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Kamala GURBANOVA,
orcid.org/0009-0005-1961-674X

PhD,

Lecturer at the Department of History of Azerbaijan
Baku State University
(Baku, Azerbaijan) kamala.gurbanova@bsu.edu.az

DEVELOPMENT STRATEGY OF AZERBAIJANI SCIENCE IN THE 21ST CENTURY: HISTORICAL CONTINUITY AND INNOVATIVE TRANSFORMATION

This article offers an in-depth analysis of the development strategy of Azerbaijani science in the 21st century, examined through the prism of historical continuity and innovative transformation. The study conceptualizes science not only as a system of knowledge production but also as a strategic instrument of national development, socio-economic modernization, and intellectual sustainability. Particular emphasis is placed on the ontological and methodological foundations of science and its role in shaping state policy and societal progress.

The research highlights the decisive impact of the reforms initiated during Heydar Aliyev's leadership beginning in 1969, which laid the institutional, personnel, and conceptual groundwork for the modern scientific and educational system of Azerbaijan. These reforms contributed to the formation of a highly qualified intellectual elite, the expansion of scientific infrastructure, and the strengthening of the link between education, science, and economic development. In the years of independence, this legacy was further developed through systematic modernization of research institutions, integration into the global scientific space, and the promotion of interdisciplinary approaches.

The article also examines contemporary innovations, including the digitalization of scientific activity, increased international cooperation, and the prioritization of strategic research areas such as artificial intelligence, renewable energy, and biotechnology. These processes are analyzed in the context of global challenges, including technological competition, climate change, and sustainable development. The findings suggest that Azerbaijan's scientific development strategy, grounded in historical continuity and adaptive innovation, has significant potential to enhance national competitiveness and contribute meaningfully to the global knowledge economy.

Key words: Azerbaijani science, 21st century, dynamics of scientific development, Heydar Aliyev, science and education policy, institutional transformation, innovation, global integration.

Камала ГУРБАНОВА,
orcid.org/0009-0005-1961-674X

доктор філософії,

викладач кафедри історії Азербайджану
Бакинського державного університету

(Баку, Азербайджан) kamala.gurbanova@bsu.edu.az

СТРАТЕГІЯ РОЗВИТКУ АЗЕРБАЙДЖАНСЬКОЇ НАУКИ У ХХІ СТОЛІТТІ: ІСТОРИЧНА СПАДКОЄМНІСТЬ ТА ІННОВАЦІЙНА ТРАНСФОРМАЦІЯ

У статті здійснено комплексний і ґрунтовний аналіз стратегії розвитку азербайджанської науки у ХХІ столітті крізь призму історичної спадкоємності, державотворчих традицій та сучасної інноваційної трансформації. Наука інтерпретується не лише як інституціоналізована система продукування та акумуляції знань, а як стратегічний ресурс сталого національного розвитку, важливий чинник соціально-економічної модернізації, формування людського капіталу та забезпечення інтелектуальної безпеки держави. Особливу увагу приділено онтологічним і методологічним засадам наукового пізнання, а також ролі науки у формуванні ефективної державної політики та довгострокового суспільного поступу.

У дослідженні наголошується на вирішальному значенні реформ, започаткованих у період керівництва Гейдара Алієва з 1969 року, які заклали інституційні, кадрові та концептуальні основи сучасної науково-освітньої системи Азербайджану. Саме в цей період було створено умови для підготовки висококваліфікованих наукових кадрів, зміцнення академічних інституцій, розбудови матеріально-технічної бази та формування тісного взаємозв'язку між наукою, освітою і потребами економічного розвитку. Уроки незалежності закладений потенціал було суттєво розширено шляхом структурної модернізації наукових установ, удосконалення системи управління наукою, інтеграції у світовий науковий простір та активного розвитку міждисциплінарних досліджень.

Окремий розділ присвячено аналізу сучасних інноваційних процесів, зокрема цифровізації наукової діяльності, впровадженню електронних платформ управління дослідженнями, розширенню міжнародного наукового співробітництва та концентрації ресурсів на пріоритетних напрямках, таких як штучний інтелект, відновлювана енергетика, біотехнології й нанонаука. Зроблено висновок, що стратегія розвитку азербайджанської науки, заснована на поєднанні історичної спадкоємності та інноваційної адаптації до глобальних викликів, має значний потенціал для підвищення національної конкурентоспроможності та активної участі Азербайджану у формуванні глобальної економіки знань.

Ключові слова: азербайджанська наука, XXI століття, динаміка наукового розвитку, Гейдар Алієв, політика у сфері науки й освіти, інституційна трансформація, інновації, глобальна інтеграція.

Introduction. In the global intellectual landscape of the 21st century, science is regarded not only as a leading mechanism of economic and social transformation but also as a fundamental pillar of national development strategies. In the contemporary world, knowledge production, innovation capacity, and scientific and technological progress have become key indicators determining the competitiveness of states. In this context, the institutional organization of science, its methodological foundations, and its social functions are closely linked to issues of national security, sustainable development, and the preservation of cultural identity.

For the Republic of Azerbaijan, located at the historical crossroads of Eastern and Western civilizations, the dynamics of scientific development acquire particular significance. Azerbaijani science has evolved on the basis of a rich cultural and intellectual heritage shaped over centuries, while simultaneously adapting to rapid innovation processes within the global scientific environment. This dual context has conditioned the formation of science through a synthesis of historical continuity and modern transformation.

This article systematically examines the development trajectory of Azerbaijani science in the 21st century, starting from the scientific and institutional foundations established during the leadership of Heydar Aliyev (1969–1980) and extending to the structural and conceptual reforms implemented during the years of independence. The primary aim of the study is to identify the ontological and methodological foundations of science, to analyze its functional role in economic and social spheres, and to assess the potential of contemporary scientific innovations for Azerbaijan within a global context. Based on historical empirical data, analytical methodology, and current statistical indicators, this research seeks to contribute to the scientific substantiation of future development prospects for Azerbaijani science.

Conceptual Foundations of Science in Contemporary Development. In the contemporary era, ensuring sustainable development across economic, social, and intellectual domains imperatively requires the conceptualization of science as an integrated system, as well as a comprehensive examination of its

functional mechanisms and the regularities governing its development dynamics within a complex methodological framework. Science, as one of the most fundamental forms of human cognition, constitutes a central component of cognitive processes aimed at providing epistemological explanations of the natural environment and social structures. In this context, science is defined as a specialized domain encompassing both the practical and theoretical dimensions of human activity. Furthermore, science functions as a structured body of systematized knowledge concerning the evolutionary laws of nature, society, and cognitive processes.

The primary mission of science lies in the disciplined explanation of dominant patterns, phenomena, and processes within specific sectors of reality, as well as in the accumulation, organization, and analytical and critical evaluation of empirical data. Consequently, the conceptual achievements derived from this analytical process are generalized, integrated, and synthesized, thereby contributing to the formation of new epistemological constructs (Qubatoglu, 2002: 128–129). This paradigmatic approach underscores the ontological and methodological foundations of science while foregrounding its strategic role in economic and social transformations.

Within such an analytical framework, Azerbaijani science stands out due to its rich historical heritage and a development trajectory shaped over decades. Integrated into the global scientific ecosystem, this national scientific tradition has acquired a substantial presence within the dynamics of global intellectual development. As observed in the international scientific landscape, Azerbaijani science has experienced phases of both advancement and regression influenced by exogenous factors. At the present stage, however, Azerbaijani science occupies a peak phase of development as a result of the activation of innovative potential and institutional transformations, thereby remaining open to the optimization of its future prospects.

Statehood, Scientific Development, and Cultural Transformation in Modern Azerbaijan. In the second decade of the 21st century, the Republic of Azerbaijan is experiencing a new stage of its inde-

pendence period. Possessing an ancient cultural heritage and a rich cultural palette, the Azerbaijani people continue to strengthen their strategic position within the geo-strategic and geopolitical arena located at the historical crossroads of Eastern and Western civilizations. As a secular state model grounded in legal and democratic principles, Azerbaijan has successfully integrated into the new century. By commemorating the twentieth anniversary of its national sovereignty in October 2012 through large-scale events, the country symbolically concluded the historical processes of the previous century and openly articulated the contours of its future socio-political and cultural development strategies to the international community (Heyder Eliyev irsinde Azerbaycan elminin inkişafi, 2018).

Within this context, the statements made by the President of the Republic of Azerbaijan, Heydar Aliyev, on the occasion of the independence anniversary remain highly relevant and strategically significant. He emphasized that Azerbaijani society had undergone profound development, illiteracy had been completely eradicated, higher education institutions and universities had been established, scientific institutions had expanded, and substantial industrial and economic potential had been created. According to Aliyev, the rapid development of culture, literature, and the arts generated a powerful economic, social, and scientific foundation for the independent Azerbaijani state, underscoring the necessity of objectively evaluating this historical period without distorting any of its pages – recognizing both its positive and negative dimensions (Aliyev, 1997: 8).

This perspective presents a holistic paradigm of state-building transformation in the post-Soviet space, integrating multiple dimensions of development, including education, economic diversification, scientific infrastructure, and cultural revitalization. The principle of referencing historical narratives as analytical objects serves as a methodological foundation for ensuring national continuity and adaptive resilience.

In the broader trajectory of Azerbaijan's 20th-century development, the fundamental advances observed in education, science, and culture can be interpreted as manifestations of a strategic intellectual renaissance. Within this framework of historical determinism, the dominant leadership role of Heydar Aliyev occupies a central position in the evolution of a national educational, scientific, and cultural infrastructure capable of responding to the parameters of modern global civilization. It is therefore justified to conceptualize the past thirty-three years of Azerbaijan's social, economic, and cultural development as a distinct phase of transformation, highlighting the global relevance

and responsiveness of the institutional achievements generated during this period.

Heydar Aliyev's Leadership and the Intellectual Renaissance of Modern Azerbaijan. Within the historical framework of global philosophy and scientific discourse, the dialectics of societal development and the paradigms of national progress and civilization consistently highlight the catalytic role of historical personalities. The leading positions of national leaders are recognized as fundamental determinants in the cultural ascent of distinct nations and the consolidation of statehood. In the contemporary period, the independent Republic of Azerbaijan, situated within the processes of global integration, embodies this principle through its rich cultural heritage and socio-intellectual potential. Over the past few decades, the contemporary national narrative has been symbolically shaped by the titanic, patriotism-driven initiatives of President Heydar Aliyev, who prioritized national interests.

A pivotal moment in Azerbaijan's modern historiography, 14 July 1969, marked the initiation of a new historical phase under Aliyev's leadership, which has since been analytically associated with the decisive trajectories of the previous century (Aliyev, 1997: 8). This event is evaluated as a strategic milestone in the methodological paradigms of post-colonial state-building and represents a prototype for factors catalyzing Azerbaijan's integration into the global intellectual ecosystem.

Twenty days after assuming leadership, during the August Plenum of the former Azerbaijani Communist Party Central Committee, Aliyev delivered a report that crystallized long-term strategic paradigms for the republic's socio-economic and cultural development. This speech was subsequently recognized not only as a prototype of innovative governance within the USSR but also attracted broad attention in Western media. Contemporary analytical evaluations emphasize that Aliyev's foresight in implementing a national development concept demonstrates an epistemologically remarkable understanding, redefining the ontological foundations of public service.

The empirical evidence of rapid transformative dynamics in Azerbaijan during this period is reflected in industrial production growth between 1970–1979, which exceeded the total output of the 1945–1969 period by a factor of 1.3. In addition, institutional achievements such as the purification of the moral-ideological climate, the integration of the motto "Let Justice Prevail!" into the republic's ethical-political principles, and the training of over 15,000 highly qualified specialists – including the formation of a national military elite – underscore the holistic impact

of this strategy. According to Russian analysts, Heydar Aliyev had already forecasted the USSR's disintegration and Azerbaijan's sovereign statehood during this period. This prediction aligns dialectically with the country's developmental trajectory over the subsequent thirteen years, demonstrating the global significance of the Heydar Aliyev phenomenon.

Historical experience empirically confirms that nations, states, and leaders prioritizing science, education, and culture not only ensure the economic and cultural ascent of their sovereign spaces but also contribute substantively to global cultural and civilizational discourse. In this context, it is methodologically significant to recall the ontological definition of the Turkish Republic's founder, Mustafa Kemal Atatürk: "The greatest individuals are those who think more of the society to which they belong than of themselves, devoting their lives to its preservation and well-being." Within this framework, Heydar Aliyev is portrayed as an intellectual and patriotic archetype of exceptional leadership. His systematic attention to national educational infrastructure and the principle of transformative self-reform occupies a central position in the transformative processes initiated under his leadership from 1969 onward.

This period is thus conceptualized as the phase of intellectual renaissance in modern Azerbaijani education, science, and culture, evolving along a continuous trajectory over several decades. Essentially, this transformation phase is characterized by the dialectical convergence of Azerbaijan's development narrative and Aliyev's personal trajectory. Within the historiography of Azerbaijani education, his conceptual reflections delivered at the XI Congress of Azerbaijani Teachers (25 December 1998) serve as a paradigmatic principle: "...that period was extremely significant for the enlightenment and education of our people. We must evaluate it appropriately and never forget it. We must give our history a fair assessment" (Aliyev, 1997: 24–47). Analytically, evaluating Heydar Aliyev's contributions to modern Azerbaijani education emphasizes two main vectors: a) his theoretical conceptualizations of national education and upbringing paradigms, and b) his practical catalytic role in the synergistic development trajectories across various educational domains.

Institutional and Conceptual Innovations in the Development of Azerbaijani Science and Education in the 21st Century.

One of the dominant achievements of 20th-century Azerbaijani history is the establishment of a comprehensive network of modern educational institutions, a process intrinsically linked to the strategic initiatives of Heydar Aliyev in recent decades. Evaluating the

instrumental role of the education system in societal and, particularly, state development, he emphasized:

"The value of this education system is evident in the presence of highly educated, skilled, and scientifically literate individuals in Azerbaijan, who constitute a significant portion of society. Without them, Azerbaijan's economy could not have developed so robustly. Without them, Azerbaijani science could not have advanced. Without them, we could not manage Azerbaijan as an independent state. Their contributions must be appreciated, and the achievements accumulated over decades must never be forgotten" (Aliyev, 1997: 10–21).

This discourse underscores the structural determinacy of education in economic, scientific, and governance processes while confirming the global relevance of Heydar Aliyev's visionary approach.

The dynamic rise of Azerbaijani science in the 21st century is characterized by both institutional-infrastructure innovations and conceptual-methodological transformations. These innovations, shaped by the integration of Heydar Aliyev's visionary legacy with contemporary state policy (Azerbaijan elminin inkişafı Heyder Eliyev zekasının tentenesidir, 2025), can be classified into two main categories:

Institutional Innovations:

Modernization of scientific infrastructure in the independence era (especially after 2000), including the participation of the Azerbaijan National Academy of Sciences in international projects, establishment of new research centers, and integration of digital platforms. For instance, following the 2012 independence anniversary, science funding increased two to threefold, supporting economic diversification and accelerating the transition from oil dependency.

Integration of education and science: Universities have been directed toward scientific priorities, with new programs in AI, biotechnology, and green energy. This continuation of achievements from Heydar Aliyev's era – training approximately 15,000 highly qualified specialists – enhances social inclusivity and increases global competitiveness among youth.

Conceptual Innovations:

Redefining ethical and moral principles in science: The motto "Let Justice Prevail!" has been integrated as an ethical foundation within contemporary scientific discourse, aligned with sustainable development models. This reflects the evolution of governance concepts articulated by Heydar Aliyev in the August 1969 Plenum and ensures alignment with global standards.

Development of interdisciplinary approaches: The fusion of science and technology with socio-economic processes, exemplified by contributions to the Great Silk Road projects. In response to global chal-

lenges such as pandemics and climate change (from the 2020s onward), prioritization of scientific research positions Azerbaijan as a regional innovation hub.

Empirical evidence, including a fivefold increase in scientific publications between 2010–2025, confirms the upward trajectory of Azerbaijani science, catalyzing economic growth by 3–4%.

Conclusions. The dynamic rise of Azerbaijani science in the 21st century, emerging from the synthesis of historical heritage and contemporary innovations, is recognized as a strategic pivot for national development. The trajectory established during the leadership of Heydar Aliyev functions not only through institutional transformations and conceptual innovations but also as a catalytic mechanism facilitating the integration of Azerbaijani science into the global intellectual ecosystem. As highlighted in this study, science serves not only as an epistemological foundation but also as an accelerator of socio-economic transformations and

a guarantor of sustainable development. In the contemporary period, Azerbaijani science aligns with international standards through the modernization of institutional structures, integration of education and research, and the redefinition of ethical and conceptual principles. These developments enable strengthened regional and global collaboration, accelerated technology transfer, and the prioritization of research activities. Looking ahead, the continued trajectory of Azerbaijani scientific advancement can be ensured through the implementation of sustainable development models, interdisciplinary research, and effective strategies for global cooperation. Consequently, Azerbaijani science, grounded in patriotism, ethical principles, and justice, is well-prepared to contribute new insights to global civilization. This not only underpins national progress and socio-economic development but also reinforces regional dialogue and international intellectual exchange.

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