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COMPARATIVE AND APPLIED RESEARCH ON THE EDUCATION SYSTEMS OF UKRAINE AND THE UNITED STATES

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The strategic partnership between Ukraine and the United States seeks to foster long-term cooperation in science, innovation, and education and calls for a thorough examination of the scientific, methodological, and pedagogical foundations of the two countries' education systems. Such cooperation is an important factor in preparing competitive professionals whose competencies meet the changing demands of the contemporary labour market. As globalisation intensifies and national education systems converge, the study of international approaches to organising education is becoming increasingly relevant. The US model attracts researchers and educators because of its emphasis on competency development, logical and mathematical thinking, and the practical application of knowledge in everyday life. An analysis of US educational practices makes it possible to identify major trends in the development of educational environments and effective approaches to developing students' key and subject-specific competencies. Comparative and applied research on the education systems of Ukraine and the United States is therefore important for reforming Ukrainian education, particularly for implementing the competency-based approach and renewing educational content. A comparative examination of educational standards, didactic approaches, and forms of organising learning reveals the principal characteristics of the Ukrainian and US systems. The Ukrainian system prioritises compliance with state standards and the acquisition of solid academic knowledge, predominantly through subject-based instruction. At the same time, it places considerable emphasis on the key competencies defined by the New Ukrainian School concept, including reading, mathematical and digital literacy, lifelong learning skills, and the holistic development of learners. By contrast, the US model emphasises practical competencies, student autonomy, and soft skills, primarily through project-based and inquiry-based learning. Its main priorities include critical and analytical thinking, creativity, collaboration, communication, and digital literacy. The strengths of the Ukrainian system include its solid academic foundation and coherent, unified system of state standards, whereas its challenges include limited institutional autonomy and uneven material and technical provision. The US system is characterised by flexibility, a broad choice of courses, and a practical orientation; however, it is also marked by substantial inequalities between schools because of locally based funding and by the lack of uniform standards nationwide. This comparison identifies opportunities to adapt effective elements of international experience to Ukrainian educational practice. The findings may support the improvement of Ukraine's educational environment and the further modernisation of its education system.

Key words: education, educational process, STEM education, competence, lesson, school education, higher education, teacher, Ukraine, United States.



КОМПАРАТИВНО-ПРИКЛАДНІ ДОСЛІДЖЕННЯ СИСТЕМ ОСВІТИ УКРАЇНИ ТА США

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Стратегічне партнерство між Україною та Сполученими Штатами Америки має на меті забезпечення тривалої співпраці у сфері науки, інновацій та освіти і передбачає ґрунтовне осмислення наукових, методичних і педагогічних основ розвитку освітніх систем України та США. Такий підхід є важливим чинником підготовки конкурентоспроможних фахівців, професійна компетентність яких відповідає динамічним запитам сучасного ринку праці. За умов посилення глобалізаційних процесів і зближення національних освітніх систем особливої актуальності набуває вивчення міжнародного досвіду організації освіти. Американська модель привертає увагу дослідників і педагогів завдяки орієнтації на формування компетентностей, розвиток логіко-математичного мислення та спрямованість на практичне застосування знань у повсякденному житті. Аналіз освітніх практик США дає змогу визначити провідні тенденції розвитку освітнього середовища та окреслити результативні підходи до формування ключових і предметних компетентностей учнів. Отже, компаративно-прикладні дослідження освітніх систем України та США є важливим здобутком у контексті реформування національної освіти, зокрема впровадження компетентнісного підходу та оновлення змісту навчання. Порівняльне вивчення освітніх стандартів, дидактичних підходів і способів організації навчання дає підстави визначити провідні характеристики української та американської систем освіти. Освітня система України зорієнтована насамперед на виконання державних стандартів і засвоєння ґрунтовних академічних знань, переважає предметна організація навчання. Водночас значна увага приділяється формуванню ключових компетентностей, визначених концепцією Нової української школи, зокрема навичок читання, математичної та цифрової грамотності, уміння навчатися впродовж життя, а також гармонійному розвитку особистості здобувача освіти. Американська модель освіти, на відміну від української, зосереджена на розвитку практичних компетентностей, самостійності учнів і формуванні м'яких навичок, що реалізується через активне впровадження проєктного та дослідницького навчання. Ключовими орієнтирами сучасної освіти США є розвиток критичного й аналітичного мислення, креативності, здатності до співпраці, комунікативних умінь і цифрової грамотності. До основних переваг української системи освіти належать її академічна фундаментальність, а також наявність цілісної та уніфікованої системи державних стандартів. Водночас серед проблемних аспектів можна виокремити обмежений рівень автономії закладів освіти та нерівномірність матеріально-технічного забезпечення. Американська освітня система вирізняється гнучкістю й широким вибором навчальних курсів, а також виразною орієнтацією на практичні навички. Разом із тим, її недоліками є суттєва нерівність між школами, зумовлена локальним характером фінансування, а також відсутність єдиних і послідовних стандартів освіти на рівні всієї країни. Такий аналіз відкриває можливості для адаптації ефективних елементів зарубіжного досвіду до реалій національної освітньої практики. Результати дослідження можуть бути використані як підґрунтя для вдосконалення освітнього середовища України та подальшої модернізації вітчизняної системи освіти.

Ключові слова: освіта, освітній процес, STEM-освіта, компетентність, урок, шкільна освіта, вища освіта, вчитель, Україна, США.

General statement of the problem and its connection with important scientific or practical tasks. The strategic partnership between Ukraine and the United States, based on equality and directed towards shared long-term goals, encompasses cooperation not only in the economic, political, and military spheres (Government of

Ukraine & Government of the United States of America, 2025) but also in science, technology, and education (Cabinet of Ministers of Ukraine, 2024). This cooperation involves the exchange of information and expertise and the analysis of scientific, methodological, and pedagogical aspects of educational development (Ukraine & International Bank for Reconstruction and Development, 2024). Such an approach is essential for developing learners' professional competencies in line with contemporary labour-market requirements.

Against the background of globalisation and the increasing integration of education systems, international experience, particularly in the organisation of education, has become increasingly important. The US education system attracts attention because of its competency-based orientation, emphasis on mathematical thinking, and integration of scientific knowledge into everyday contexts. Studying US experience helps to clarify current trends in the organisation of education and identify effective ways to develop students' key and subject-specific competencies. Particularly relevant in the context of Ukrainian education reform is the examination of teaching practices in US schools, colleges, and universities. These practices include competency-based learning, curriculum renewal, conceptual understanding in mathematics and the natural sciences, information modelling, formative assessment, and STEM education. A comparative analysis of standards, methods, and organisational forms can therefore reveal strengths of the US model and indicate which approaches might be adapted to Ukrainian conditions. A more thorough study of US experience may contribute to improving teaching quality in Ukrainian educational institutions, strengthening teachers' professional competence, and modernising the national education system in response to current challenges.

Analysis of recent research and publications addressing the problem. Comparative and applied studies of education systems in different countries address key features of compulsory schooling and higher education (Batyuk, 2023; Beilinson, 2025). They examine the introduction of compulsory curricula, approaches to assessing learning outcomes, and measures to increase the number and improve the qualifications of teachers. In the United Kingdom, for example, the emergence of the STEM education paradigm was accompanied by the introduction of more tightly regulated national curricula in mathematics and science and by revisions to the format and difficulty of external assessments (Education Reform Act 1988; House of Lords Science and Technology Select Committee, 2014; Parliamentary Office of Science and Technology, 2013). In the United States, the adoption of national standards in mathematics and science in 2010 and 2013, respectively, represented an attempt to establish common nationwide expectations within a decentralised education system (Batyuk, 2024). In Australia, the development of STEM education in the United States and the rapid expansion of specialised public STEM high schools became important reference points for educational reform (Erdogan & Stuessy, 2015). Informal supplementary programmes accompanied formal school provision and subsequently contributed to the introduction of STEM-oriented provision in higher education (Marginson et al., 2013). Changes in educational environments may be initiated by public authorities, educational institutions, and commercial or non-commercial

external organisations. Since 2010, many such initiatives have focused on supporting programmes in mathematics and the natural sciences (Batyuk, 2025a; Clark et al., 2016; Varha, 2022).

Federal funding and support for educational initiatives in the United States contributed to the development of many formal STEM initiatives (President's Council of Advisors on Science and Technology, 2010), which later became strategic reference points for similar developments in other countries, including Ukraine (Cabinet of Ministers of Ukraine, 2021). Nevertheless, inconsistency, duplication of effort, and the absence of systematic evaluation remain obstacles to the long-term, large-scale implementation of effective STEM curricula in both Ukraine and the United States. European Union governments likewise invest in STEM education and promote partnerships between public authorities and private initiatives (European Commission, 2025). In addition, the education ministries of more than 30 European countries support schools, teachers, and other stakeholders engaged in transforming education across Europe (European Commission, 2019; European Schoolnet, 2025). These networks provide opportunities for discussion, the exchange of good practice, mutual learning, and collaboration in addressing societal challenges that affect education in EU countries.

The meaning of STEM education depends on the context in which the term is used. In broad social and political discourse, it usually denotes education in science, technology, engineering, and mathematics. In academic and professional educational discourse, it may also refer to the teaching of these disciplines through innovative, student-centred pedagogies designed to transform the learning process (Batyuk, 2025d; Rakhmanina, 2024; Valko, 2020). In policy and public discourse, by contrast, STEM education is often linked primarily to economic priorities and the strategic goals of education systems.

Efforts to improve science and mathematics education in OECD countries gained prominence in the 1980s, largely in response to declining student performance in international assessments (Klein, 2003; National Research Council, 1996; Office of Educational Research and Improvement, 1997) and insufficient numbers of students choosing STEM fields in higher education (Batyuk, 2024). During the 2000s, economic reports forecasting shortages of skilled STEM workers in several countries (National Academy of Sciences et al., 2007; Office of the Chief Scientist, 2012a, 2012b; Roberts, 2002; Schoenfeld, 2007) drew considerable attention to the role of schools and higher education institutions in developing the required skills. Addressing these trends consequently became an “almost universal government priority”. In this context, the term “STEM education”, introduced by the National Science Foundation to describe higher education focused on science, technology, engineering, and mathematics, acquired a broader meaning (Batyuk, 2025b). It came to encompass primary and secondary education as key stages in the so-called “STEM pipeline”, which is intended to increase the number of interested and suitably prepared students progressing to higher education in STEM fields. STEM education is now understood to span all levels, from primary to higher education, and has become a prominent element of global policy discourse.

Education, pedagogy, and the organisation of learning in schools, colleges, and universities in Ukraine and the United States have been examined by M. Nagach (2006), S. Burdina (2007), K. Rybachuk (2008), S. Lukianchuk (2009), M. Boichenko (2010), P. Atamanchuk and O. Atamanchuk (2011), V. Kravchenko (2013), Y. Bezukh (2013), M. Bratko (2017), N. Zaitseva (2017), T. Tron (2018), A. Ocheretyanyi (2020), O. Kozmenko (2021), Y. Slutskyi (2022), N. Ivanytska (2025), L. Nikolenko (2025), and others. Education in Ukraine under martial law has been analysed by N. Nychkalo et al. (2022), Ye. Nikolayev et al. (2023), Yu. Kostyunina (2023), O. Dushchenko (2024), and contributors to the collection published by the Ministry of Education and Science of Ukraine and the Institute of Educational Analytics (2023). Historical-pedagogical and theoretical-methodological aspects of US education have been addressed in the volume edited by M. N. Bastedo, P. G. Altbach, and P. J. Gumport (2023), as well as by C. Beck and C. Kosnik (2006), T. A. Campbell (2015), B. Bernstein (2004), J. Engler (1999), P. A. Brady (2020), W. C. Purdy (2003), L. Roy et al. (2017), F. Rudolph (1990), and others. STEM education in Ukraine and the United States has been investigated by N. Balyk and G. Shmyger (2017), N. Valko (2020), I. Vasilashko and T. Bilyk (2017), S. Volyanska (2016), T. Hodovaniuk (2019), O. Kuzmenko (2020), O. Stryzhak et al. (2017), M. Rostoka (2017), M. Fitzgerald et al. (2025), L. Hobbs et al. (2018), Z. Lavicza et al. (2022), K. Beswick and S. Fraser (2019), L. M. Burke and J. B. McNeill (2011), M. Caprile et al. (2015), the National Academies of Sciences, Engineering, and Medicine (2018), and other scholars.

Ukraine's global integration is becoming increasingly important, particularly for its full participation in the international education and research space. Under the New Ukrainian School concept, which places the learner at the centre of the educational process, the development of the child's personality takes precedence over the mere accumulation of knowledge (Ministry of Education and Science of Ukraine, 2021). Reform of education is therefore especially relevant, including the democratisation of the system and improvements in its efficiency. In this context, comparative and applied research on education systems and national educational priorities can facilitate the exchange of experience and international cooperation. It can also support children's and young people's digital well-being, strengthen the digital skills and competencies of students and teachers, advance STEM education, and contribute to current and emerging policy priorities and strategic developments in education.

The aim of this article is to conduct a comparative study of the education systems of Ukraine and the United States.

Presentation of the main research material. The education systems of Ukraine and the United States differ substantially because of their historical, cultural, and legislative contexts. In Ukraine, education is administered centrally by the Ministry of Education and Science; in the United States, responsibility is largely delegated to state education authorities. This decentralised approach has constitutional roots, as the US Constitution contains no explicit provisions on education and leaves this area primarily to state and local authorities. Each state has its own education legislation governing the duration of compulsory schooling, admission requirements, teacher qualifications and remuneration, and the sources and levels of school funding. Consequently, the

organisation of schooling and educational requirements vary considerably between states (Boyd, 1986; Boyer, 1983; Common Core State Standards Initiative, 2010; Hamkins, 2020; Office of Educational Research and Improvement, 1997; Polhill, 2020; Raimi & Braden, 1998).

The US education system comprises a wide range of institutions and forms of provision, including public and private schools, primary and secondary education, inclusive education, adult education, and home schooling. It generally includes early childhood education (pre-school and pre-kindergarten), elementary school, middle and high school, and colleges and universities (see Table 1).

Table 1

Structure of education in Ukraine and the United States

Level	Ukraine	United States
Pre-school	Optional; kindergarten	Optional; pre-school/pre-K
School	12 years (Grades 1–12)	K–12 (kindergarten to Grade 12)
Stages	Primary (Grades 1–4), basic secondary (Grades 5–9), specialised upper secondary (Grades 10–12)	Elementary (K–5), middle school (Grades 6–8), high school (Grades 9–12)
Higher education	Bachelor's degree → master's degree → doctoral degree	Associate degree → bachelor's degree → master's degree → doctoral degree (PhD)

Schooling through the secondary level is compulsory and may be provided by public or private schools or through home education. At the end of the twentieth century, approximately 90% of students attended public schools (National Council of Teachers of Mathematics, 2000). The federal government has a role in promoting equal access to education and equal educational opportunity. The development of educational standards has been influenced by major policy documents and legislation, including *A Nation at Risk* (National Commission on Excellence in Education, 1983), *America 2000* (U.S. Department of Education, 1991), the Goals 2000: Educate America Act (1994), the No Child Left Behind Act of 2001 and its implementation reports (U.S. Department of Education, 2005), and related federal initiatives (Batyuk, 2025c; The White House, n.d.).

For the purposes of this comparative analysis, educational standards in the United States can be considered in terms of three broad areas:

- curriculum standards;
- assessment standards;
- staffing and resource standards.

The first group – curriculum standards – defines what students are expected to know and be able to do at particular stages of education. Such standards identify key

concepts, knowledge, skills, and competencies within particular subject areas and provide a framework for the development of curricula and instructional programmes.

The second group – assessment standards – establishes criteria for evaluating students' knowledge, skills, and educational achievements. These standards provide a basis for different forms of assessment and for determining the extent to which expected learning outcomes have been achieved.

The third group – staffing and resource standards – concerns the human, material, instructional, technological, and infrastructural resources required to support the educational process. These include the availability of qualified personnel, curricula and instructional materials, appropriate facilities, and other resources necessary for schools and school districts to implement curriculum requirements and support students in achieving the expected learning outcomes.

One particularly important dimension of resource provision is staffing stability. Teacher turnover and inter-school mobility constitute a significant organisational challenge for US schools. Ingersoll (2001) found that school staffing problems were driven to a considerable extent by teacher turnover rather than simply by an insufficient supply of qualified teachers. Organisational conditions, including salaries, administrative support, student discipline, and teachers' influence over decision-making, were among the factors associated with teachers' decisions to move to another school or leave the profession. The consequences of high turnover are particularly significant for high-need schools, which may have to devote substantial human and financial resources to repeatedly recruiting, hiring, and preparing replacement teachers and may consequently have disproportionate concentrations of inexperienced or under-prepared staff (Carroll, 2007). The financial costs are also considerable: the National Commission on Teaching and America's Future estimated that teacher turnover in US public schools could cost more than **\$7.3 billion** annually (Carroll, 2007).

The content of subjects and curricula is another important component of educational standardisation in the United States. Curricula are developed on the basis of standards and methodological guidance at state, district, and school levels (OECD, 2024). Teachers also play an important role as practical curriculum developers. In English, the term curriculum denotes a course or programme of study. More broadly, it refers to an organised framework of educational aims, content, teaching methods, and assessment. In the United States, curricula translate standards and minimum learning requirements into programmes of instruction and assessment. The UNESCO International Bureau of Education therefore regards the study of curriculum development and implementation across countries as an important area of work.

Curricula are intended to develop competencies and personal qualities such as initiative, creative problem-solving, respect for cultural diversity, tolerance, ethical awareness, independent decision-making, the practical application of knowledge, and

commitment to lifelong self-development. A curriculum integrates knowledge, skills, abilities, and values appropriate to learners' age and needs. It is based on an understanding of learning as an active, learner-centred process. Through subject content, it should help students acquire ways of thinking and acting and apply them in different contexts. This requires coherent alignment among educational aims, content, methods, modes of communication, and assessment. Curricula should also support students' value judgements, broaden their social outlook, and leave scope for individual development and self-realisation.

Lesson plans typically include the following elements:

1. Teacher's full name;
2. Class or grade;
3. Lesson topic;
4. Aim and learning objectives;
5. Required equipment and materials;
6. Learning activities;
7. Lesson sequence (introduction, main stage, conclusion);
8. Assessment;
9. Homework;
10. Additional comments.

Teachers may select the textbooks they use for a subject. Teaching and learning packages may include the main textbook, workbooks, teachers' guides, and audio and video materials.

US educational standards include both content standards and student achievement standards, the latter expressed through performance indicators. These indicators describe expected learning outcomes at different stages. Three achievement levels may be used to indicate the extent to which students have mastered the prescribed content (Common Core State Standards Initiative, 2010; Miles & Williams, 2016; What Works Clearinghouse, 2017).

The United States has an extensive system for monitoring student achievement at school, state, and national levels. Its purposes include evaluating the effectiveness of the education system, reviewing programmes and policies, placing students in appropriate courses or levels, certification, and diagnosing learning gaps so that they can be addressed.

Multiple-choice tests are widely used, alongside open-response tasks. At upper-secondary level, course completion is commonly recorded through a credit system based largely on instructional time.

Many US high schools use the Carnegie unit, introduced in the early twentieth century as a measure of instructional time. One Carnegie unit traditionally represents approximately 120 hours of instruction in a subject, often calculated as one hour per day, five days a week, for 24 weeks. A full-year course generally earns one credit, while a semester course earns half a credit.

Graduation requirements vary by state, but a minimum of around 16 credits is often cited, with approximately half allocated to compulsory subjects. The school year

may be divided into two or three terms, and final grades may be reported on a letter or percentage scale. One possible conversion is:

- A (93–100) – excellent;
- B (85–92) – above average;
- C (75–84) – satisfactory;
- D (65–74) – poor;
- E/F (0–64) – fail.

Tables 2 and 3 provide a comparative overview of the content and teaching methods of school education in Ukraine and the United States.

Table 2

General characteristics of school education in Ukraine and the United States

Indicator	Ukraine	United States
Purpose and educational philosophy	Emphasis on state standards and academic knowledge.	Emphasis on practical competencies, soft skills, and learner autonomy.
	Subject-based instruction predominates.	Project-based and inquiry-based learning play a substantial role.
	Emphasis on key competencies in the New Ukrainian School (reading, mathematical and digital literacy, and learning-to-learn skills) and on the holistic development of the learner.	Emphasis on critical and analytical thinking, creativity, collaboration, communication, and digital literacy. These priorities are often summarised as the 4Cs: critical thinking, creativity, collaboration, and communication. Less emphasis is placed on memorisation and more on practical application.
	Assessment is generally more formalised.	Strong emphasis on individualisation and subject choice.
	Main components of educational content: 1. Cognitive: knowledge of the world, nature, human beings, and society; foundations of the sciences. 2. Activity-based: skills and experience in cognitive, practical, and creative activity. 3. Values and worldview: attitudes towards knowledge, oneself, others, and the world; moral orientations. 4. Reflective: self-knowledge, self-regulation, and capacity for self-improvement.	Main components of educational content: 1. Cognitive: core academic knowledge; critical and logical thinking; information analysis; interdisciplinary connections; subject-specific competencies. Emphasis on flexible pathways and practical application. 2. Activity-based: projects, teamwork, research, practical problem-solving, case studies, modelling, discussion, debate, group tasks, and digital technologies. Emphasis on learning by doing and the 4Cs. 3. Values and worldview: responsibility, autonomy, initiative, civic and democratic values, respect for diversity and human rights, motivation, and readiness for life challenges. 4. Social and emotional learning (SEL): emotional self-regulation, empathy, teamwork, leadership, and responsibility. 5. Reflective: self-assessment, self-regulation, planning individual pathways, identifying strengths and weaknesses, and

Indicator	Ukraine	United States
Regulatory framework and documents governing educational content		making responsible choices. Practices may include individual education plans, reflective reports, and portfolio assessment.
	Education is organised in accordance with: 1. State standards for general secondary education, which specify learning requirements; 2. model/basic curricula, which allocate instructional time across subjects; 3. subject curricula, which specify content and expected knowledge and skills; 4. textbooks and teaching materials.	Each state adopts its own educational standards. Provision may include: 1. State standards specifying learning outcomes, subject content, and expected levels of preparation; many states use the Common Core State Standards for mathematics and English language arts. 2. Flexible curricula and individual educational pathways, including elective subjects and courses at different levels of difficulty (regular, honours, and Advanced Placement).
	Structure: primary (Grades 1–4), basic secondary (Grades 5–9), specialised upper secondary (Grades 10–12).	Structure varies by state and district; a common pattern is elementary school (K–5), middle school (Grades 6–8), and high school (Grades 9–12).
	The competency-based New Ukrainian School reform is being implemented progressively.	Schools have considerable autonomy in curriculum design and offer a developed system of elective, applied, and project-based courses.
Curricula and subjects	Programmes are approved by the Ministry of Education and Science and set clear requirements for learning outcomes.	No single national curriculum applies to all states. Each state adopts its own standards, including the Common Core State Standards for English language arts and mathematics in participating states.
	A compulsory set of subjects is defined for each level. Upper-secondary specialisation is being developed. Integrated courses are increasingly used, particularly in primary school.	High-school students complete compulsory courses and select electives such as psychology, business, robotics, culinary arts, art, and design. Advanced Placement courses support preparation for higher education. STEM, applied, and research-oriented courses are widely offered.
Assessment	12-point grading scale; formative assessment is increasingly used within the New Ukrainian School.	Letter grades (A–F); assessment may also include participation, projects, and presentations.
	Final assessment may include the State Final Attestation (DPA) and the NMT/ZNO.	College-admissions and advanced-course examinations may include the SAT, ACT, and AP examinations; requirements vary.
	Frequent tests and written checks.	Greater emphasis on portfolios and coursework; the balance with testing varies.
Teaching methods	Expository instruction remains common, while the New Ukrainian School increasingly promotes activity-based and integrated	Project-based learning, group tasks, discussion, and debate are widely used. Lessons may be flexible and interdisciplinary. The teacher often acts as a

Indicator	Ukraine	United States
	learning. Group work and debate are used less consistently.	facilitator rather than solely as a source of knowledge.
Inclusive resource support	Inclusive education has expanded in recent years. Inclusive resource centres, teaching assistants, and adapted programmes are available, although access remains uneven across regions.	Inclusive education is supported by federal legislation, including IDEA. Students may receive individualised education programmes (IEPs) or Section 504 plans, with support from psychologists, therapists, and counsellors.
Funding and access	Education is predominantly publicly funded. Private schools represent a small share. Provision varies between regions.	School funding depends substantially on state and local sources, including property taxes, which contributes to differences between districts. Private and charter schools are also widespread, and numerous initiatives are grant-funded.
Advantages and challenges of the educational models	Advantages: solid academic foundations; coherence and uniformity of state standards. Challenges: limited institutional autonomy; uneven material and technical provision.	Advantages: flexibility, broad course choice, and strong emphasis on practical and soft skills. Challenges: substantial inequalities associated with local funding; variation in standards between states.

Table 3

Comparison of teaching methods in Ukraine and the United States

Method	Ukraine	United States
Project-based learning	Used selectively	Integrated into many courses
Interactive methods	Widely used	Used regularly
Discussions and debates	Used occasionally	Used systematically
Research-based learning	Implemented in accordance with curricula	Forms the basis of learning in many subjects

In general, Ukrainian schools place greater emphasis on academic knowledge and state standards, whereas US schools place greater emphasis on individualisation, practical application, project-based learning, and student choice.

In the absence of a fully coherent national policy for STEM education, teachers' prior training and professional experience are among the factors influencing implementation in US educational institutions. Their subject knowledge is particularly important for both teaching effectiveness and self-efficacy.

According to data for 2020–2025 (Batyuk, 2025d), many teachers of mathematics and science from kindergarten to upper-secondary level in both the United States and Ukraine have completed fewer subject-specific courses than professional associations recommend. Many have also undertaken only limited preparation for

teaching STEM subjects. Teacher-education data therefore indicate gaps in mathematical and scientific preparation, while surveys suggest that a substantial proportion of mathematics and science teachers lack confidence in teaching engineering-related content.

Alongside subject knowledge, integrated STEM education requires teachers to be both able and confident in teaching across disciplinary boundaries. Teachers must be competent in their own specialisms and possess pedagogical approaches that help students identify connections between subjects and develop knowledge across fields. However, relatively few teacher-education programmes explicitly prepare teachers to integrate several STEM disciplines; a similar situation can be observed in Ukraine. Although professional development in STEM education is becoming more widespread in the Ukrainian education system, it remains largely associated with individual projects.

Successful implementation of integrated STEM education also requires substantial financial investment. Educational institutions need both funding and time to plan and provide teachers' professional development. These resources should enable teachers to extend their competence beyond their initial specialisation and accumulated experience. Funding is also required to develop, pilot, and scale new assessment systems capable of ensuring the quality and effectiveness of integrated STEM education.

Results. The comparative analysis identifies both common features and substantial differences between the education systems of Ukraine and the United States. The Ukrainian system emphasises thorough academic preparation, whereas the US model gives greater prominence to practical skills, learner autonomy, and individual educational pathways. A considered combination of the strengths of the two models could improve the effectiveness of education and the quality of student preparation.

Recommendations for adapting elements of US experience in Ukraine include:

1. Broaden the range of elective subjects in upper-secondary school.
2. Expand the use of project-based learning.
3. Promote a culture of discussion, debate, and public presentation.
4. Further develop formative assessment.
5. Create stronger conditions for implementing interdisciplinary STEM projects.

Over the next decade, Ukrainian education should pursue a strategic roadmap that strengthens its role in shaping the future of European and global education. Schools and higher education institutions should cooperate with policymakers, researchers, practitioners, and industry to reassess established approaches and identify effective ways of introducing educational innovation nationally and internationally. Support from the Ministry of Education and Science of Ukraine is required to develop solutions that enhance the safety, capacity, and opportunities of the next generation of students and teachers. Effective implementation will depend on synergies among practitioners, researchers, educational institutions, policymakers, and industry at national and international levels. Such cooperation can strengthen teacher capacity, develop school partnerships, attract young people to STEM careers, and promote the safe and responsible use of data, emerging technologies, learning environments, and teaching methods, thereby supporting current and future priorities in education, digital skills, and competencies.

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