для відсічі ворогам. Наші дослідження зібрали безліч доказів того, що упродовж років відновленої незалежності українські професійні археологи та історики продовжували тематику досліджень радянських часів. Вони не розпочали цікавитися розкопками в Гебеклі-Тепе чи в поселенні Чатал-Гьоюк, ігнорують появу нооархеології й задовольняються вивченням подій після формування Київської Русі. Дехто вивчає і пише про Трипільську культуру, але адміністративний загал гальмує цю цікавість. Прикладом є те, що фаховий журнал «Українознавство» за понад 30 років свого існування не вмістив жодного матеріалу про Трипільську культуру, яка насправді виявилася неперевершеним для всієї історії людства моральним, культурним і світоглядним досягненням.

Ми вважаємо своїм громадянським обов'язком продовжувати нооархеологічні й інші ноодослідження, поширювати корисні для всіх їх результати. Запрошуємо приєднатися до нас, робити запити на адресу kvkorsak@gmail.com з проханням надіслати наші найважливіші твори для поліпшення власних наукових і футурологічних аналізів, для успіхів у колективному захисті України — ноодержави зразка XXI ст.

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Geographic Sciences

SLOW TOURISM'S SPATIAL IMPACTS AND SUSTAINABILITY: WHY SLOW TRAVEL MATTERS GEOGRAPHICALLY

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Key words: Slow tourism, green infrastructure, tourism infrastructure, economic benefits, cultural preservation, sustainability, spatial planning, local communities

Annotation

This paper examines how slow tourism—characterized by deliberate pace, local immersion, and environmental sensitivity—intersects with spatial planning, green infrastructure, and connectivity to foster sustainable tourism development. With a well-articulated geographic framework and a balanced analysis of environmental and socio-economic impacts, the article offers a conceptual and empirical foundation. Its integrative approach makes it especially valuable for researchers and planners interested in tourism geography, sustainable development, and regional regeneration.

Introduction

Slow tourism stems from the broader «slow movement», which originated with the Slow Food initiative launched in Italy in 1986 by Carlo Petrini. This movement championed quality, tradition, and locality as an intentional rejection of fast-food convenience and cultural homogenization. Over time, this philosophy extended to lifestyle and spatial domains—culminating in offshoots like «Cittaslow» (Slow Cities), which promote holistic well-being and heritage preservation in urban environments. Slow tourism emerged organically from these ideas, transforming travel into a mindful, immersive interaction with place—contrasting sharply with hurried, checklist-driven mass tourism.

At its core, it is distinguished by its deliberate pace, environmental sensitivity, and cultural genuineness. Unlike typical package-based, fast sightseeing, slow tourism encourages travelers to spend more time in fewer places, exploring local history and culture with intention, while minimizing ecological and social footprints. Research indicates people gravitate toward relaxation, self-reflection, novelty, emotional experiences, and personal growth—far more than ticking off famous landmarks. Travelers seek experiences that align with values of sustainability, authenticity, and mindful engagement—especially prominent among millennials and experience-driven segments.

Geographic Framework

The geographic framework of slow tourism is an interplay of three pillars:

Component	Role in Slow Tourism
Spatial Planning	Ensures tourism is integrated, inclusive, place-sensitive, and infrastructure-conscious.
Green Infrastructure	Anchors tourism in ecological, cultural, and recreational networks, enhancing sustainability and wellbeing.
Connectivity	Enhances accessibility and mobility through multimodal, nature-integrated routes that connect tourism demands with spatial contexts.

Slow tourism reshapes spatial planning by prioritizing integrated, territorially mindful development rather than sporadic or centralized tourist zones. Strategic spatial planning views tourism as a tool for territorial integration, achieving a balance among socio-cultural values, heritage conservation, economic resilience, and environmental stewardship. In rural areas like Sardinia's Sulcis-Iglesiente region in Italy, combining green infrastructure with slow tourism initiatives—such as walking, cycling, or horse-riding trails—helps revitalize depopulated landscapes. These initiatives reinforce local identity while maintaining ecological and cultural integrity.

Green infrastructure (GI)—a coordinated network of natural and semi-natural spaces—provides diverse ecosystem services, ranging from clean air and water to recreation and biodiversity support [2]. It enhances human well-being in both urban and rural contexts. When overlaid with tourism objectives, GI becomes a framework that ensures tourism development contributes positively to social, environmental, and landscape health. Benefits include:

- Encouraging low-impact modes of mobility (walking, cycling)
- Preserving biodiversity and cultural landscapes
- Supporting rural and urban integration of tourism infrastructure

For instance, planning pedestrian and cycle routes as part of GI creates a dual function—serving recreational needs while reinforcing ecological connectivity and cultural access.

Connectivity is a foundational component in linking tourism with territory by merging transport, accessibility, and permeability. In Sardinia, the Trenino Verde ("Green Train") integrates with bicycle paths and pedestrian routes to bridge coastal access with inland heritage villages [1]. This model fosters multimodal connectivity and positions stations as gateways to slow tourism experiences. At a broader scale, planned routes like the «Magna Grecia» section of the EuroVelo network in southern Italy urge regional authorities to ensure that slow mobility paths align with environmental conservation, cultural values, and spatial planning policies. More generally, enhancing public transport and pedestrian infrastructure in urban tourism contributes to reducing private vehicle dependence, improving spatial accessibility, and supporting sustainable tourism models.

Environmental Impacts

One of the most tangible benefits of slow tourism lies in its potential to significantly lower carbon emissions. By emphasizing longer stays and selecting eco-friendlier modes of transport, slow tourism directly challenges the high-emission trends of traditional travel. Modes like trains, buses, cycling, or walking dramatically reduce emissions compared to air travel—ground transport can cut emissions by up to 90% per passenger-mile [3]. A single flight may emit as much CO_2 as dozens of cars—slow travel helps offset this by minimizing short-haul flying. Extended stays curb the carbon impact associated with frequent departures and turnovers, like repeated airport transfers or hotel check-ins. Overall, the combined effect of such informed choices is to reduce pollution for individual travelers and the tourism sector at large.

Slower, more immersive travel patterns tend to generate less resource waste and environmental strain. Travelers staying longer often engage in more sustainable practices—cooking meals at local homes or kitchens, using reusable items, and supporting businesses that prioritize eco-conscious operations. As tourists settle into daily routines akin to residents, they're less inclined to rely on single-use packaging, fast food, or disposable conveniences. Furthermore, choosing eco-lodgings—such as eco-gites, refuges, or lodges—can slash emissions associated with accommodations.

Slower travel fosters deeper awareness of natural environments, which often translates into stronger support for conservation efforts. Immersed in local environments, travelers are more likely to participate in eco-conscious activities, like hiking, birdwatching, and immersive outdoor experiences, that highlight ecological value. Research highlights that tangible, meaningful engagements in cultural and ecological settings—known as «intra-personal authenticity»—strengthen personal environmental responsibility, while «inter-personal authenticity» builds community ties that support ecological stewardship [4].

Environmentally driven tourism initiatives in Ireland are playing a transformative role in accelerating ecosystem recovery and addressing climate change. Faced with the economic uncertainty of communities long reliant on peat extraction, the Irish government—alongside Bord na Mona and EU partners—is spearheading an ambitious project to restore around 33,000 hectares of former peatlands in the Midlands. This comprehensive rehabilitation effort, backed by approximately €108 million in public and EU funding, aims to reverse peatland degradation and convert these landscapes back into functional ecosystems capable of sequestering an estimated 3.3 million tonnes of carbon by 2050 [5]. Central to this project is the establishment of walking and cycling trails that repurpose disused infrastructure—such as old rail lines—into pathways that weave through revitalized bog habitats. They are envisioned not merely as recreational assets, but as ecological corridors that invite visitors to engage with nature while supporting biodiversity recovery. Tourism becomes a lever for sustainable restoration: local entrepreneurship is encouraged, with over 80 small businesses receiving support to develop eco-accommodations (adding more than 200 beds regionally), all adhering to strict criteria around climate action, accessibility, and regenerative design.

By coupling large-scale habitat restoration with green tourism infrastructure, Ireland is illustrating how visitors can become part of the ecosystem solution—not a source of strain. Trails enable controlled foot traffic that fosters environmental appreciation without damaging sensitive sites; at the same time, economic benefits flow back to local communities, strengthening social resilience.

Socio-Economic Impacts

Slow tourism consistently generates meaningful economic benefits for host communities. By fostering extended stays and encouraging spending on locally owned accommodations, food, and crafts, it strengthens micro-economies. For instance, Costa Rica's emblematic ecotourism boom has revitalized rural coffee economies. Tourists there consume roughly 22 million cups of locally produced coffee each year, injecting approximately $16.5 million into the national economy. This demand has provided farmers with stable income and a diversified livelihood beyond volatile global commodities.

Slow tourism often encourages visitors to engage more deeply with local life and traditions, nurturing cultural preservation and communal pride. As tourists express genuine interest in crafts, food, and cultural practices, communities sometimes revitalize traditions that might otherwise fade. However, this dynamic can also lead to commodification, where cultural expressions are tailored or performed to fit tourist expectations—a phenomenon described by the "tourist gaze" [6]. It can reinforce stereotypes or strip cultural practices of their deeper significance. This tension

underscores the need for authenticity strategies that respect tradition without turning it into a performance.

Communities engaging in slow tourism often display greater resilience to external shocks like economic downturns or environmental crises. In China's Miao villages, for instance, many locals transitioned from agricultural migration to operating family-run guesthouses and craft stalls. While tourism brought increased living costs, residents valued the ability to stay rooted in their communities and avoid separation from their families. In Indonesia's Waerebo, it has been programmed so that villagers—particularly women—participate in rotation schemes for providing services. This ensures income equity and prevents over-dependence on tourism, enabling residents to continue their usual livelihoods even during disruptions like the COVID-19 pandemic. Elsewhere in Turkey's rural heritage village Behramkale, community-driven infrastructure planning has successfully prevented resident displacement and maintained traditional economies—even as tourism expanded—thus reinforcing social cohesion and resilience [7].

Despite the advantages, slow tourism also brings challenges. In many resort-oriented destinations, up to 80% of revenue leaks out to international chains and intermediaries, leaving minimal benefits for local economies. Tourism can create seasonal employment with unstable income, especially when over-relied upon. This makes communities vulnerable during off-peak periods or crises. Rapid growth can raise living costs or change demographics, potentially eroding authenticity or displacing long-term residents.

Impact Dimension	Positive Effects	Potential Risks
Economic Benefits	Job creation, local business growth, income multipliers (e.g. pilgrimage routes)	Revenue leakage to external firms, economic dependence on tourism
Cultural Authenticity	Reviving traditions, local pride, cultural preservation	Commodification, stereotyping, loss of genuine cultural expression
Resilience	Local livelihoods stabilization, crisis resistance (e.g. Waerebo, Miao villages)	Uneven benefit distribution, over-reliance on tourism
Social Equity & Inclusion	Wider distribution of tourism benefits, community-led models	Gentrification, loss of housing affordability, infrastructure pressure

Slow tourism offers a powerful model for nurturing resilient, culturally vibrant, and economically diverse rural communities — especially when it emphasizes local agency, equitable benefit distribution, and cultural integrity. Yet, achieving these outcomes demands intentional planning, monitoring, and community governance to mitigate risks like commodification or economic leakage.

Case Studies

Sardinia's Sulcis-Iglesiente region in Italy presents a powerful model of transforming former mining zones into slow-tourism destinations. The initiative focuses on integrating green infrastructures—such as walking and horse trails—into mining landscapes. Key sites like Posada di Pitzinurri, Monti Mannu, and Parco is Muras serve as accessible stopping points or "Posadas" along routes that carefully balance heritage conservation and natural recovery [8]. Furthermore, there's a move to develop a dynamic electronic dashboard to coordinate stakeholder input, real-time feedback, and governance across visitor networks. This blend of physical infrastructure and digital intelligence supports sustainable slow tourism grounded in landscape context and smart planning. Another Sardinian success is the restoration of the Great Mine Serbariu in Carbonia. Once the largest coal mine in Italy, it has been repurposed into a hub for culture, tourism, research, and education. The new Italian Cultural Centre of Coal Mining, within its shell, now draws nearly

220,000 visitors, turning once-degraded industrial heritage into cultural capital and economic opportunity

The southern segment of the EuroVelo Route, known as the Sun cycle route, spans from Lagonegro to Pozzallo, passing through Sicily along the Ionian Coast. Its design strategically reconnects coastal conurbations with inland cultural sites and landscapes, fostering slow tourism rooted in deeper spatial reflection and historical continuity. By envisioning the route through ecologically and culturally rich territories, planners aim to re-establish landscape connectivity and tourism that both enhances and preserves place identity.

As Bulgaria's first UNESCO Geopark, the Iskar–Panega Geopark demonstrates successful slow tourism development in a regional context. Situated near Lukovit, it includes two significant natural zones, the Karlukovo Karst Complex and Panega Landscape Park. Investment in infrastructure like wooden bridges, platforms, and interpretive signage significantly bolstered tourist access, resulting in a 40% increase in overnight stays and heightened visitation overall. This illustrates how physically sensitive structural components and storytelling can reshape regional tourism flows and strengthen local economies.

The Trasimeno Ring in Umbria (Italy) is a 61 km circular walking and cycling route that skirts Lake Trasimeno. It links towns, natural zones, heritage sites, and local agricultural landscapes such as olive groves and historic settlements. This "slow route" underlines how cohesive routing and regional collaboration between municipalities deepen spatial integration and identity—creating a tourism experience that is both immersive and place-based.

Each case demonstrates how strategic spatial routing, whether green corridors, trails, or repurposed infrastructure, can generate immersive slow tourism that balances mobility with nature and culture. From peatland rehabilitation to trail networks and heritage reactivation, green infrastructure shapes tourism patterns while enabling ecological recovery. Each initiative amplifies local narratives—be that mining heritage, cultural landscapes, or natural features—and often incorporates community-led conservation or business models. Case studies show that slow tourism isn't just an experience—it's an engine for economic empowerment, place-based resilience, and ecological stewardship.

Conclusion

In exploring slow tourism through the lenses of spatial planning, environmental preservation, and socio-economic resilience, this paper underscores that slow-paced travel carries transformative potential. Far from being a niche trend, slow tourism offers a compelling alternative to mass tourism, one that aligns deeply with sustainable development goals and meaningful place engagement. From the Geographic Framework, we see how slow tourism reconfigures the physical and perceptual landscape. Spatial planning strategies—like trail networks, repurposed railways, and green corridors—connect visitors with the essence of place, distributing tourist flows through heritage-rich and ecologically important regions. These interventions are not about building more but about guiding engagement—ensuring that tourism supports territory rather than overburdening it. The Environmental Impacts section illustrates how slow tourism actively contributes to carbon reduction and ecosystem appreciation. By emphasizing longer stays, low-impact modes of travel, and immersive engagements with nature, slow tourism encourages a mindful approach to travel. The Irish peatland restoration project epitomizes a regenerative model—where tourism facilitates both ecological recovery and community benefit, rather than damaging it. In the Socio-Economic Impacts part, we highlighted how slow tourism can nurture local economies, uphold authenticity, and enhance community resilience. Unlike extractive tourism models, slow tourism directs spending toward local businesses, encouraging economic equity and cultural preservation. Yet, vigilance is required—commodification and leakage remain risks if local involvement and narrative control are neglected. Through Case Studies ranging from Sardinia to Bulgaria, from Italy to Ireland, the real-world application of slow tourism principles

becomes tangible. These examples demonstrate how principles of slow tourism—spatial cohesion, environmental resources, cultural integrity, and local governance—can converge in diverse contexts, achieving multiple objectives: regenerative landscapes, revitalized economies, and enriched visitor experiences.

Ultimately, slow tourism invites us to rethink what travel can be. It shifts the narrative from counting destinations to fostering connection; from fast consumption to slow appreciation; from external growth to internal sustainability. It asks communities, planners, and travelers alike to prioritize depth over breadth, authenticity over spectacle, and resilience over transience.

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WATERFRONT REDEVELOPMENT AND URBAN TOURISM: HOW CITIES TURN RIVERFRONTS INTO ATTRACTIONS

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Key words: waterfront, smart city**,** urban transformation, public access, waterfront zones, riverfront redevelopment, public park, ecological impact, urban elements

Annotation

This article examines how cities around the world have successfully transformed neglected riverfronts into vibrant urban attractions by skillfully blending environmental resilience, cultural programming, and economic vitality. It examines the economic, social, and environmental impacts of waterfront redevelopment, highlighting strategies such as public–private partnerships, adaptive reuse, green infrastructure, and smart city technologies. Its integrative approach makes it especially valuable for researchers interested in tourism geography, sustainable development, and urban development.

Introduction

Urban waterfronts, once dominated by industrial zones and underutilized spaces, are undergoing a remarkable transformation into vibrant hubs of tourism and community life. Cities worldwide are recognizing the untapped potential of their riverfronts, reimagining them as dynamic destinations that blend recreation, culture, and commerce. It is a strategic move to enhance urban resilience, stimulate economic growth, and foster a deeper connection between residents and their environment. The allure of riverfronts lies in their unique ability to offer scenic views, historical narratives, and opportunities for leisure—all within an urban context. From the bustling promenades to the cultural renaissance, these redeveloped areas are redefining what it means to live and visit in a city. As climate change and urbanization present new challenges, the redevelopment of waterfronts also serves as a proactive approach to environmental sustainability and disaster resilience.

The Importance of Riverfronts in Urban Development

Riverfronts have traditionally served as the lifeblood of cities—centers of trade, transport, and industry. With industrial decline, many urban waterfronts lapsed into neglect. Today, they're being reimagined as spaces of renewal and vitality, with the power to strengthen urban identity and catalyze economic growth. Well-designed waterfronts boost nearby property values, draw tourists, and stimulate local business development. The ripple effects include workforce expansion across sectors from hospitality to retail. For instance, Ahmedabad's Sabarmati Riverfront (India) has become a thriving recreational and commercial linear district, generating thousands of jobs and revitalizing the local economy.

Promenades, parks, and cultural facilities along the water foster avenues for public interaction, leisure, and community events. These accessible spaces enhance wellbeing and civic pride. Furthermore, revitalized riverfronts increase equitable access to recreation and natural light

in dense urban landscapes. Revamped riverfronts often serve dual purposes—both as public spaces and as ecological safeguards. Green infrastructure, such as bioswales, permeable pavements, and restored habitats, helps manage flooding, improve water quality, and mitigate urban heat effects. In Seattle, for example, investments in green and resilient design have fortified the waterfront against earthquakes and storms while expanding community access [1]. Riverfront redevelopment succeeds when economic, social, and environmental goals are balanced—through policies prioritizing accessibility, public participation, and partnerships. Cities like Glasgow exemplify how strategic waterfront regeneration can deliver jobs, infrastructure, housing, and public spaces.

Key Strategies in Waterfront Redevelopment

Cities are increasingly embedding nature-based elements to enhance sustainability and climate resilience. These include permeable pavements, bioswales, rain gardens, wetlands, and multi-functional public areas that absorb stormwater and reduce flooding risks—known as the "sponge city" concept [2]. In Seattle's redevelopment, these features not only improve environmental outcomes but also elevate public access and resilience. Similarly, integrating green infrastructure—such as green roofs, rain gardens, and flood-resistant materials—is essential for long-term durability and aesthetic appeal. Waterfronts are often vulnerable to sea level rise, storm surges, and other climate impacts. Successful redevelopment includes elevated structures, flood-resistant materials, seawalls, levees, and adaptive features like floating gardens or amphibius architecture. Public–private collaborations play a crucial role here: Seattle's $1 billion Elliott Bay project developed a new, more resilient seawall with ecological improvements alongside parks and promenades.

Complex waterfront projects often rely on blended funding models. For example, Brooklyn Bridge Park in New York is funded through private real estate development that sustains the public park, balancing financial self-sufficiency with public benefit [3]. International examples, such as Athens's Ellinikon (Greece) coastal redevelopment, illustrate how public–private partnership can deliver large-scale, sustainable transformations like Europe's largest coastal park, while mobilizing substantial private investment alongside public support. Engaging stakeholders—residents, businesses, civic groups, and experts—is vital for the legitimacy and success of redevelopment efforts. The Fuxing Island project in Shanghai exemplified inclusive planning by involving a range of stakeholders early in the design visioning process. Similarly, Hong Kong's harbourfront redevelopment emphasized comprehensive civic engagement through workshops, forums, and multi-stage public consultation.

Revamping historic waterfront structures, like warehouses or industrial buildings, can preserve cultural heritage while creating unique mixed-use spaces, as seen in Livorno's Porta a Mare project in Italy, which transformed shipyards and industrial zones through adaptive reuse [4]. Balancing history and modern development ensures that place identity remains intact even amid renewal. Harmonious design that blends natural and urban elements enhances both aesthetics and functionality. This involves sustainable architecture, green building materials, and structures that offer natural ventilation and minimize ecological impact. Mixed-use combines residential, recreational, commercial, and cultural uses to generate vibrancy and economic vitality in waterfront precincts.

In the age of smart cities, waterfront developments often incorporate technologies for efficient resource use, real-time monitoring, waste management, and visitor experience improvement. Green infrastructure integration can benefit from digital solutions, ensuring operational insight and adaptive maintenance. Protection and restoration of natural habitats—wetlands, biodiversity corridors, green corridors—are critical ecological strategies in waterfront redevelopment. Incorporating water-based transit (e.g., water taxis, pontoons), cycling paths, and pedestrian-friendly layouts supports sustainable mobility and reduces reliance on cars.

Global Case Studies

Seattle's comprehensive waterfront transformation stands as a leading model. After removing the overbearing Alaskan Way Viaduct, the city launched "Waterfront Seattle"—an $806 million project introducing 20 acres of new parks, promenades, protected bike lanes, piers, and improved city connections [5]. The natural shoreline has been revitalized with Habitat Beach, integrating engineered marine features like salmon-friendly grooves, sunlit pathways, and native plantings—offering ecological benefits alongside recreation. Additionally, "Elliott Bay Connections", funded by private philanthropy, will link more than 50 acres of public space along 3.5 miles of waterfront, completing greenways, restoring parks, and reinforcing cultural ties. In July 2025, the newly revamped Pier 58 reopened, featuring 50,000 sq ft of parkland and a jellyfish-themed climbing sculpture—symbolizing the project's playful yet resilient design ethos.

Ahmedabad's once-neglected Sabarmati riverbanks have been transformed through a visionary revitalization led by the Sabarmati Riverfront Development Corporation (India). The strategy includes 22.5 km of promenades, parks, infrastructure, and mixed-use developments on both riverbanks. This initiative reclaimed public spaces, improved ecological and social conditions, and generated global recognition—including KPMG's "100 Most Innovative Urban Regeneration Projects" and the HUDCO National Award [6]. The redesigned Ghats (steps leading to the river) also enhanced community access while curbing pollution—boosting the social and economic status of residents. On a related note, Ahmedabad is redesigning its riverside food plaza to address pollution concerns, replacing open-air structures with domed buildings and emphasizing local, eco-conscious planning.

In Shanghai, the West Bund Corniche is an ambitious riverfront renewal along the Huangpu River. An international design competition led to a master plan that integrates mixed-use functions—residential, commercial, cultural, and recreational—while restoring ecology and promoting low-carbon development. Recognized at a national level for excellence in urban design, the Corniche demonstrates how city planning can revive formerly industrial frontages into sustainable and accessible waterfronts.

Singapore's Marina Bay is more than just a scenic waterfront—it's the core of a long-term urban transformation that redefined the city's identity. Beginning in the 1970s, this initiative involved extensive land reclamation to expand the Central Business District and create a vibrant, multifunctional waterfront that seamlessly blends civic spaces, culture, and leisure. At its heart stands "Marina Bay Sands**"**, an iconic integrated resort completed in 2010. Designed by Moshe Safdie, it features three towers topped with a panoramic SkyPark that includes the world's largest public cantilever platform and an infinity-edge pool. Alongside luxury accommodations, the complex hosts a vast convention center, upscale shopping (including the world's first floating Apple Store and the Louis Vuitton Island Maison), a cutting-edge ArtScience Museum, performance theaters, celebrity chef restaurants, and more. This masterplanned waterfront serves multiple roles—it's a tourism magnet, a cultural and commercial hub, and a civic gathering place all in one. The Urban Redevelopment Authority describes it as "the People's Bay," emphasizing how public spaces, event programming, and architectural landmarks—like Gardens by the Bay and the Esplanade—invite both locals and visitors to live, work, and play in harmony with the city's skyline and waterfront. Moreover, the area continues to evolve, and $8 billion expansion to the resort is underway, adding a fourth tower, a new "Skyloop" with infinity pools, rooftop gardens, and a 15,000-seat arena—all reinforcing Marina Bay's status as a global urban tourism beacon [7].

Economic and Social Impacts

Impact Type	Economic Benefits	Social Benefits & Challenges
Revenue & Jobs	Property value, tourism, retail, construction	Improved livability, cultural engagement
Investment& Development	City branding, follow-on growth	Public access, better recreational environments
Anchor Institutions	Catalyze surrounding urban renewal	Identity building, community cohesion
Risks / Equity	Risk of gentrification and displacement	Places need inclusive planning and affordable safeguards

Revitalizing riverfronts can serve as powerful economic catalysts. Shore-adjacent property values typically rise, which bolsters tax revenues and stimulates further investment in the area. For instance, waterfront redevelopment often contributes significant economic returns: one study estimates that every dollar invested generates around $3.41 in property value increases [8]. Mixed-use developments such as the Capitol Riverfront in Washington, D.C. have added thousands of housing units, hotels, retail spaces, and public parks, turning once industrial zones into vibrant economic nodes.

Tourist activity is another major economic driver. Projects like Brooklyn Bridge Park in New York draw over five million visitors annually, with its self-sustaining financial model combining public park space and private development. Similarly, Columbus's riverfront plans project to generate approximately 89 construction jobs and inject $1.6 million into the local economy, sparking long-term economic opportunities [9]. On the social front, riverfront transformations open up previously restricted urban spaces—creating places where communities gather, exercise, and find recreation. Newark's Riverfront Park, for example, provides the city's first riverside public access to many residents.

Despite their benefits, redevelopment projects risk unintended negative consequences if not managed inclusively. Gentrification can erode neighborhood identity, displace residents, and reduce affordable housing access. Proactive strategies—such as safeguarding housing affordability, ensuring stakeholder engagement, and embedding social equity goals from the start—are essential to achieving sustainable, community-centered riverfront development.

Future Trends in Riverfront Redevelopment

Urban waterfront planning is increasingly embracing nature-positive design principles, aiming to integrate green spaces, biodiversity corridors, and ecological infrastructure into cityscapes. Projects are incorporating wetlands, urban forestry, green roofs, permeable surfaces, and tidal parks to enhance environmental health, manage stormwater, and boost resilience to flooding and climate extremes. Rotterdam's tidal park exemplifies this trend, transforming industrial zones into flood-adaptive spaces that combine ecological function with urban attractiveness.

Smart technologies are becoming central to future riverfront projects. Digital twins, powered by real-time sensor data, enable dynamic simulation of urban environments, optimizing design outcomes and supporting scenario planning. Alongside this, data-driven flood resilience tools—such as predictive models, community-scale big data, and situational awareness systems—are enhancing preparedness and responsive urban management. The broader Urban Metaverse concept further envisions immersive digital-physical interfaces to inform inclusive design, civic participation, and infrastructure optimization.

Looking forward, adaptability will be a core design strategy—creating flexible riverfront spaces that accommodate evolving environmental and social dynamics. Innovative planning frameworks distinguish between fixed characteristics of the site and variable factors, such as climate risks and shifting city needs, allowing smarter, modular infrastructure responses [10]. Future riverfronts will increasingly serve as hubs for sustainable mobility and high-performance urban living. Mixed-use waterfront zones are expected to prioritize active travel, incorporating cycling paths, pedestrian promenades, and water-based transport options, enhancing connectivity while reducing carbon footprints. These developments align with broader trends in sustainable urbanism, including biophilic design and high-density living, creating livable riverfront communities that enrich both human well-being and ecological performance.

Conclusion

Waterfront redevelopment demonstrates how cities can turn once-neglected spaces into engines of cultural vibrancy, economic growth, and environmental resilience. From Seattle to Singapore, global case studies reveal that successful projects balance ecological sustainability, public accessibility, and innovative urban design. These transformations not only elevate tourism and property values but also restore civic identity and community well-being. At the same time, they remind us of the importance of inclusive planning to prevent displacement and ensure equitable benefits. Looking ahead, the integration of smart technologies, adaptable infrastructure, and nature-based solutions will define the next generation of resilient waterfronts. In reimagining their riverfronts, cities are not just reshaping landscapes, they are building more sustainable, connected, and livable futures.

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Historical Sciences

AN INNOVATION AT AZERBAIJAN STATE PEDAGOGICAL UNIVERSITY (ASPU)

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ABSTRACT

There are important factors that influence the development of every culture. Although there are many of them, some are of particular importance. One of them is education and the development of the education system, which plays an important role in the development of society. Since ancient times, the role of education in the development of the personnel it produces to the development of society. At the same time, education is considered the most conservative part of society. Thus, education is a source of values such as knowledge, skills, competence, abilities etc. accumulated over millennia. Through it, students are trained as personnel, prepared for a new life and contribute to the future development of the nation. İn this regard, the new rules for passing pedagogical internship, which Azerbaijan State Pedagogical University implemented as a pilot project last year and in all faculties this academic year (2024|2025), are very noteworthy. İt can be said that the main aspects of internships have changed, the long and tedious process and waste of time have been eliminated, and the difficulties that students face in schools have been eliminated. Internship students completed their studies by defending their achievements during their internship months before the Defense Commission.

Keywords: education, new statute, academic year, the internship, ASPU, undergraduate degree

Among Azerbaijani universities, Azerbaijan State Pedagogical University (ASPU) occupies a unique place. Since its establishment, this university has been very different from other educational institutions in Azerbaijan. This tradition has been continued for many years. Azerbaijan State Pedagogical University [Image 1], formed on the basis of those tradions, maintains its loyalty to the past historical path in the modern era, does not throw away the established rules, and also tries to create a system that can meet the requirements of the moderns era. In this regard, the adoption and practical implementation of the new Regulations on the transfed of students by specialty in the second half of the 2024 / 2025 academic year is of interest.

İt should be noted that the internship at ASPU and all its documentation were carried out in the 2024 / 2025 academic year. This process was carried out in accordance with the Regulation approved by the decision of the Cabinet of Ministers of the Republic of Azerbaijan dated December 30, 2023 and paragraph I of this order [2].

İmage 1. Azerbaijan State Pedagogical University

This regulation of ASPU was prepared in accordance with the "Rules for the internship of students of higher and secondary specialized education institutions" approved by the aforementioned decision of the Cabinet of Ministers of the Republic of Azerbaijan and regulates the rules for internship. The regulation applies to all organizations at the higher and secondary specialized levels at the University, its branches and affiliated colleges.

The regulations pay special attention to the main objectives and types of practice.
The main goals of the internship are to consolidate the theoretical knowledge acquired by the student, supplement it with practical skills and competencies, prepare the student for effective labor activity, familiarize him with new technologies, modern production areas, working methods and other issues depending on the profile of the spealty. It is important to add to this the development of innovative training and competence of the student [1].

According to the regulationsç teaching, industrial, pre – diploma, scientific – pedagogical and scientific research internships are defined as the main types of internships at the University. A separate internship program has been developed in the curriculum for several types of internships per specialty.

The list of institutions (organizations) where students will go for internships was determined at least 4 months before the internship began. At this time, the principle of subordination was observed.

Students` internships in their specialty were organized during the spring semester, which spanned February – May. In May – June, reports were prepared and defenses were organized in the internship commission in the specialty. The time frame for the internship is aligned with the academic calendar of the relevant academic year.

When organizing pedagogical practice, ensuring the relevance of the practice base to the student`s specialty, organizing safe and harmless practice conditions for life and health, and establishing a continuous connection between teaching, and practice are among the main requirements. At the same time, ensuring of the student`s participation, improving skills in the application of modern information technologies in creative and research work, introducing of the student to modern technology, work methods and other innovations and etc. were included in the requirements during the organization of internship [2].

During the period of study, the student`s work activity in the specialty was recognized as internship by the Internship Commission established by the educational institution based on the opinion of the department in accordance with the aforementioned Regulations. At this time, each week of work activity is equal to 1.5 credits [2]. During the internship, the weekly internship period was at least 20 hours, based on a 5 – day work schedule.

According to the regulations, the University has determined the report form of the student`s internship. The report is determined in accordance with the requirements of the internship program. It reflects conducted and the conclusions reached by the student [1].

The students submitted their internship report in Microsoft Word format and their PowerPoint presentation to the Commission in the language of their study. The presentation provided information about the student himself, the base where he did his internship (the school, its history, information about famous graduates of the school, pupils and teachers, structural scheme and etc.), the class where he did his internship, the specialized methodologist, pedagogue, psychologist, departmental internship supervisor with whom he worked directly during the internship, the school administration and specialized teachers. It contains sample and test lessons (schedule, work program, topics, pictures), as well as the information about the class the student is assigned to, the pupils and the learning environment.

The report devoted the special attention to the issues such as knowledge, skills, habits, values, qualities and competencies acquired by the student. The report included the student`s scientific, methodological, pedagogical and psychological content evaluations, the diaries they compiled, the summaries and plans of the lessons they taught. The photos from the events held with the participation of the intern – student, the text of the moral – educational conversation he had with the pupils, the psychological profile of a pupil, the comparative psychological profile of two pupils, the educational resource he prepared during the internship, the student`s suggestions and conclusions were reflected here.

During the internship, the groups of 10 – 15 people were created, 6 sample lessons in the teaching experience and 4 test lessons in the production experience were held.

The teaching load related to internship at the university is regulated by the “Rules for internship of students of higher and secondary specialized education institutions” approved by the Resolution No. 489 of the Cabinet of Ministers of the Republic of Azerbaijan dates December 30, 2023, the “Teaching work time norm of professors and teaching staff” approved by the Resolution No. KQ-12 of the Collegium of the Ministry of Science and Education of the Republic of Azerbaijan dated September 03, 2024 and this regulation.

The university has allocated 5 – 10 hours per working week for each group for teaching practice, including checkinf and accepting reports and 3 – 5 hours per working week for each group for supervising production and pre – diploma practice, checking and accepting reports.

The main internship documents are the sample lessons held during the teaching internship and their objectives (App.1), the evaluation form for students` internship (sample and test) lessons (App. 2), the procedure for preparinf the internship report (presentation) and the feedback form (App. 3), the final evaluation table of the internship commission (App. 4), the evalution sheet of the internship commission member (App. 5), the internship proqram (App. 6), the internship diary (App. 7) and the sample contract with the internship base (App. 8) [1].

The evaluation of the results of the internship was carried out by internship commissions established by the educational institution and including internship leaders appointed by the educational instution and the internship base, based on the evalution criteria determined by the educational institution. The evaluation was carried out separately for each type of internship [1]. The exact distribution of the internship workload at the university by major was formalized by the rector`s order on the distribution of the teaching load the for the new academic year. The evaluation of the results of the internship was conducted by internship commissions established by the educational institution, based on the evaluation criteria determined by the educational institution and including internship leaders appointed by the educational institution and the internship base. The assessment is determined separately for each type of experience. Of the 30 credits intended for internship in undergraduate educational specialties at the university 15 (10 weeks) are allocated to teaching experience, 7.5 (5 weeks) to pedagogical experience and 7.5 to

the preparation, verification and acceptance of the internship report by the internship commission in the specialty.

The evaluation of the teaching and reform (pedagogical) experience was carried out by the experience supervisor (teacher) based on the evaluation form in Form [App. 1]. This evaluation form was considered one of the important documents for evaluating the knowledge of the intern student during the internship. Through it, it became more accurate to correctly assess the student`s knowledge, skills, competence, abilities and other aspects.

Form 2

Azerbaijan State Pedagogical University
Students` practical (sample and test) lessons
Evaluation form

Intern student:		Photo
Student`s Personal No.:		
Faculty:		
Specialization:		
Head of practice:		
Practice base school:		
Internship start date:	Internship end date:	

Explanation of the abbreviations in front of the items in this assessment form:
(C): It has weaknesses, (B): Acceptable, (A): It`s goog.
Mark the appropriate option with a (+).

			C	B	A
1	SPECIALIZATION AND VOCATIONAL EDUCATION				
1.1	SPECIALIZED SKILLS				
	1.1.1.	Knowledge of basic principles and concepts related to the topic			
	1.1.2.	Connecting the main principles and concepts covered in the topic in a logical framework			
	1.1.3.	Use oral speech and visual aids (pictures, diagrams, graphs, formulas, etc.) appropriately as required by the topic			
	1.1.4.	Ability to relete the topic to other topics in the field			
1.2	VOCATIONAL EDUCATION				
	1.2.1.	Knowledge of special education approaches, methods and techniques			
	1.2.2.	Ability to use educational technologies			
	1.2.3.	Being able to identify misdeveloped concepts in students			
	1.2.4.	Inability to provide appropriate and sufficint answers to student questions			
	1.2.5.	Ability to ensure the safety of the learning environment			
2	TEACHING AND EDUCATIONAL PROCESS				
2.1	PLANNING				
	2.1.1.	Ability to write a lesson plan in a clear, understandable and systematic manner			
	2.1.2.	Being able to clearly express goals and target behaviors			

	2.1.3.	Ability to identify target behaviors using appropriate methods and techniques			
	2.1.4.	Be able to select and prepare appropriate equipment and materials			
	2.1.5.	Being able to identify assessment forms appropriate to target behaviors			
	2.1.6.	Ability to connect the topic with previous and subsequent lessons			
2.2	TEACHING PROCESS				
	2.2.1.	Ability to use various teaching methods and techniques appropriately			
	2.2.2.	Inability to use time effectively			
	2.2.3.	Ability to organize educational games to increase pupil activity			
	2.2.4.	Ability to continue the training process based on individual differences			
	2.2.5.	Ability to use teaching equipment and materials appropriately at the grade level			
	2.2.6.	Ability to generalize and make appropriate recommendations			
	2.2.7.	Inability to relate the topic to real life			
	2.2.8.	Ability to assess the level of achievement of target behaviors			
2.3	CLASS MANAGEMENT				
		When the class starts			
	2.3.1.	Not being able to make an appropriate introduction to the lesson			
	2.3.2.	Inability to attract interest and attention to the lesson			
		Lesson process			
	2.3.3.	Ability to create a democratic learning environment			
	2.3.4.	Ability to maintain interest and motivation in the lesson			
	2.3.5.	Inability to take appropriate measures against interference and disruptions in the lesson			
	2.3.6.	Ability to use tool without encouragement or punishment			
		At the end of the lesson			
	2.3.7.	Being able to summarize and conclude the lesson			
	2.3.8.	Being able to provide information and assignments related to the next lesson			
	2.3.9.	Ability to prepare pupils to leave the classroom			
2.4	COMMUNICATION				
	2.4.1.	Ability to communicate effectively with pupils			
	2.4.2.	Ability to give understandable explanations and instructions			
	2.4.3.	Being able to ask thought – provoking questions about the topic			
	2.4.4.	Ability to use voice tempo effectively			
	2.4.5.	Being able to listen to pupils with interest			
	2.4.6.	Ability to use oral speech and body language effectively			
3	EVALUATION AND REGISTRATION				
	3.1.	Ability to prepare appropriate assessment materials			
	3.2.	Providing feedback appropriate to students` levels of understanding			
	3.3.	Assessing students` results (answers) in a short time and reporting to relevant persons			
	3.4.	Record assessment results			
4	OTHER PROFESSIONAL SKILLS				
	4.1.	Know the laws and regulations related to the profession			
	4.2.	Be open to professional feedback, suggestions and criticism			
	4.3.	Being able to participate and contribute to school events			
	4.4.	To be an example to others with personal and professinal behavior			

5	CONTINUITY			
	TOTAL			

Appendix 1. Form 2

The final evaluation of the experiment was carried out by the Experiment Commission as follows [App. 2].

No	Assessment direction	Score
1.	According to the compilation of the experimental	0-15
2.	For the consistency of the content of the internship report and the absence of grammatical and stylistic errors	0-15
3.	According to the level of defense of the internship report (report, presentation etc.)	0-50
4.	According to the student`s answers to the questions asked regarding the internship report	0-20
	Total	100

Appendix 2. Evaluation of the internship Commission for the Specialization (Duration: 5, credit: 7.5)

According to the regulations, a student who fails any type of Internship must be given the opportunity to retake the internship of that type in the next academic year by paying the credit value. A student who does not pass the teaching internship is not allowed to participate in the pedagogical internship and a student who does not pass the pedagogical internship is not allowed to defend the internship report. According to the new rules, a student who achieved a successful result (51 points or higher) from both types of internship and the report from the Internship Commission was considered to have successfully completed the internship semester [1].

The following normative and legal documents of the Republic of Azerbaijan can be cited as the basic sources used by both the University administration, methodologists participating in the experimental process and interns – students when preparing the Regulations and using its main provisions during the Internship (Form 9):

- ✓ Constitution of the Republic of Azerbaijan [4];
- ✓ Labor Code of the Republic of Azerbaijan [13];
- ✓ State Strategy and Action Plan for the Development of Education in the Republic of Azerbaijan [15];
- ✓ Law of the Republic of Azerbaijan on Education [6];
- ✓ Law of the Republic of Azerbaijan on General Education [12];
- ✓ Assessment Concept in the general education system of the Republic of Azerbaijan [5];
- ✓ State standards of general education in the Republic of Azerbaijan [7];
- ✓ Ethical Code of Conduct for Educators [14];
- ✓ Samples of state documents on education and the Rules for their issuance [11];
- ✓ Duration of implementation of educational programs (curriculums) [8];
- ✓ Material and technical base of the educational institution and educational infrastructure standards [10];
- ✓ Rules for organizing formal education [9];
- ✓ Rules on the organization of individual education [3] and etc.

Operating on the basis of the New Statute and the documents reflected therein, I, Mehdiyeva Ayten Ali, as a methodologist, have always tried to organize my work correctly [Image 2]. To this end, in addition to documents, I have been in constant contact with interns and students and have tried to learn to their opinions. In this regard, the information provided by several surveys I conducted

with them has been very helpful in building my own business. First of all, I would like to note that this years`s students were diverse in every way. This diversity is reflected in their self – awareness, the way they express their inner world, the way they choose methods and means to achieve their goals, the way they determine their behavior, character and attitude toward students, the way they form a system of successes and mistakes in communicating with children and so on. When the intern talked about topics that concerned students, it was of great interest to study the options they presented to solve the problems. “Aggression in pupils and their elimination” (intern – student R.Talibova), “Formation of moral and spiritual values in senior pupils” (intern – student F.Garayeva), “ The importance of using ICT in teaching students” (intern – student A.Khidirova), “Segregation among pupils in secondary schools and its elimination” (intern – student N.Musayeva), “Digital transformations in the education system in the modern era” (intern – student M.Yuzbekova) and others are the topics chosen by the students. The experimental students not only prepared a text for a speech on this topic, but also organized debates during classes at the University.

Image 2. Methodist Ass.Prof. Ayten Mehdiyeva and students of TCM2002B group

When the experimental and trial lessons at the university ended, the group of the interns in which I was the methodologist again selected problems such as their successes, the place and role of innovations introduced into the experimental process in the activities of students, the main issues that modern teachers should pay attention to, expectations and real results from the first stage of pedagogical practice, etc., exchanged ideas and organized a discussion around the mentioned topics. In this regard, “My achievemets in the process of pedagogical practice” (F.Garazade), “The role of innovations acquired during pedagogical practice in my formation as a teacher” (A.Khidirova), “The main issues facing the teacher in modern times and ways to solve them (based on the experience gained as a results of pedagogical practice)” (N.Musayeva), “Knowledge, skills, tools and competencies necessary to achieve high success in the teaching process in the pedagogical practice” (R.Talibova), “The main requirements facing the teacher for the successful receipt of the lesson (based on the experience gained in the process of pedagogical practice)” (M.Yuzbekova), “Pedagogical experience: realities and expectations” (A.Shururov), “What innovations did the construction of pedagogical practice in a new form lead to for me?” (H.Umudov), ets. the choice of such topics already informs that the experience gained by students leads to changes in their views and the level of preparation for the passage of real lessons at school.

Thus, the successful implementation by both teachers and students of the new type of internship process, which began to be applied since Fabruary 2025, can be considered an important achiement in the pedagogical life of the Azerbaijan State Pedagogical University. This process will improve futher in the coming years and will condition the process of experimentation

to become a perfect process. Practice always raquires the application of innovations with the mind, restranit and perseverance. The activities carried out by our university in this area are commendable.

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Medical Sciences

NEW STRATEGY FOR PRIMARY PREVENTION OF RADIATION-INDUCED CANCER THROUGH THE LENS OF THE CHERNOBYL EXPERIENCE

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Key words: cancer prevention, low doses of radiation, co-mutagens, radioprotectors, cytogenetics

Introduction. *The problem of radiation carcinogenesis has been studied intensively for only a few decades and has become particularly relevant due to the long-term negative consequences of the Chernobyl disaster, the development of the nuclear industry, and the use of radiation methods of diagnosis and treatment in medicine, which increases the number of people exposed to additional radiation loads. But most importantly, the Chernobyl experience has proven the carcinogenic danger of radiation to the human body in the low-dose range. The prolonged radioecological crisis that developed after the accident at the Chernobyl Nuclear Power Plant dictates the need for new approaches to the development of prevention of stochastic effects, including carcinogenic ones, caused by the action of ionising radiation in low doses. A limiting factor in the study of this problem is the long latent period of radiation carcinogenesis, since no morphological or functional changes are observed in the body in the relatively early stages after exposure to low (above background) doses. Ethical indicators, individual radiosensitivity of humans.*

Justification and development of new prevention measures for radiation-induced cancer in the post-Chernobyl period. Genome instability plays a special role in the process of oncogenesis, determining the high probability and consolidation of genetic disorders in the cell population. "Chromosome destabilisation is the first and direct sign of general genome instability" [1]. An example of chromosomal instability is unstable aberrations – dicentrics observed several cell divisions after irradiation, the so-called "delayed" dicentrics [2], which, unlike the first mitosis, are not accompanied by paired fragments [3, 4]. It is known that radiation-induced chromosomal aberrations are involved in malignant cell transformation, the formation of which is associated with changes in the structure and activity of oncogenes, which is one of the causes of human cell malignancy [5].

The relationship between radiation-induced mutagenesis in human somatic cells and their malignant degeneration supports the use of cytogenetic indicators as prognostic markers for cancer development in a particular individual [6-11]. This also indicates that chromosomal aberrations in human peripheral blood lymphocites can be legitimately used not only as the "gold standard" for biological indication/dosimetry of radiation exposure, but also as a preclinical marker for the onset of cancer [12].

The author of the idea has developed and proposed a new strategy for the primary prevention of radiation-induced cancer [13], based on cytogenetic studies using a test system of human peripheral blood lymphocyte (PBL) culture and subsequent analysis of chromosome aberrations. The results of the studies that formed the basis for this strategy were described in detail in the previous chapters.

This methodological approach is based on the fact that human blood lymphocytes are recommended as a target for assessing the mutagenicity of various environmental factors and for genetic monitoring of its condition, for the development and improvement of radiation protection of the human genome, and as a model for determining and predicting the individual radiation sensitivity of the human body. Among various blood cells, mature T-lymphocytes are responsible for cellular immune responses, perform immunological surveillance of the body's antigenic homeostasis, and provide the body's antitumour activity. Formed from multipotent bone marrow stem cells, they differentiate in the thymus, acquiring cell receptors and surface markers. Lymphocyte maturation occurs continuously (106 new lymphocytes appear every second) and therefore their population consists of cells at different stages of differentiation. In peripheral blood, lymphocytes do not divide, remaining in the G0 (resting) stage and representing a naturally synchronised population of cells.

The low and relatively constant spontaneous level of chromosome aberrations in the LPC of clinically healthy donors (on average 1.2-1.5%) and, at the same time, high radiosensitivity of lymphocyte chromosomes compared to chromosomes of other cells, both in vivo and in vitro, allows a reliable increase in the induced level of chromosome aberrations above the spontaneous level at low levels of irradiation to be recorded. The high mobility of lymphocytes in the bloodstream, the distribution of lymph nodes throughout the body, and the ability to accumulate chromosome damage make it possible not only to assess the radiosensitivity of the human body as a whole, but also to predict the consequences of radiation exposure.

The peripheral blood lymphocites test system allows clear differentiation between the effects of two main types of mutagenic exposure: chemical and physical (including ionising radiation). Chemical agents mainly induce chromosomal aberrations in the LPC, while radiation exposure induces chromosomal aberrations. Radiation cytogenetics manuals repeatedly report approximately the same yield of chromosome aberrations when lymphocytes are irradiated in vitro and in vivo, i.e. cells respond to irradiation as an autonomous biological system [14]. Recently, it has been noted that mitogen-stimulated lymphocytes contain elevated levels of DNA polymerase and ligase, and their ability to repair single breaks is increased. Leading experts in the field of radiation cytogenetics have repeatedly noted that the frequency of chromosomal aberrations in blood lymphocytes most reliably reflects the reactions of the human body's " " to radiation exposure. It should be taken into account that the combined effect of radiation and chemical agents causes a negative synergistic effect.

A new strategy for the primary prevention of radiation-induced cancer has been developed, based on data from experimental cytogenetic studies, which includes the following stages: assessment of the individual radiation sensitivity of a group of healthy individuals; consideration of the effects of co-mutagens; use of non-toxic, effective radioprotectors.

1. Assessment of the individual radiation sensitivity of a group of healthy individuals is a key stage of the strategy, as it allows the individual risk of developing radiation-induced cancer to be predicted and thus primary prevention of its development to be carried out at the individual level. For this purpose, we recommend using the G2-radiation sensitivity assay, which we have modified based on the classical principles of radiation cytogenetics, to identify individuals with increased IRR among the healthy population. In short, it involves assessing the cytogenetic effect induced by test irradiation during the most radiosensitive period (late G2) of the mitotic cycle of peripheral blood lymphocites in culture. Individual differences in radiosensitivity of healthy

individuals during test irradiation of blood samples at the same dose are formed due to chromatid deletions and cells with multiple aberrations. For practical use of this test, we have proposed a coefficient for determining IRR values – IRR.

An increase in IRR in conditionally healthy individuals compared to its average population values is considered a factor of increased carcinogenic risk. In this regard, we have developed indications for priority cytogenetic screening of individuals working (or for career guidance purposes) in the field of ionising radiation, as well as for other priority population groups using the G2 chromosome test (G2 radiation sensitivity assay) to identify those who are hypersensitive to radiation [15]:

• during professional selection of individuals for work in the field of ionising radiation, even when sanitary and hygienic regulations are observed;

• during repeated X-ray examinations of persons with a family history of cancer, as well as patients with chronic diseases, weakened immunity, during X-ray contrast studies with increased radiation exposure (e.g., irrigoscopy, vascular catheterisation, computed tomography, etc.);

• when deciding on the safety of families with a hereditary cancer burden living in areas contaminated with radionuclides;

• as part of routine medical examinations of healthcare workers exposed to ionising radiation, primarily radiation oncologists and X-ray technicians.

The use of these indications will make it possible to justify narrowing the group of people for cytogenetic examination based on the modified G2-radiation sensitivity assay, given its relative complexity. When assessing IRW values, we recommend taking into account information from the examinee's medical history about concomitant precancerous diseases, harmful habits, etc. Thus, the recommended method for identifying individuals who are hypersensitive to radiation (G2-radiation sensitivity assay) among the healthy population will allow, at the first stage, the formation of groups at increased risk of developing radiation-induced tumours for transition to the next stages of primary prevention at the individual level.

2.Taking into account the impact of co-mutagens. Co-mutagens are drugs that do not have mutagenic properties but significantly modify (potentiate) the effects of low doses of ionising radiation. The dominant mechanism in the formation of co-mutagenic effects is the suppression of the repair system for primary radiation damage.

The effect of drugs with co-mutagenic activity (e.g. verapamil, ascorbic acid, caffeine, etc.) in concentrations exceeding therapeutic levels potentiates cytogenetic effects in the low-dose radiation range by an average of 1.2-1.5 times [16].

Given the oncogenic risk of increased chromosomal changes in the cell population, the second stage of primary prevention for individuals with identified increased radiosensitivity is an individualised approach to the use of drugs with co-mutagenic activity for therapeutic and prophylactic purposes.

3. Prescription of non-toxic, effective radioprotectors, the action of which is due to the activation of repair processes. Such protectors include inosine (riboxin) and thymic preparations (thymalin), which, in prophylactic doses, reduce the level of genetic damage induced by low doses of radiation to spontaneous levels. Preparations with this type of action should be prescribed primarily to individuals with a high IRR [17,18].

A new scientifically based strategy for the primary prevention of radiogenic tumours at the individual level will reduce the carcinogenic risk from exposure to low (above background) doses by assessing the individual radiation sensitivity of healthy individuals using the chromosomal G2 test, taking into account (limiting) the additional influence of co-mutagens with the subsequent appointment of non-toxic radioprotectors to individuals with radiosensitive genotypes (Ukrainian patent No. 67007) [19].

We associate further improvement of primary prevention of radiogenic tumours with comprehensive testing of priority population groups by including not only cytogenetic, but also molecular-genetic, biochemical, and immunological methods. When developing systematic approaches to the prevention of radiation carcinogenesis, the mechanisms of genetic instability formation should be taken into account. Under the action of low-intensity, rare ionising radiation, indirect rather than direct mutagenesis processes dominate through the formation of active free radical states. Therefore, preventive measures should include enriching the body with antioxidants and using all means that promote the activation of antioxidant enzymes, among which the powerful antimutagen catalase is key. Equally important is the determination of the content of LGCs (large granulocyte-containing lymphocytes), which are natural killers that perform antitumour surveillance [20].

Conclusion. A new strategy for the primary prevention of radiogenic cancer has been developed and scientifically substantiated on the basis of cytogenetic studies by identifying individuals with increased individual radiosensitivity among the healthy population and protecting their genome from the effects of low doses of radiation. Cytogenetic studies were performed on peripheral blood lymphocyte cultures, which are the most radiosensitive human somatic cells recognised by leading international organisations such as the WHO, IAEA and UNSCEAR as an informative bioindicator of radiation exposure, including in the low-dose range. Analysis of the metaphases of the first mitosis allows the identification of individuals who are hypersensitive to radiation (G2-radiation sensitivity assay) and thus the formation of groups at increased risk of developing radiation-induced cancer. The genetically determined ability of cells to repair themselves is an indicator of their radiosensitivity/radioresistance. The most important processes include the repair of single-strand and double-strand DNA breaks. Therefore, the use of prophylactic drugs (e.g. inosine, thymidine, etc.) that activate repair processes can reduce the frequency of damage induced by low doses of radiation to spontaneous levels and thus increase the radio-resistance of the genome. On the other hand, individuals with increased sensitivity to radiation should monitor their use of medical drugs with co-mutagenic properties (in doses not exceeding therapeutic levels). In conclusion, we emphasize that the novelty of the proposed strategy for primary prevention of radiation-induced cancer lies in its real possibility of implementation at the individual level. This should also be taken into account in view of the real threat of a nuclear attack by the aggressor country, the Russian Federation.

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