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***Tertiary Sector Economics***

Vitalina KURYLIAK,
Maksym KURYLIAK,
Viktoriia SAVITSKA,
Nataliia LIVITSKA

# ECONOMIC CONVERGENCE OF UKRAINE'S ONLINE LEARNING MARKET WITHIN EUROPEAN AND GLOBAL EDUCATIONAL FRAMEWORKS

## Abstract

The study analyses the academic discourse on contemporary trends that shape the current state and future transformations of the online learning and Ed-Tech market. To assess the scale, growth rates and regional characteristics of the market's evolution, secondary statistical data from international educational organisations and analytical agencies were analysed. An approximate short-term extrapolation of these trends in the regional distribution of market shares in the



Kuryliak Vitalina, DSc (Economics), Professor, Department of International Economics, West Ukrainian National University, Ternopil, Ukraine. ORCID: 0000-0002-3566-7900 Email: ternopil2000@yahoo.com
Kuryliak Maksym, PhD (Economics), Senior Lecturer, Department of International Economics, West Ukrainian National University, Ternopil, Ukraine. ORCID: 0000-0003-1540-0915 Email: kurylyak-max@gmail.com
Savitska Viktoriia, PhD (Pedagogy), Senior Lecturer, Department of Educology and Pedagogy, West Ukrainian National University, Ternopil, Ukraine. ORCID: 0000-0002-9438-1734 Email: Savitska.Vika@ukr.net
livitska Nataliia, PhD (Philological Sciences), Senior Lecturer, Department of Educology and Pedagogy, West Ukrainian National University, Ternopil, Ukraine. ORCID: 0000-0003-0851-456X Email: n.livitska@wunu.edu.ua

EdTech sector was carried out. Concurrently, the economic convergence of the online learning market within global and European educational paradigms was analysed, with Ukraine serving as a case study. A number of issues have been identified in the development of online education in Ukraine, in particular uneven access to digital infrastructure and limited financial resources. The authors offer a series of recommendations for the development of the Ukrainian online learning market and outline potential opportunities for its economic integration into the European educational area.

## Key Words:

artificial intelligence, EdTech, education market, educational technologies, European educational framework, flexible learning, immersive technologies, online learning, personalisation.

**JEL:** I21, I23, O33.

3 tables, 4 formulas, 7 figures, 40 references.

## Problem Statement

In the contemporary era, innovative trends are driving profound changes in the economy, politics, culture, and the global order. In this context, education is becoming one of the most rapidly developing areas of international trade in services (Burch & Miglani, 2018). An entire sector of the global economy is being formed – the global market for educational services (Tsymbal & Kalenyuk, 2023). In the prevailing market economy, knowledge is becoming a special product, and its competitiveness increasingly determines the economic stability of individual participants, companies and their communities, cities and regions, countries and their associations.

In today's context, education is a significant factor in human capital formation, given its ability to promote knowledge acquisition, skill development and sociocultural experience (Savitska, Gomotiuk, et al., 2025; Savitska, Matveieva, et al., 2025). It influences the development of intellectual, social and professional competencies, thereby contributing to self-realisation and improving the quality of life. At

the current stage of technological development and intensifying global political, economic and social challenges, a fundamentally new approach to education has emerged, driving its transition to digital formats. Therefore, online learning is currently a combination of information technologies and teaching methods that allow students to obtain an education without physically attending an educational institution and using educational technologies to improve their results. Among the key incentives for educational institutions to offer online programmes, financial considerations and benefits stand out (for example, reduction of infrastructure for classrooms, offices, cafeterias, dormitories, libraries, etc.), the need to increase inclusiveness, the growing number of non-traditional students who work full-time, and the advanced level of technology that facilitates implementation. Simultaneously, there are a number of significant challenges related to ensuring the quality of online education, motivating and engaging students and teachers, access to digital infrastructure, and legal and regulatory support, which makes it necessary to systematically study the phenomenon of online learning. Despite the ambiguity of this format of learning, there has been a rapid growth in the market for online learning and educational technologies, and therefore, there is a need for a systematic academic understanding of the main trends, structural changes, drivers, and barriers to the development of online education systems in the global context and Ukrainian realities.

For the purposes of this study, we define economic convergence in the Ukrainian online learning market as the gradual alignment of the national digital education sector with European and global education systems. This alignment occurs across four interconnected dimensions: institutional and regulatory; technological; market-related; qualitative and analytical. In this context, we refer to increasing compatibility in terms of regulations, digital platforms, learning formats, assessment mechanisms, quality assurance procedures, and methods for integrating educational products into a transnational space.

The **research problem** therefore lies in determining whether the development of the Ukrainian online learning market shows signs of genuine economic convergence with the European education space or whether such convergence remains partial, asymmetrical, and predominantly technological. Considering this, the **main hypothesis (H1)** of the study is as follows:

The Ukrainian online learning market demonstrates partial convergence with European and global education systems; however, this convergence is uneven. This is most evident in the growth of digital platforms, flexible formats and EdTech solutions. In terms of quality, institutional support, digital analytics and financial integration, however, such convergence remains incomplete.

Therefore, **this study aims** to conceptualise the economic convergence of the Ukrainian online learning market and to determine the extent to which it is aligning with European and global education systems through an analysis of current market trends, technological transformations and institutional mechanisms for developing online education. To achieve this objective, the article intends to:

– summarise academic approaches to the development of online education and EdTech;

– identify key global and European trends in digital education;

– analyse the dynamics and structure of the global market for online education and EdTech;

– identify the specific dimensions in which economic convergence of the Ukrainian online learning market manifests itself;

– substantiate the limits and prospects for the integration of Ukrainian digital educational products into the European educational space.

## Literature Review

Today, online education is an innovative form of educational services provided using internet-based resources and technologies and aimed at professional training and retraining, continuing professional development, training in specific subjects, in-depth study of curriculum disciplines, additional education, and other educational purposes (Melnykova & Oliynyk, 2020). The main advantages of online learning are the ability of learners to independently define their educational goals (Makhsma & Kozlov, 2021); access to a large amount of information (Loban et al., 2021); unlimited communication with all participants in the educational process, regardless of their geographical location,and meeting society's need for highly qualified professionals (Bondar, 2024; Kobylarek, 2025); and diversification of funding for educational activities (Melnykova & Oliynyk, 2020). The need for a rapid reorientation of educational institutions towards online and remote formats (primarily due to global challenges (the COVID-19 pandemic), as well as local issues in some regions), has led to the expansion of the functionality of existing educational technologies and the creation of new opportunities in this field. The use of educational technologies contributes to the effectiveness of teaching and learning processes by increasing flexibility, thereby ensuring access to education in remote regions; an individualised approach that takes into account students' specific goals and learning pace; and improved student engagement (Zeyab & Alayyar, 2023). In particular, in the United States, educational programmes such as Summit Learning, K12 and Edgenuity, integrating traditional and online learning, provide personalised learning, particularly to support a high level of digital literacy and maintain the flexibility of the educational process. In Canada, on the other hand, the Canvas university learning management system (LMS) is used, which is an interface for Quercus, allowing the institution to effectively organise the learning process, ensure flexibility in the choice of teaching methods, support the interactivity of courses, and promote the individualisation of learning according to student needs.

It is worth noting that after the widespread shift towards distance learning in 2020, international studies quickly recorded a significant decline in academic performance (Abbas et al., 2025; Goldhaber et al., 2022). According to Birkelund & Karlson (2023), one of the key factors determining the extent of the losses was the duration of online learning: short-term school closures (up to 8 weeks), as was

the case in well-prepared systems in Switzerland, Denmark and Australia, had virtually no impact on results (Tomasik et al., 2021; Gore et al., 2021); however, after about six months of distance learning, educational losses begin to grow rapidly (Goldhaber et al., 2022). The authors of some studies, in particular Palvia et al. (2018), suggest that educational losses may have been temporary and concentrated mainly at the beginning of the pandemic, when schools and teachers had not yet had time to adapt to the new format.

Similar concerns are expressed by Vasta and Prenko (2022) and Che et al. (2022), who express reservations about the quality of online education, as many teachers have not had time to adapt to the new conditions or do not have sufficient resources to introduce the necessary tools into the lesson content. Marchisotti et al. (2022), who conducted a study in Brazil on perceptions of distance learning, identified the main reasons for bias as the anticipation of low-quality teaching, lack of trust in the teaching and learning process, lack of knowledge about this method of learning, and resistance to new things. In addition, Yalokha et al. (2023) notes that applicants face new challenges due to fluctuating study schedules.

Similar trends have been observed in Ukrainian scientific discourse, which is further complicated by the consequences of the ongoing war. In particular, Rudnytska et al. (2022) note that in the context of crises such as the COVID-19 pandemic, russia's invasion of Ukraine, and other global challenges in recent years, the online format has become a necessity that protects both higher education employees and students. However, Kraiova and Tsybaniuk (2024) note that such challenges are also a driving force for change; it is precisely under quarantine restrictions that educational technologies (EdTech) and online learning tools, such as interactive platforms, multimedia tools (But, 2024), video conferencing and virtual laboratories (Reznikov, 2023), have become widespread.

EdTech encompasses not only online learning, but also a whole range of software, digital tools and services that can assist in the delivery of education (Table 1). This includes mobile learning applications, curriculum management software, communication platforms for students, teachers and parents, online programme management software, electronic textbooks, digital content, online and cloud platforms.

A distinct strand of contemporary academic discourse concerns the use of artificial intelligence (AI) as a mechanism for monitoring and improving the quality of digital education. A systematic review by Banihashem et al. (2022) demonstrates that the integration of AI solutions into learning analytics significantly enhances the potential for feedback practices in technology-mediated learning. These systems operate at both the teacher and learner levels. In the European context, these processes are increasingly linked to digital education quality policy; in particular, the EU Action Plan on Digital Education for 2021–2027 defines digital education as high-quality, inclusive and accessible, and considers digital tools, content and assessment as components of the

modernisation of education systems (European Commission, 2021). Concurrently, Ncube et al. (2026) underscore that the integration of AI into online learning underscores not only the benefits but also the risks associated with academic integrity, the reliability of assessment, the transparency of algorithms and institutional responsibility.

*Table 1*

**The largest EdTech companies in the world (2025)**

| Organisation name | Country of origin | Field of activity | Approximate valuation, million US dollars |
|---|---|---|---|
| TAL Education | China | Educational services(K-12, STEAM education, tutoring) | 6200 |
| Headway | Ukraine | Educational services for micro-learning (courses, seminars) | 900.1 |
| Stepful | United States | Online platform for training and employment | 260 |
| Pebble | United Kingdom | Higher education learning platform | 77.17 |
| Goodwall | Switzerland | Educational platform for professional growth | 75 |
| Morressier | Germany | Platform for scientific communications and conferences | 50 |
| Shape Robotics | Denmark | Educational robotics for STEAM education | 39.038 |
| Pickatale | Norway | Educational platform for interactive language learning for K-12 | 32.5 |
| BYJU'S | India | Educational app | 22.0 |
| Yuanfudao | China | Educational app | 15.5 |
| Pearson plc | United Kingdom | Educational books and training programmes | 7.67 |
| Duolingo, Inc. | United States | Educational apps (language certification) | 5.51 |

Source: compiled by the authors based on Statista (n.d.) and Yahoo Finance (n.d.).

Despite a significant number of studies devoted to the development of the global online learning market, a number of conceptual and applied aspects remain insufficiently explored. Most empirical studies focus on developed countries. In contrast, the education systems of countries with transition

economies, such as Ukraine, tend to be presented in a fragmented way or only considered briefly. This limitation of contemporary academic literature restricts the ability to extrapolate global conclusions to national educational contexts characterized by high levels of instability and resource constraints.

## Methodology

A synthesis of the academic literature was used to develop a conceptual framework for the study to identify trends shaping the present state and future transformations of the online learning and educational technology market. The systematisation of theoretical approaches helped to structure market trends and prospects by thematic, temporal and regional characteristics.

The analytical part of the study was conducted using secondary statistical information obtained from official sources of international organisations and analytical agencies (Didask, Market Data Forecast, Market.us, Precedence Research, Statista, UNESCO). This stage of the research was aimed at assessing the scale, growth rates and regional characteristics of the development of the online learning and educational technology market.

A comparative analysis and synthesis of theoretical approaches and empirical findings made it possible to characterise the impact of global trends on the development of the Ukrainian online learning market. Linear regression was employed to analyse short-term trend dynamics. Additionally, the method of generalisation enabled us to identify dominant trends, draw scientifically sound conclusions, and outline directions for future research in online learning.

Secondary statistical data from Market.us (2025) were used to quantitatively assess trends in the regional distribution of market shares for educational technologies (2019–2024). The figure for 2025 is regarded in this study as a short-term analytical extension of the identified tendency. Based on this time series, simple linear regression models were constructed for each region separately within the JASP software environment (version 96.0). In these models, the dependent variable represented the respective region's market share, while the independent variable represented the time index of the observation period. This approach avoided the need to construct a separate forecast dataset, instead identifying the nature of trend changes in the existing time series and obtaining model values for each period.

The accuracy of the approximation of the actual data was assessed using the model's predicted values (*Predicted*), absolute error (*Abs Error*) and absolute relative error (*APE*), as well as the generalised indicators of mean absolute error (*MAE*) and mean absolute relative error (*MAPE*). These were calculated by comparing actual and model values using the following formulas:

I. The mean absolute error (*MAE*) is determined by the formula:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}\left|y_i - y_i\right| \quad (1)$$

where $y_i$ is the actual value of the indicator; $\hat{y}_i$ i s the model value; $n$ is the number of observations.

II. The absolute percentage error (*APE*) for each particular observation is calculated using the following formula:

$$APE_i = \left|\frac{(y_i - y_i)}{y_i}\right| \times 100\% \quad (2)$$

where $APE_i$ is the absolute percentage error for the *i*-th observation.

III. The mean absolute percentage error (*MAPE*) is calculated using the formula:

$$MAPE = \frac{100\%}{n}\sum_{i=1}^{n}\left|\frac{y_i - y_i}{y_i}\right| \quad (3)$$

However, taking into account the limited length of the series, the results are primarily interpreted as an estimate of the linear trend and a short-term extrapolation of that trend.

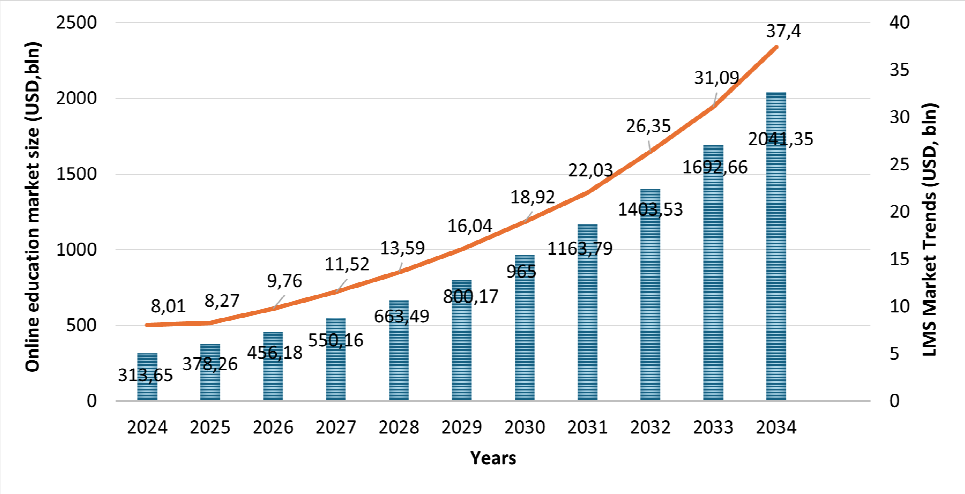
## Research Results

### Current State and Dynamics of the Global Online Learning Market

Digital transformation has led to the spread of digital technologies across all areas of public life. In particular, online learning or e-learning has radically changed the approach of participants in the educational process to teaching and learning. As institutions around the world adapt to these changes, the highly dynamic educational landscape has attracted enormous interest among researchers, educators, administrators, policymakers, publishers, and businesses (Palvia et al., 2018). The prerequisites for the emergence of the online learning market are technological (the latest learning tools and technologies, including LMS systems, video conferencing, interactive simulations, multimedia resources, etc.), social (society's demands for quality educational services) and economic (contribution to the development of the national economy) factors (Melnykova & Oliynyk, 2020). These factors have determined the current state of the online learning market (Figure 1).

*Figure 1*

**Dynamics of the online learning market in relation to the LMS market (2024-2034)**




Source: developed by the authors based on Zoting (2025).

In 2025, the global online learning market was estimated at $378.26 billion, which is 20.6% higher than in 2024. The forecast made by Zoting (2025) indicates the prospect of continued positive dynamics in the online learning market; with the current average annual growth rate (CAGR = 20.6%), this will mean growth to approximately $2041.35 billion. In view of this, the main factors driving the growth of the online learning market are the growing demand for education among various categories of citizens, stimulating government policies, and the COVID-19 pandemic, which has forced people to adapt to activities in conditions of isolation or limited mobility.

At the same time, the market for learning management systems (LMS), which provide the technical basis for organising online education, is developing synchronously. According to current forecasts, the LMS market will grow from $8.01 billion in 2024 to $37.4 billion in 2034, indicating the active introduction of digital platforms in the field of education, corporate training and professional development.

The key characteristics of the online learning market include flexibility, modularity, parallelism, distance learning, asynchrony, coverage, cost-effectiveness, the development of information and educational technologies, social interaction, internationality, and diversification of funding for educational activities. These features of the online learning market give it advantages over

other forms of education, but at the same time place specific demands on all participants in the educational process: provision of technical equipment; basic digital skills for working with educational platforms; self-discipline, responsibility and organisation on the part of the learner during training; and the ability of teachers to adapt teaching materials and ensure the interactivity of the educational process.

It is also important to highlight the issue of distance and online learning formats, which raise the question of the availability of resources for online learning, which includes not only access to educational platforms and applications, but also the opportunity for full interaction with educational content, participation in joint projects and academic discussions. To this end, it is necessary to provide higher education students with modern digital tools, electronic textbooks, databases, scientific journals and other sources of knowledge, in line with UNESCO's recommendations on the digital transformation of education (Normén-Smith et al., 2024). Likewise, an important element of the online learning infrastructure is the functioning of technical support centres, which provide prompt solutions to problems related to equipment, software and internet connection, which directly affects the continuity and quality of the educational process.

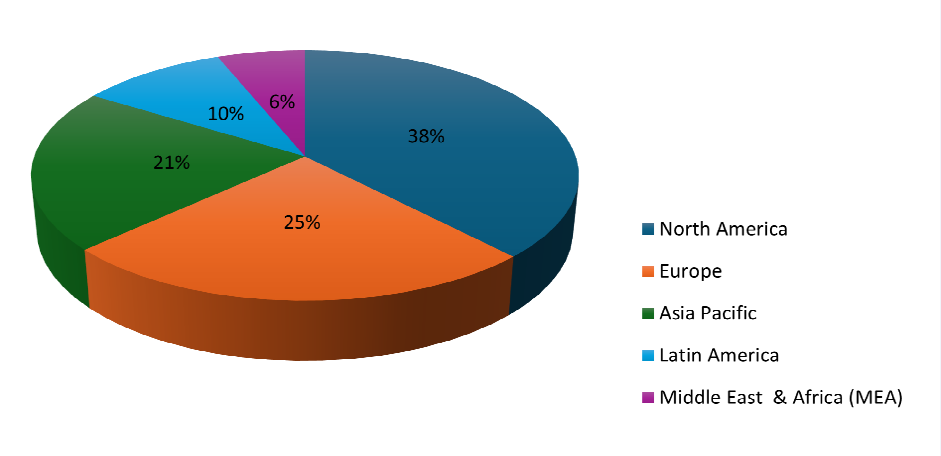
The above trends have varying degrees of development depending on regional characteristics of the implementation of online education practices. The regional distribution of online learning market shares is presented in Figure 2. The differences in the size of the online services market share are mainly influenced by the above-mentioned technological, social and economic factors and, in addition, the significance of the impact of global challenges (pandemic, military actions, etc.) in a particular geographical region or country.

The current regional distribution of the global online learning market – where North America accounts for about 38% of the global volume, Europe for 25%, the Asia-Pacific region for 21%, Latin America for 10%, and the Middle East and Africa (MEA) countries for only 6% – is the result of the combined effect of long-term socio-economic, technological and institutional trends. In particular, the smallest market shares in Latin America and the Middle East and Africa region are due to differences in socio-economic development, the level of digital infrastructure and stable internet access.

In contrast, the key reasons for the growth of the online learning market share in Europe are a number of macroeconomic factors: (1) growing demand for skilled professionals in various fields is prompting people to seek additional education and training; (2) it is an economically optimal way to acquire and/or improve skills to meet the needs of the labour market; (3) demand for digital skills; and (4) changing customer preferences, which have led to the emergence of massive open online courses (MOOCs) and online tutoring platforms that provide personalised learning and support (Statista, n.d.).

*Figure 2*

**Regional distribution of online learning market shares (2025)**




Source: developed by the authors based on Zoting (2025).

Within Europe, it should be noted that according to Market Data Forecast (n.d.), Northern European countries are leading the way, with the level of online learning adoption in the Netherlands and Finland exceeding 50%; in Germany, this level exceeds 60%; the United Kingdom, despite Brexit, retains its dominant position with a 30.3% share of the European educational technology market. In turn, institutional support plays a decisive role in this dynamic. For example, the European Union's Action Plan for Digital Education for 2021-2027 aims to support the adaptation of education and training systems to the digital age; and the Digital Europe programme allocates an additional €8.1 billion for the digital transformation of education.

The online learning market in Europe is also influenced by changing customer preferences, with customers choosing a wide range of more convenient and flexible online learning platforms. And while the growth of the online learning market in Europe can be explained by global trends, there are also local characteristics that contribute to its development. One such circumstance is the linguistic diversity in Europe. Online education platforms offer courses in several languages, allowing people to learn in their native language or acquire knowledge of a foreign language. This linguistic flexibility attracts learners from different European countries and increases the accessibility of online education (UNESCO, 2023).

The main reasons for North America's dominance in the online learning market include widespread internet access, significant private and venture capital

investment in digital education, the early creation of a strong EdTech ecosystem, and the active use of online learning in the corporate sector. It is worth noting the rapid change in the dynamics of the online learning market in the United States, as shown in Figure 3. According to Zoting's (2025) data on current trends in the online learning market, the concentration of leading global online platforms (e.g., Coursera, edX, Udacity, etc.) in the United States standardises and shapes global demand for digital educational content.

Based on the above empirical data and a synthesis of scientific findings, Table 2 was compiled to characterise the latest practices in the development of the global online learning market.

*Table 2*

**Latest trends in the development of the global online learning market**

| Trend | Characteristics | Statistical justification |
|---|---|---|
| Growth of the global online learning market | The growth of the global online learning market is driven by the need for continuous learning, the adaptation of education to modern requirements, innovation and its role in career growth, making it an important tool for professional development. | Forecast data for the global online learning market indicates the sector's potential to grow to approximately $2041.35 billion by 2034 (at a CAGR of 20.6%). |
| Integration of artificial intelligence (AI) | As one of the key segments of education, online learning demonstrates the potential of AI to transform traditional teaching methods and provide opportunities for individuals to acquire knowledge regardless of their location or material resources. | The AI market in education has shown rapid growth from $5.88 billion in 2024 to $8.3 billion in 2025 (or 41%), with a forecast growth to $32.27 billion by 2030. |
| Microlearning | Microlearning is a new approach to learning that involves presenting information in small, independent portions. | Adaptive platforms and informal learning improve knowledge retention by 25% to 60% compared to traditional methods. |
| Immersive technologies (VR / AR / MR) | Immersive technologies such as virtual reality (VR), augmented reality (AR) and mixed reality (MR) provide an adaptive learning environment that can take into account the individual characteristics of all participants in the educational process. | The VR market in education, estimated at $17 billion in 2024, is expected to grow rapidly and reach $65.55 billion in 2032. |

| Trend | Characteristics | Statistical justification |
|---|---|---|
| Effectiveness and ROI (return on investment) | More and more online learning projects are showing high ROI through cost reduction and increased learning productivity. | Currently, online learning improves student retention by 25-60% compared to 8-10% for face-to-face learning, reduces learning time by 40-60% and provides average savings of 50% to 70% on learning costs. |

Source: developed by the authors based on Micky (2026), Grand View Research (2024), Zoting (2025), andKhan (2022).

Consequently, current trends in the development of online learning are determined by the diffusion of AI technologies, the increasing personalisation of the learning process, the growing relevance of short modules (microlearning) and the expansion of immersive technologies (VR/AR/MR), which are radically changing the structure of educational practices. In addition, the corporate sector plays an important role in the development of the market, promoting the integration of e-learning into corporate training and employee retraining.

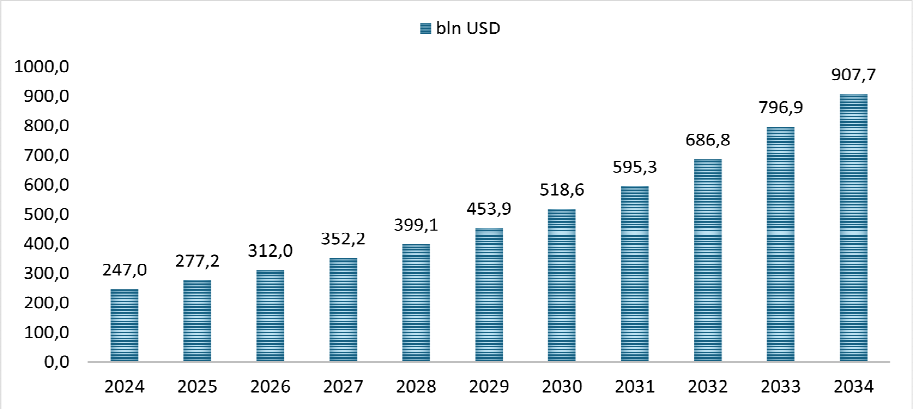
**Key Trends in the Development of the Global Educational Technology Market**

The rapid spread of technology during the pandemic has changed the approach to the learning process at all levels of education and outlined their optimal use in learning. Current trends in education help to identify and select the most effective teaching methods that motivate students to acquire knowledge, develop and improve their skills. Using modern methods and technologies, education is becoming more accessible to all participants in the educational process. This has shaped the growth dynamics of the educational technology market (Figure 3).

The global educational technology market was worth $247 billion in 2024 and is projected to grow from $277.2 billion in 2025 to approximately $907.7 billion by 2034, representing a compound annual growth rate (CAGR) of 13.9% over the forecast period. However, the growth of the educational technology market is uneven across regions, given the current challenges (local and global) and the degree of influence of technological, social and economic factors on education in a country/region. The regional distribution of educational technology market shares is shown in Figure 6.

*Figure 3*

**Dynamics ofchange in the EdTech market volume (2024-2034), USD billions**




Source: developed by the authors based on Market.us. (2025).

The method of single-factor linear regression was used to describe the short-term trends in the regional distribution of global market shares in EdTech; this method enables the direction of the linear trend to be assessed and an approximate extrapolation to be made for the coming periods.

We define the linear regression model by the equation:

$$y=b_0+b_1x \quad (4)$$

where $y$ is the predicted value of the indicator; $x$ is the year of observation; $b_0$ is the constant term (intercept); and $b_1$ is theslope coefficient, which characterises the average change rate of the indicator over one year.

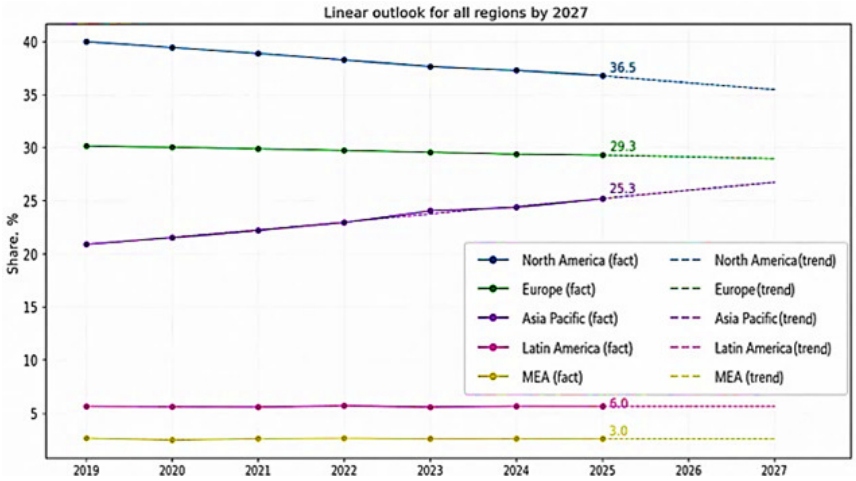
The model parameters were estimated using the least squares method, which made it possible to minimise the sum of the squares of the deviations between the actual and modelled market share values.

Upon evaluating the model parameters, model values were calculated for the observation period and an approximate short-term trend extrapolation was carried out for the coming periods. The results of the linear trend extrapolation are shown in Figure 4 and Figure 5.

Subsequently, simple linear regression models were constructed for each region based on secondary statistical data for the periods labelled 1–6 (2019–2024), as shown in Figure 6. This enabled an assessment of the direction and stability of the trend in market share changes (Table 3). The 2025 value was considered as a short-term analytical extension of the identified dynamics.

*Figure 4*

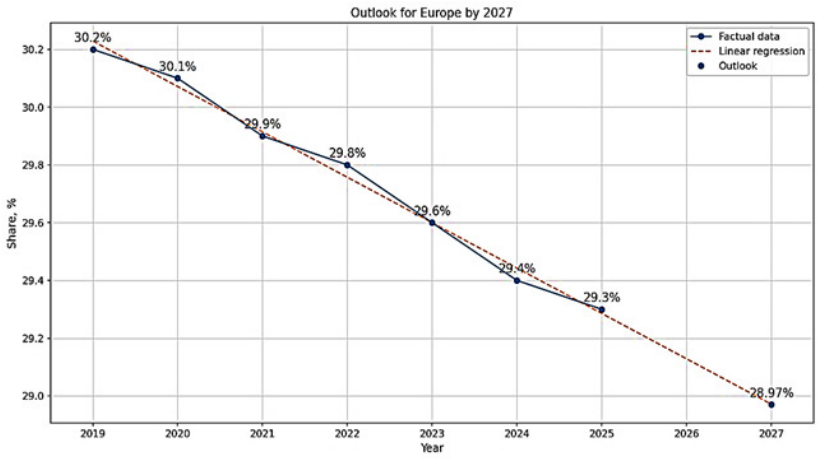
**Dynamics and approximate extrapolation of regional EdTech market share distribution (2019–2027)**




Source: developed by the authors.

*Figure 5*

**Dynamics and projected distribution of EdTech market shares within Europe (2019-2027)**




Source: developed by the authors.

*Table 3*

**Assessment of the adequacy of linear regression models for the regional distribution of market shares in EdTech**

| **North America** | | | | **Europe** | | | |
|---|---|---|---|---|---|---|---|
| **Year index** | **Predicted** | **Abs Error** | **APE** | **Year index** | **Predicted** | **Abs Error** | **APE** |
| 1 | 0.398857 | 0.000143 | 0.036% | 1 | 0.302333 | 0.000333 | 0.110% |
| 2 | 0.393114 | 0.000114 | 0.029% | 2 | 0.300733 | 0.000267 | 0.089% |
| 3 | 0.387371 | 0.000629 | 0.162% | 3 | 0.299133 | 0.000133 | 0.045% |
| 4 | 0.381629 | 0.000371 | 0.097% | 4 | 0.297533 | 0.000467 | 0.157% |
| 5 | 0.375886 | 0.002886 | 0.774% | 5 | 0.295933 | 0.000067 | 0.023% |
| 6 | 0.370143 | 0.001857 | 0.499% | 6 | 0.294333 | 0.000333 | 0.113% |
| **MAE** | 0.001000 | | | **MAE** | 0.000267 | | |
| **MAPE** | 0.266% | | | **MAPE** | 0.089% | | |
| **Asia-Pacific** | | | | **LatinAmerica** | | | |
| **Year index** | **Predicted** | **Abs Error** | **APE** | **Year index** | **Predicted** | **Abs Error** | **APE** |
| 1 | 0.209095 | 0.000095 | 0.046% | 1 | 0.058905 | 0.000095 | 0.161% |
| 2 | 0.216124 | 0.000124 | 0.057% | 2 | 0.059076 | 0.000076 | 0.129% |
| 3 | 0.223152 | 0.000152 | 0.068% | 3 | 0.059248 | 0.000248 | 0.420% |
| 4 | 0.230181 | 0.001181 | 0.516% | 4 | 0.059419 | 0.000581 | 0.968% |
| 5 | 0.237210 | 0.003790 | 1.573% | 5 | 0.059590 | 0.000590 | 1.001% |
| 6 | 0.244238 | 0.002238 | 0.925% | 6 | 0.059762 | 0.000238 | 0.397% |
| **MAE** | 0.001263 | | | **MAE** | 0.000305 | | |
| **MAPE** | 0.531% | | | **MAPE** | 0.513% | | |

| **Middle East and Africa countries (MEA)** | | | |
|---|---|---|---|
| **Year index** | **Predicted** | **Abs Error** | **APE** |
| 1 | 0.030000 | 0.000000 | 0.000% |
| 2 | 0.030400 | 0.000400 | 1.333% |
| 3 | 0.030800 | 0.000200 | 0.645% |
| 4 | 0.031200 | 0.000800 | 2.500% |
| 5 | 0.031600 | 0.000600 | 1.935% |
| 6 | 0.032000 | 0.000000 | 0.000% |
| **MAE** | | 0.000333 | |
| **MAPE** | | 1.069% | |

Source: calculated by the authors.

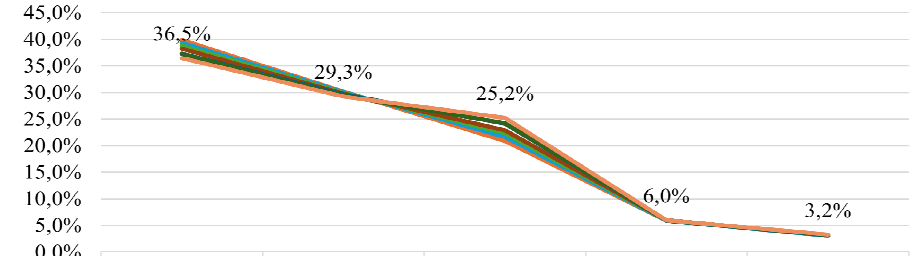
The results obtained indicate that the linear approximation most accurately captures the dynamics of the European and North American shares, for which the

lowest values of mean absolute and relative error were recorded. Similar results are observed for the Asia-Pacific region. In contrast, for Latin America and the MEA, the model errors are higher, indicating that a simple linear trend is less accurate for describing the dynamics of these regions. Therefore, the linear approximation is more suitable for describing stable regional trends and reproduces series with lower variability or weaker linearity less accurately.

Since the study analyses market shares specifically, the results of the independent regional trend models should be interpreted as approximate estimates of trends rather than as a comprehensive forecast of the future structure of the global educational technology market. This is because separate modelling of each region does not impose a compositional constraint whereby the sum of all regions' shares must equal 100%. Accordingly, the model values obtained should primarily be used to identify the direction of change, rather than to accurately forecast future market proportions.

*Figure 6*

**Regional distribution of EdTech market shares**




| | North America | Europe | Asia Pacific | Latin America | MEA |
|---|---|---|---|---|---|
| 2019 | 39,9% | 30,2% | 20,9% | 5,9% | 3,0% |
| 2020 | 39,3% | 30,1% | 21,6% | 5,9% | 3,0% |
| 2021 | 38,8% | 29,9% | 22,3% | 5,9% | 3,1% |
| 2022 | 38,2% | 29,8% | 22,9% | 6,0% | 3,2% |
| 2023 | 37,3% | 29,6% | 24,1% | 5,9% | 3,1% |
| 2024 | 37,2% | 29,4% | 24,2% | 6,0% | 3,2% |
| 2025 | 36,5% | 29,3% | 25,2% | 6,0% | 3,2% |

Note: the 2025 figures were calculated as an approximate short-term continuation of the linear trend.

Source: developed by the authors based on Market.us (2025).

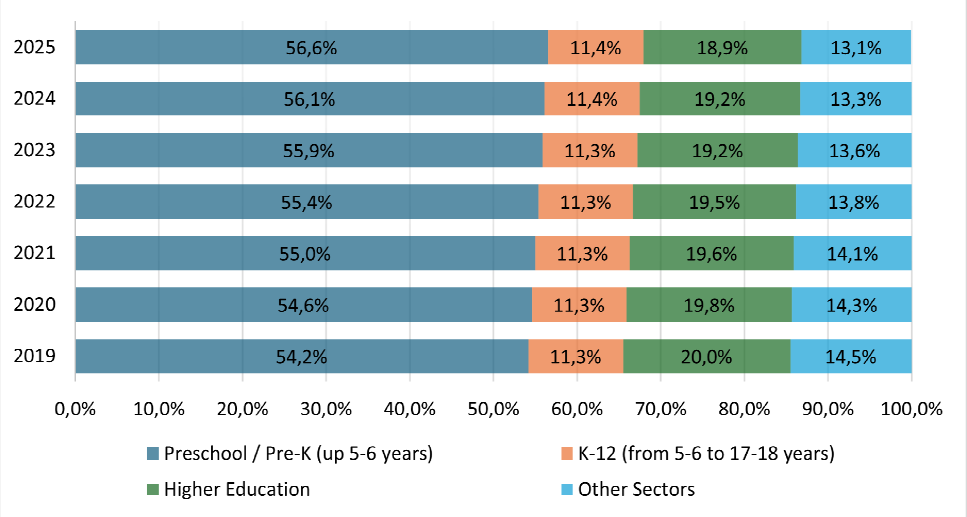
North America is expected to hold the leading position in the 2025 EdTech market (presumably due to its dominant role in the e-learning sector), accounting

for over 36.5% of the market share and generating revenue of US$91.8 billion. The region benefits from a developed market for innovative educational tools, including AI-based learning platforms and immersive technologies. Educational institutions and enterprises are the key drivers of demand, stimulating the sustained growth of digital education ecosystems. It should be noted that the US EdTech market is one of the main drivers of growth in North America. With an average annual growth rate of 11.7%, the US EdTech market, valued at approximately US$84 billion, plays a key role in the development of education in the region (according to Market.us, 2025).

The strength of the K-12 education sector and its widespread use across different age groups is a key factor behind the country's leadership in this sector. The development of digital learning infrastructure in the US is driven by government initiatives and the widespread use of content management systems and artificial intelligence-based tools. In addition, investment in the US is focused on improving educational outcomes through the implementation of technology-based personalised learning. A range of flexible, affordable learning options meets the growing demand for workforce development and lifelong learning and contributes to market expansion. Thus, global trends in the sectoral development of the educational technology market (especially in the K-12 sector) are directly dependent on investment, infrastructure, and public and private initiatives in the United States, but there are other shifts in indicators as well (Figure 7).

*Figure 7*

**Market share of EdTech by sector (2019-2025)**




Note: data for 2025 were projected by the authors.

Source: developed by the authorsbased on Market.us (2025).

The educational sectors cover a wide range of learning levels (early childhood, primary/general, post-general) and related fields. It mostly highlights the growing EdTech sector, which serves these diverse stages, from pre-school institutions to university digital platforms. Additionally, it focuses on market growth, technology integration, and personalised learning at all these levels and within professional development. Specifically, in 2024, the K-12 segment accounted for a significant share of the educational technology market at 56.1%, driven by growing demand for digital tools to support basic education, where interactive content and adaptive learning platforms increase student engagement and outcomes. This growth is also driven by education policies that encourage technology integration and investments by key stakeholders aimed at improving access and quality at the primary and secondary levels. The use of immersive technologies such as augmented reality (AR) and virtual reality (VR) in classrooms helps to create a more engaging and effective learning experience, promoting student creativity and knowledge retention.

## Discussion

In Ukraine, despite the fact that the online format has been in use for a long time, the online learning market as a whole remains in its early stages of development. One of the first forms of such education was online courses for learning foreign languages. Other types began to develop with the emergence of platforms such as Prometheus, EdEra, Coursmos, and others, where students can take online courses and, in some cases, receive certificates. With the development of internet technologies and the emergence of more modern devices on the market, learning is shifting to a format that uses educational technologies. It should be noted that global transformations in the field of education are significantly influencing the formation and development of the Ukrainian online learning market, leading to both an expansion of access to educational services and an exacerbation of a number of systemic problems. The most problematic issues at present are challenges related to hostilities (Rudnytska et al., 2022); a potential decline in educational quality due to the increased distance between participants in the learning process (Loban et al., 2021; Makhsma & Kozlov, 2023); low levels of digital skills among participants in the educational process (Melnykova & Oliynyk, 2020), and other factors. In other words, unlike the stable education systems of North America and Europe, online learning in Ukraine performs not only an innovative function, but also a compensatory and security function, ensuring the continuity of the educational process in times of crisis (Rudnytska et al., 2022; Kraiova & Tsybaniuk, 2024).

Thus, one of the key global trends that has significantly influenced the Ukrainian educational space is the mass transition to distance and blended learning models, which was accelerated by the COVID-19 pandemic and, in

Ukraine, additionally by military hostilities. While in international practice blended learning is seen as a tool for improving the quality and personalisation of learning (Zeyab & Alayyar, 2023), in Ukraine it has become an adaptive model that allows internally displaced persons, students abroad and residents of frontline territories to maintain access to education (But, 2024; Reznikov, 2023). Other noteworthy trends include the integration of artificial intelligence, microlearning, the development of immersive technologies, and economic trends towards the growth of the online learning market and return on investment. To summarise, global trends have contributed to the acceleration of the digitalisation of Ukrainian educational institutions, the expansion of distance learning programmes, the growing role of informal and postgraduate education, and the revival of the private EdTech segment. Concurrently, the implementation of global innovations is asymmetrical due to unequal access to digital infrastructure, limited financial resources, and insufficient digital readiness of some teaching staff.

Currently, the integration of the online learning market into the European Higher Education Area (EHEA) is facilitated through the use of global platforms (such as Coursera, edX, etc.), cooperation between Ukrainian universities, and the creation of national resources (such as Prometheus, EdEra, and others), which provides students with access to high-quality courses, a personalised approach, and flexible learning, strengthening ties between European and Ukrainian education systems.

However, the empirical results obtained are generally consistent with the findings of international studies, notably those by Palvia et al. (2018), Tsymbal and Kalenyuk (2023) and Zeyab & Alayyar (2023), who link the growth of online learning to the spread of digital platforms, in creased flexibility of the educational process,and the strengthening of technology's role in shaping new educational models. At the same time, in the Ukrainian context, these processes have a different functional nature; that is, whilst in stable education systems digitalisation largely serves as a tool for improving quality, personalisation and competitiveness, in Ukraine online learning also fulfils a compensatory and security function, ensuring the continuity of education under wartime conditions. In this context, the findings are similar to the conclusions of Rudnytska et al. (2022), Kraiova Tsybaniuk (2024), & Bondar (2024), who emphasise the adaptive nature of distance learning in the Ukrainian reality.

At the same time, the study’s findings show that economic convergence between the Ukrainian online learning market and the European educational space is incomplete and asymmetrical. In technological terms, the most pronounced convergence is evident in the widespread adoption of LMS platforms, blended learning formats, national online resources, and EdTech solutions. However, regulatory harmonisation, digital infrastructure, financial integration, and quality assurance mechanisms are proceeding at a much slower pace. This is consistent with the views of Konrad et al. (2024), Polishchuk et al. (2025) & Kwilinskiet al. (2021), who emphasise that Ukraine’s integration into the European

educational space requires deeper institutional and economic alignment, not merely formal recognition or technical access to platforms. Therefore, it is important to emphasise that the current stage of development of the Ukrainian online learning marketshould be viewed as a phase of functional convergence with the European model, as full market integration has not yet been achieved.

## Conclusions

The study confirms that the evolution of the Ukrainian online learning market is significantly influenced by global and European transformations in digital education; however, this convergence is neither complete nor uniform. The proposed approach to interpreting economic convergence has established that the Ukrainian online learning market demonstrates, first and foremost, technological and organisational convergence with European and global education systems, whereas in regulatory, qualitative-analytical, and financial dimensions such convergence remains partial. Thus, the study's hypothesis regarding the asymmetric nature of economic convergence in the Ukrainian online learning market is generally confirmed.

The limitations of the study include the use of a short time series comprising six annual observations to construct regression models; while this does not diminish the analytical value of the study as a description of existing trends, it does require caution when interpreting extrapolated values, particularly regarding long-term conclusions about the future structure of the global EdTech market. Therefore, the results obtained should be viewed as a tool for identifying the direction of short-term changes, rather than as a definitive forecast of the market's regional distribution.

The main promising areas for the economic integration of the Ukrainian online learning market into the European educational space are: (1) regulatory convergence (removing legal barriers to cross-border sales of educational products); (2) education quality standards (building trust among European consumers); (3) financial integration (transforming online education into an investment sector); (4) digital integration (reducing transaction costs for recognition and verification); and, as a result, (5) the formation of a shared education market (the inclusion of Ukraine in a single education market, including competition, exports and internationalisation). This could support the integration of Ukrainian educational products into a single European educational and digital space.

In order to ensure the continued growth of the online learning market in Ukraine, the following measures are recommended: (1) the institutionalisation of online learning within the national education system; (2) the reduction of digital inequality by attracting investment in digital infrastructure; (3) the creation of

mechanisms to strengthen cooperation between higher education institutions, EdTech companies, and employers; and (4) the gradual integration of innovative technologies (AI, data analytics, immersive environments) into the educational space.

A promising area for further research in the Ukrainian context is the analysis of challenges related to war and post-war recovery, and the assessment of the role of online learning in ensuring educational resilience and post-crisis recovery.

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