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Mykhailova Ye. V. [1; ORCID ID: 0000-0002-1539-1548],
Doctor of Economics, Candidate of Philological Sciences (Ph.D.),
Associate Professor,
Tymoshchuk I. O. [1; ORCID ID: 0000-0002-0709-5087],
Associate Professor

[1]*National University of Water and Environmental Engineering, Rivne*

EDUCATION AND THE KNOWLEDGE ECONOMY IN THE CONTEXT OF GLOBAL TRANSFORMATIONS

This paper examines the role of education as a key driver of the knowledge economy and its impact on global economic development. The study applies a comparative approach, analyzing groups of countries with different socio-economic contexts, including European states, highly developed economies, and Middle Eastern countries. The analysis is based on international indices such as the Index of Economic Freedom (IEF), complemented by the concept of information entropy as a measure of uncertainty within educational and socio-economic systems. The paper also highlights Ukraine's position within global transformations. Despite structural challenges such as underfunding, uneven access to information resources, and external informational pressures, Ukraine shows potential for development through digitalization, international integration, and human capital growth. Strategic reforms aimed at reducing informational entropy, strengthening institutional capacity, and enhancing international cooperation are essential for transforming education into a catalyst of economic resilience and sustainable progress.

Keywords: education; knowledge economy; economic freedom; human capital; international integration.

The development of education has become a fundamental driver of the knowledge economy, which is characterized by the intensive use of information and communication technologies, the crucial role of innovation, and the growing importance of research. In today's global context, where knowledge is regarded as a strategic resource, education plays a key role in ensuring sustainable economic development and strengthening the competitiveness of nations.

Education not only prepares highly qualified specialists but also

fosters innovation, supports scientific research, increases productivity, and contributes to social equity. The integration of digital technologies into the educational process creates new opportunities for access to knowledge, human capital development, and economic growth.

At the same time, the interplay between education and the knowledge economy requires deeper analytical understanding, particularly in the light of globalization and international integration. Comparative analysis of countries with different socio-economic contexts and educational models makes it possible to identify common trends, regional specifics, and the factors that determine the effectiveness of educational policies.

This article aims to explore the international dimension of the relationship between education and economic development by analyzing groups of countries with diverse development trajectories and by assessing their position in global indices of human capital, economic freedom, innovation, and information entropy.

Literature Review and Methodology. The relationship between education and economic development has been widely discussed in economic and social sciences. A growing body of literature emphasizes that human capital is a decisive factor in shaping the knowledge economy, where innovation, information technologies, and scientific research serve as the key drivers of growth [2; 3]. International organizations such as UNESCO, the World Bank, and the OECD highlight the importance of education not only as a social institution but also as a strategic resource for enhancing productivity, competitiveness, and social cohesion.

In recent years, particular attention has been paid to the role of information systems and the concept of entropy in assessing the uncertainty and complexity of educational and economic processes. Entropy is increasingly viewed as a measure of information quality, accessibility, and stability, which directly influences decision-making processes and institutional efficiency. This perspective enables a deeper understanding of the external informational challenges that shape education systems in both developed and developing countries.

The methodological framework of this study combines both comparative and quantitative approaches in order to capture the complexity of the relationship between education and economic development. Comparative analysis allows for the identification of similarities and differences across countries with diverse socio-economic models, while quantitative indicators ensure that these observations are grounded in empirical evidence.

For empirical evaluation, the Index of Economic Freedom (IEF) was

employed as the central measure, as it reflects institutional conditions that are critical to the functioning of the knowledge economy, including property rights protection, regulatory efficiency, market openness, and transparency. To provide additional context, auxiliary indices such as the Human Development Index (HDI) and the Global Innovation Index (GII) were also considered in the discussion of broader international trends. The concept of information entropy was applied as a complementary tool to assess the degree of uncertainty and disorder in educational and socio-economic systems, thereby linking informational dynamics with institutional performance.

To ensure comparability, countries were grouped according to both their geographic proximity and their level of development. The first group included European neighboring states (Poland, France, Germany), which share historical and cultural linkages as well as EU-driven integration processes. The second group consisted of highly developed economies with global influence (United States, United Kingdom, China), representing diverse approaches to innovation, education policy, and technological leadership. The third group involved Middle Eastern countries with distinct socio-political contexts (Turkey, Israel, Saudi Arabia), selected to highlight the role of institutional diversity in shaping the education–economy nexus.

This grouping provided a balanced framework for analysis, enabling a cross-regional comparison that reveals both structural commonalities and unique trajectories. By combining institutional indicators with entropy-based measures, the methodology not only evaluates the current state of education systems but also captures their capacity to adapt to uncertainty and to contribute effectively to the development of the knowledge economy.

The comparative analysis of the selected country groups highlights the strong interconnection between education, economic freedom, and innovation capacity. Countries with high levels of economic freedom generally demonstrate more consistent educational policies, stronger institutional support for research, and greater integration of digital technologies into learning. In such contexts, the education system becomes not only a mechanism for preparing specialists but also an active contributor to innovation, knowledge transfer, and the creation of new economic opportunities.

The Index of Economic Freedom (IEF) proved to be a reliable indicator of the institutional conditions under which the knowledge economy develops. Nations such as the United States, Germany, and

France, which occupy higher positions in the IEF ranking, provide favorable environments for entrepreneurship, transparent regulatory frameworks, and effective protection of property rights. These elements create a virtuous cycle: secure property rights and efficient markets stimulate private investments in education, while an advanced education system in turn generates skilled labor and new technologies that strengthen economic freedom.

In contrast, countries with lower IEF scores face structural barriers that constrain both economic activity and the development of education systems. Weak regulatory frameworks, insufficient protection of property rights, and higher levels of corruption undermine incentives for long-term investment in human capital. As a result, the education sector often lacks resources for modernization, which negatively affects innovation capacity and limits participation in the global knowledge economy.

This correlation becomes especially evident when comparing countries across different levels of development. While advanced economies tend to reinforce the synergy between education and economic freedom, emerging economies often struggle to overcome institutional weaknesses that increase systemic uncertainty and reduce efficiency (Table 1).

Table 1

Country rankings according to the Index of Economic Freedom

№	Country	The Index of Economic Freedom												
		General score	Property Rights	Judical Effectiveness	Govt Integrity	Tax Burden	Gov't Spending	Fiscal Health	Business Freedom	Labor Freedom	Monetary Freedom	Trade Freedom	Investment Freedom	Financial Freedom
1.	Ukraine	**54.1**	39.7	33.8	31.4	89.1	44.5	73.6	61.1	60.7	71.2	78.6	35.0	30.0
2.	Poland	**68.7**	72.3	60.6	54.7	73.6	41.9	78.3	78.7	55.7	79.1	79.2	80.0	70.0
3.	France	**65.9**	93.8	75.9	85.5	52.1	0.5	39.1	81.9	58.8	79.1	79.2	75.0	70.0
4.	Germany	**76.1**	95.7	89.4	95.3	59.9	34.5	90.4	87.2	52.3	79.5	79.2	80.0	70.0
5.	USA	**72.1**	95.7	75.7	77.9	75.9	54.5	0.0	87.5	75.8	82.3	75.2	85.0	80.0
6.	UK	**72.7**	96.2	87.1	85.9	65.4	46.3	22,6	79.1	62.1	83.0	84.2	80.0	80.0
7.	China	**48.0**	43.7	39.3	37.4	71.2	64.2	11,1	68.8	57.2	70.0	73.2	20.0	20.0
8.	Turkey	**56.9**	42.0	39.4	25,6	74.7	63.8	59.2	63.4	47.1	61.9	75.6	70.0	60.0
9.	Israel	**68.0**	83.2	65.2	85.0	60.4	48.4	23,1	81.1	56.5	84.8	78.8	80.0	70.0
10.	Saudi Arabia	**55.5**	46.7	50.7	35.8	99.3	57.3	17,9	68.1	41.2	79.0	74.8	45.0	50.0

Source: developed by the author

At the same time, the analysis of information entropy revealed its significance as a complementary indicator of the quality and stability of educational and economic systems. While traditional indices such as HDI or IEF measure institutional and structural aspects of development, entropy provides an additional perspective by capturing the degree of uncertainty and disorder within information and decision-making processes. In educational contexts, high levels of entropy may reflect information overload – where excessive and fragmented data complicates the process of identifying relevant knowledge or information scarcity, which limits access to necessary resources and creates learning gaps. Both conditions undermine efficiency and weaken the ability of education systems to serve as a driver of the knowledge economy.

The comparative findings demonstrate that countries with higher levels of economic freedom tend to exhibit lower entropy. This correlation suggests that transparent institutions, effective governance, and robust digital infrastructure help to reduce informational uncertainty, leading to greater consistency and homogeneity in educational and economic strategies. By contrast, in states with limited economic freedom, such as Turkey, higher entropy values indicate greater variability, uncertainty, and fragmentation of development approaches. In such environments, inconsistent access to information and weak institutional support create systemic instability, which not only hampers educational progress but also constrains innovation and broader economic development.

The relationship between entropy and economic freedom therefore provides valuable insights: reducing systemic uncertainty is not merely a technical challenge but a strategic priority for strengthening the resilience of education systems and their capacity to contribute to sustainable economic growth (Table 2).

Taken together, the findings suggest that reducing informational entropy and strengthening economic freedom are mutually reinforcing processes. When uncertainty in information flows is minimized, education systems are able to function more efficiently, ensuring better access to knowledge, higher quality of learning outcomes, and stronger alignment with the needs of the labor market. At the same time, transparent institutions and open economic frameworks create the incentives and stability required for long-term investment in human capital.

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Table 2

Entropy value according to the Index of Economic Freedom

№	Country	The Index of Economic Freedom												
		Property Rights	Judical Effectiveness	Govt Integrity	Tax Burden	Gov't Spending	Fiscal Health	Business Freedom	Labor Freedom	Monetary Freedom	Trade Freedom	Investment Freedom	Financial Freedom	Entropy
1.	Ukraine	39.7	33.8	31.4	89.1	44.5	73.6	61.1	60.7	71.2	78.6	35.0	30.0	2.416994
2.	Poland	72.3	60.6	54.7	73.6	41.9	78.3	78.7	55.7	79.1	79.2	80.0	70.0	2.468599
3.	France	93.8	75.9	85.5	52.1	0.5	39.1	81.9	58.8	79.1	79.2	75.0	70.0	2.37752
4.	Germany	95.7	89.4	95.3	59.9	34.5	90.4	87.2	52.3	79.5	79.2	80.0	70.0	2.453648
5.	USA	95.7	75.7	77.9	75.9	54.5	0.0	87.5	75.8	82.3	75.2	85.0	80.0	2.389867
6.	UK	96.2	87.1	85.9	65.4	46.3	22,6	79.1	62.1	83.0	84.2	80.0	80.0	2.46372
7.	China	43.7	39.3	37.4	71.2	64.2	11,1	68.8	57.2	70.0	73.2	20.0	20.0	2.378404
8.	Turkey	42.0	39.4	25,6	74.7	63.8	59.2	63.4	47.1	61.9	75.6	70.0	60.0	2.476612
9.	Israel	83.2	65.2	85.0	60.4	48.4	23,1	81.1	56.5	84.8	78.8	80.0	70.0	2.450613
10.	Saudi Arabia	46.7	50.7	35.8	99.3	57.3	17,9	68.1	41.2	79.0	74.8	45.0	50.0	2.449237

Source: developed by the author

A transparent, innovation-oriented environment not only facilitates economic growth but also enhances the ability of education systems to respond effectively to global challenges such as digitalization, globalization of labor markets, and the growing demand for lifelong learning. In this way, education becomes both a beneficiary of favorable economic conditions and a driver of structural transformations that improve resilience and competitiveness at the national and international levels.

Ukraine's position in international indices reflects both significant challenges and emerging opportunities for the development of its education system within the knowledge economy. Although the country lags behind highly developed economies in terms of economic freedom and innovation capacity, it demonstrates gradual progress in digitalization, human capital development, and the integration of new technologies into the learning process.

The key challenges for Ukraine remain structural and systemic, reflecting long-standing weaknesses in the governance of the education sector. Limited public funding constrains the ability of universities and schools to modernize infrastructure, adopt innovative teaching methods, and invest in research. This financial gap widens inequalities between

institutions, as leading universities in major cities have greater access to resources, while regional institutions struggle to maintain basic quality standards. Uneven access to modern information resources further exacerbates disparities, particularly between urban and rural areas, creating an imbalance in opportunities for students and teachers. Moreover, the destabilizing influence of external informational pressures, including disinformation and the manipulation of public discourse, contributes to higher levels of entropy within the system, reducing trust in institutions and complicating evidence-based policy-making. Another crucial challenge lies in aligning educational programs with the rapidly evolving demands of the labor market, especially in sectors driven by digitalization and innovation. Without adaptive governance and regular curriculum updates, there is a risk of widening the skills gap and limiting the employability of graduates.

At the same time, Ukraine holds substantial opportunities that, if strategically utilized, could transform these challenges into drivers of progress. The country's integration into the European Higher Education Area and participation in EU initiatives such as Erasmus+ and Horizon Europe open pathways for institutional modernization, capacity building, and knowledge transfer from leading European partners. Expanding digital learning practices, particularly through blended and distance education, provides a means to bridge regional disparities and ensure continuity of education in times of crisis. Strengthening international research cooperation can also foster joint innovation projects and enhance the visibility of Ukrainian science within the global academic community. Furthermore, prioritizing the development of human capital, by investing in teacher training, promoting STEM education, and encouraging lifelong learning can significantly improve the adaptability, resilience, and competitiveness of the national education system. Taken together, these opportunities create a window for Ukraine not only to catch up with international standards but also to position education as a strategic driver of economic recovery and long-term development.

Overall, Ukraine's position within global transformations is characterized by a dual dynamic: while the country faces considerable constraints, it also possesses the potential to transform education into a strategic instrument for sustainable economic growth and international competitiveness.

Conclusions. The study reaffirms the critical role of education in fostering the knowledge economy and supporting sustainable economic

growth. Comparative analysis has shown that higher levels of economic freedom correlate with lower informational entropy, reflecting greater consistency in educational policies, better institutional performance, and stronger innovation capacity. Conversely, in countries with weaker institutional frameworks and limited economic freedom, higher entropy translates into fragmented development strategies, inefficiencies in knowledge transfer, and reduced competitiveness.

For Ukraine, the findings reveal a dual reality of systemic challenges and significant opportunities. Structural weaknesses such as underfunded institutions, uneven access to information resources, and the destabilizing influence of external informational pressures undermine stability and generate higher entropy within the education system. At the same time, the need to adjust educational programs to the dynamic demands of the labor market exposes gaps in adaptive governance and limits the country's ability to prepare graduates for knowledge-intensive industries.

Despite these constraints, Ukraine has considerable potential to reposition education as a strategic driver of national development. Deeper integration into the European Higher Education Area and participation in EU programs create opportunities for institutional modernization and knowledge transfer. Expanding digital education practices can bridge regional disparities and improve accessibility, while strengthening international research cooperation will accelerate innovation and enhance Ukraine's visibility in the global academic arena. Furthermore, prioritizing human capital through targeted investments in teacher training, STEM education, and lifelong learning can significantly improve adaptability and resilience.

To fully unlock this potential, several policy directions are recommended. First, Ukraine must increase and diversify funding for education, ensuring not only basic provision but also strategic investments in digital infrastructure and innovation capacity. Second, reducing informational entropy requires the establishment of reliable systems for filtering, verifying, and managing information flows in education, thereby improving decision-making and institutional trust. Third, closer cooperation between universities, research institutions, and the labor market should be promoted to guarantee the relevance of educational programs. Finally, internationalization should remain a core priority, allowing Ukraine to absorb global best practices while contributing its own expertise to the international academic community.

Overall, the evidence suggests that education should be regarded not merely as a social sector but as a strategic instrument of resilience, competitiveness, and sustainable development. For Ukraine, addressing systemic weaknesses while leveraging its integration with European and global structures offers a pathway toward transforming education into a catalyst for long-term economic progress.

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Михайлова Є. В. [1; ORCID ID: 0000-0002-1539-1548],
д.е.н., к.філол.н., доцент,
Тимощук І. О. [1; ORCID ID: 0000-0002-0709-5087],
доцент

[1]*Національний університет водного господарства та природокористування, м. Рівне*

ОСВІТА ТА ЕКОНОМІКА ЗНАНЬ У КОНТЕКСТІ СВІТОВИХ ТРАНСФОРМАЦІЙ

У статті розглядається роль освіти як ключового чинника розвитку економіки знань та її вплив на соціально-економічну динаміку у глобальному вимірі. У центрі дослідження знаходиться аналіз взаємозв'язку між розвитком освітніх систем та інституційними умовами економіки, що оцінювалися за допомогою Індексу економічної свободи. Саме цей показник обрано як базовий для дослідження, оскільки він комплексно відображає рівень захисту прав власності, прозорість регуляторного середовища, умови ведення бізнесу та рівень свободи

торгівлі і праці, які є визначальними для формування знаннєвої економіки. Порівняльний аналіз груп країн із різними моделями розвитку показав, що високі значення IEF корелюють із більшою узгодженістю освітньої політики, кращою інституційною підтримкою науки й інновацій та нижчим рівнем інформаційної ентропії у системах освіти. Навпаки, країни з низьким рівнем економічної свободи стикаються з вищою невизначеністю, що послаблює якість управління інформаційними потоками, ускладнює процес прийняття рішень та обмежує потенціал освіти як рушійної сили економічного зростання. Окрему увагу приділено місцю України у глобальних трансформаційних процесах. Незважаючи на структурні проблеми, недостатнє фінансування, нерівномірний доступ до інформаційних ресурсів та вплив зовнішніх інформаційних тисків, країна демонструє потенціал до розвитку завдяки цифровізації освітнього середовища, розширенню міжнародної співпраці та інтеграції у європейський освітній простір. Підвищення ефективності освітньої політики України можливе за умови посилення інституційної спроможності системи освіти, удосконалення управління інформаційними потоками та пріоритетного розвитку людського капіталу. Таким чином, результати дослідження підтверджують, що освіта має розглядатися не лише як соціальна сфера, а як стратегічний інструмент підвищення економічної свободи, зміцнення інноваційного потенціалу та забезпечення сталого розвитку у глобальному середовищі.

***Ключові слова*:** освіта; економіка знань; економічна свобода; людський капітал; міжнародна інтеграція.

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