UDC 37.0(73+477)+37.013.74+37.014+37.012+373.5:3+378+51

http://orcid.org/0000-0003-1863-0265
http://orcid.org/0000-0002-5383-449
https://doi.org/10.34142/23128046.2025.59.03

L. V. Batyuk,
O. A. Zhernovnykova

THE GENESIS OF MATHEMATICAL EDUCATION IN THE UNITED STATES OF AMERICA IN THE SECOND HALF OF THE 20TH CENTURY – THE 20S OF THE 21ST CENTURY

The strategic partnership between the United States of America and Ukraine, the purpose of which is long-term support for our state in the scientific, technical and educational spheres, provides for scientific, methodological and pedagogical exploration of the development of mathematical education in the USA in the second half of the 20th century and in the 20s of the 21st century can be used for the development of the Ukrainian educational environment and the modernization of education in Ukraine.

In the process of scientific research, a set of methods was used that ensured the integrity of the analysis and the reliability of the results obtained; allowed to process the opinions of practicing scientists and teachers on the development of mathematical education in the USA, assess the effectiveness of the proposed scientific and pedagogical conditions, analyze expert assessments, and rank the proposed conditions according to their practical significance.

Based on the summarized data, the nine main factors influencing the development of school and higher education in the period 1945–2025 were identified. The main directions of development of educational reforms in schools and universities in Europe and the USA in the period from 1945 to 1990 were identified, which became the basis of modern educational technologies, such as STEM education. The projects of mathematical education and mathematics curricula for schools and institutions of higher education for the period from 1945 to 1990 were considered. The reasons for the decline in the level of mathematics and science education in the period from 1980 to 1990 are investigated. The problems of standardization of school education in the US, determination of the mandatory minimum of knowledge and uniform requirements for knowledge, skills and abilities of school graduates to improve the quality of general education for all students are investigated. The geopolitical changes of the 1990s - 2000s are considered, which led to a new campaign for school reform in the United States. The results of TIMSS for 1996-1998 were studied. The results of PISA of US students in mathematics (December 2023) were analyzed. The current (2025) sequence of mathematics sections in high school and the sequence of mathematics courses in university were

studied; mathematics programs in STEM education at the college and university levels were studied.

***Keywords**: education, mathematical education, high education, STEM-education, school, university, students, pedagogy, methodology, teacher training, USA, Ukraine.*

***Батюк Л. В., Жерновникова О. А. Ґенезис математичної освіти в Сполучених Штатах Америки в другій половині XX століття – 20-х роках XXI століття**. Стратегічне партнерство між Сполученими Штатами Америки та Україною, метою якого є довгострокова підтримка нашої держави в науковій, технічній та освітній сфері, передбачає науково-методологічні та педагогічні розвідки розвитку математичної освіти в США у другій половині XX століття та у 20-х роках XXI століття, що може бути використано для розвитку українського освітнього середовища та модернізації освіти в Україні.*

У процесі наукового дослідження було використано комплекс методів, що забезпечили цілісність аналізу та достовірність отриманих результатів; дозволили опрацювати думки практикуючих науковців та викладачів щодо розвитку математичної освіти в США, оцінити ефективність запропонованих науково-педагогічних умов, проаналізувати експертні оцінки, ранжувати запропоновані умови за їхньою практичною значущістю.

На підставі узагальнених даних виокремлено дев'ять основних факторів впливу на розвиток шкільної та вищої освіти у період 1945–2025 рр. З'ясовані основні напрямки розвитку освітніх реформ в школах та університетах Європи та США в період з 1945 по 1990 рр., що стали основою сучасних освітніх технологій, таких як STEM-освіта. Розглянуто проєкти математичної освіти та навчальні програми з математики для шкіл та закладів вищої освіти за період з 1945 по 1990 роки. Досліджено причини зниження рівня математичної та природничої освіти в період з 1980 по 1990 роки. Досліджено проблеми стандартизації шкільної освіти в США, визначення обов'язкового мінімуму знань та єдиних вимог до знань, умінь та навичок випускників шкіл для підвищення якості загальноосвітньої підготовки всіх учнів. Розглянуті геополітичні зміни 1990-х – 2000-х років, які призвели до нової кампанії за шкільну реформу в Сполучених Штатах. Досліджено результати TIMSS за 1996-1998 роки. Проаналізовано результати PISA учнів США з математики (грудень 2023 року). Досліджена сучасна (2025 р.) послідовність розділів математики в середній школі та послідовність курсів з математики в університеті; програм з математики STEM-освіти на рівні коледжу та університетів.

***Ключові слова:** освіта, математична освіта, вища освіта, STEM-освіта, школа, університет, студенти, педагогіка, методологія, підготовка вчителів, США, Україна.*

Introduction. The strategic partnership between the United States of America and Ukraine (Agreement between the Government of Ukraine and the Government of the United States of America, 2025; On the Signing of the Protocol on Amendments and Extension of the Agreement between the Government of Ukraine and the Government of the United States of America, 2024), the purpose of which is the long-term reconstruction and modernization of Ukraine in response to the great destruction caused by Russia's full-scale invasion of Ukraine in the pursuit of a peaceful, sovereign, and stable Ukraine, encourages researchers from both countries to a new vector of scientific relations between the parties, to a new methodological approach and new perspective on research in the scientific, technological, and educational and pedagogical spheres (Slutskyi, 2022; Varga, 2022; Pylypenko, 2023; Rakhmanina, 2024; Batyuk, 2025; Batyuk & Masych, 2025).

Support for the NUSh Pilot in grades 8-12, training for teachers, school principals and their deputies, provision of STEM, ICT and other equipment in accordance with NUSh standards for schools participating, strengthening the management capacity of the Ministry of Education and Science, preparation of infrastructure development plans to prioritize investments in educational institutions and many other innovative solutions and implementations (Loan Agreement, 2024), experimental achievements and theoretical developments, research on the educational environment of the countries, a strategy for the development of higher education in Ukraine, which is consistent with the provisions on building an inclusive, innovative and interconnected European Higher Education Area by 2030 according to the Rome Ministerial Communiqué of November 19 2020 and provides for overcoming challenges, in particular through the digitalization of higher education, the development of virtual mobility, student-centered learning and teaching (On Approval of the Strategy for the Development of Higher Education in Ukraine for 2022-2032, 2022), are necessary for monitoring and evaluation, technical assistance, data collection and analysis from the perspective of scientific and historical relationships and development, both in the United States of America and for Ukraine, for further use in the development of the Ukrainian educational environment.

In accordance with the Action Plan for the Implementation of the Concept for the Development of Science and Mathematics Education (STEM Education) by 2027 (On Approval of the Action Plan, 2021), which, among other things, in paragraphs 2, 9, 12, 13, 15 provides for: conducting seminars and career guidance events for employees of local government bodies in the field of education, professional development centers, educational and methodological (scientific and methodological) centers (offices) of vocational and technical education, heads of educational institutions on issues of organizing the implementation of science and

mathematics education (STEM education), for education seekers; developing relevant advanced training programs (2021-2027); developing new content of science and mathematics education (STEM education) for students of general secondary and extracurricular education; the issue of scientific and methodological, the pedagogical and educational research into the development of mathematical education in the education system of the United States of America in the second half of the 20th century is an important scientific professional educational research and one of many steps towards the modernization of education to meet society's demands for science-intensive education, which is an integral part of the formation of the professional competence of education seekers relevant in the labor market.

The purpose of the article is to scientifically investigate the genesis of mathematical education in the United States education system in the second half of the 20th century – the 20s of the 21st century.

Methods of research. In the course of the scientific research, a set of methods was used that ensured the integrity of the analysis and the reliability of the results obtained: theoretical methods (analysis, generalization, systematization and comparison of scientific sources, regulatory and legal documents in the field of education), which allowed to identify the state of scientific development of the problem, outline key concepts, approaches and principles of the organization and development of mathematics education in the USA; empirical methods (expert evaluation), which made it possible to process the opinions of practicing scientists and teachers regarding the development of mathematics education in the USA, assess the effectiveness of the proposed scientific and pedagogical conditions, analyze expert assessments, and rank the proposed conditions according to their practical significance.

Results. The evolution of mathematics is most vividly represented in the period from the 16th to the 20th century. It was in the 16th century that polynomial algebra flourished; the theory of numbers developed, negative numbers began to be actively used; complex numbers began to be considered; algebraic equations of the 3rd and 4th degrees were solved, etc. In the 17th century, thanks to the works of R. Descartes, coordinates began to be actively studied, which allowed geometry to be translated into the language of algebraic formulas; mathematical analysis began to develop; mathematical laws underlying natural phenomena were formulated, for example, Fermat's variational principle for light rays, Galileo's principle, Hooke's law, the universal law of gravitation, Newton's general laws, ideas of probability theory appeared, etc. The first significant precedents arose, namely the derivation of mathematical forms and laws of nature from fundamental principles (the law of refraction of light at the boundary of two media from Fermat's variational

principle; Kepler's laws, which marked the beginning of the development of the modern scientific method of studying natural phenomena and the development of the scientific method of studying mathematical ideas and mathematical thinking) (Sira, 2022). In the 18th century, the development of analysis brought linear differential equations and the method of eigen variations to mathematics, the calculus of variations, which contributed to the emergence of differential geometry and number theory. Thanks to discoveries and scientific research, mechanics, including celestial mechanics and hydrodynamics, became a developed and experiment-rich, mature scientific discipline, the laws of which are still relevant and timely. The 19th century brought us the theory of probability, complex analysis, the theory of Riemann surfaces and group theory, linear algebra, a deepening study of symmetry, number theory, the theory of differential equations, the theory of Fourier series, and many, many other mathematical innovations. Innovations, thanks to which new branches of physics with their own mathematical laws appeared: electricity and magnetism, thermodynamics born of the development of technology, followed by statistical physics, kinetics, and later, in the 20th century, nuclear and quantum physics entered. Without the development of mathematics, this would have been fundamentally impossible. At the end of the 20th century, new abstract branches of mathematics, such as set theory and functions of a real variable, came into their mathematical power (Zhernovnykova & et al., 2025). Qualitative-topological branches of mathematics arose, known as the qualitative theory of dynamical systems and topology. Mathematical logic was grown. All these directions and discoveries influenced the development of the educational system of the United States of America. The public began to have a deep awareness of the inadequacy and even unsoundness of the existing classical education system. It should be borne in mind that during this period there was a grandiose leap in the development of technology. Of course, the development of mathematics was to a large extent the source of this leap. Mathematical understanding of the laws of nature was always preceded by experimental discoveries.

In the post-war period of the late 1940s and until today, 2025, the development of school and higher education in both victorious and defeated countries was influenced by the following factors: 1) the division of the world into countries with two different political systems (capitalist, socialist) 1945-1950s; 2) the beginning of the «Cold War»; economic recovery 1946-1955; 3) the growth of the influence of the victorious countries: the USA and Great Britain, as well as the USSR 1955-1975; 4) scientific and technological progress and the interstellar space race in 1957-1975; 5) economic and cultural crises 1960-1980s; 6) the establishment of economic, scientific, educational and social ties between the USA

and the states of the post-Soviet space in the 1990s; 8) the formation of the European Union, the transformation of Europe in 1990-2010; 9) UK's exit from the EU, COVID-19 pandemic, global financial crisis, Ukrainian War of Independence, 2010-2025.

After the end of World War II, the restoration of national education systems that existed in the pre-war era began in Western countries. At the same time, improvements in the education system were observed in the following decades. Among the main ones, the following vectors of educational development can be distinguished, which have become the basis of modern educational technologies, such as STEM educational ecosystems:

– increasing the importance of complete secondary education and strengthening the state's influence on the school;

– the emergence of mass secondary schools;

– further development of traditional (public and private) and creation of innovative (alternative) schools: «wild schools», «tycoon schools», «schools without walls», community colleges, pilot colleges, etc.;

– gradual standardization of educational content, focused on increasing the functional literacy of the population and the quality of education provided to students;

– differentiation of education in incomplete secondary educational institutions: junior high school, USA; combined school, England; comprehensive school, Germany; unified college, France, as well as in educational institutions of complete general education of various types: grammar and modern school, England; real school, gymnasium and basic school, Germany; technological, vocational and general education lyceums, France; senior high school, USA; etc.

– development of higher education;

– special attention to the education of young students.

These directions of development vectors were supported by the course of educational reforms; for example, in Great Britain, the Butler Act (1944) (Education Act 1944, 2025) was adopted during the war years. The law democratized and regulated school life, expanding the rights of guardianship and parent committees; increased the period of compulsory education for children under 15 years of age; legalized three types of secondary education institutions (modern school, grammar school, secondary technical school). Since the 1960s, unified comprehensive schools began to operate, which became a mass type of secondary education institution. The 1988 education reform introduced the «Uniform National Curriculum» for schools of all types, which contributes to the unification of national education (Education Reform Act, 1988). In France,

centralized management was maintained and the transition to a complete 12-year secondary education was observed, which is divided into primary school, incomplete secondary school, now known as a college, and complete secondary school, known as a lyceum (Beilinson, 2025). Already in college, the student must determine which specialization, technical or humanitarian, he chooses for further more detailed study. Lyceum graduates were awarded a bachelor's degree and a certificate that allows them to enter a university at the faculty of the same profile without exams.

The most significant and indicative is the experience of the USA. In the first post-war decades, the country's government adopted a so much of number of laws on education that had not been in the entire previous century (Batyuk, 2025). Among them were the «National Defense Education Act of 1958» (1958) (Report № 2157, 1958; Roman, 1995), the «Act on the Development of Higher Education» (1963) (Public Law 88-204, 1963; Cervantes, 2005), the «Act on Vocational Education» (1963), the «Act on the Development of Elementary and Secondary Education» (1965), etc. This contributed to the spread and strengthening of the movement for the elimination of the remnants of racial and religious segregation in US schools in the 1960s.

The origins of such drastic changes should be sought in the 1940s and 1950s of the 20th century. In the early 1940s and during World War II, it came as a shock the news that to American society and the government that 90% of new recruits to the US Army were so bad at math that the Army was forced to provide its own arithmetic training, which was a necessary component of the basics of accounting and artillery. Admiral Nimitz complained about the lack of mathematical knowledge among future officers and volunteers of the Navy (The Letter of Admiral Nimitz, 2018). These servicemen were supposed to receive basic skills through public school education, but this did not happen. By the mid-1940s, a new educational program called the «Life Adjustment Movement» had emerged in the United States educational community (Franzen, 1951). The basic premise was that, as educators believed, high schools and their curriculum were «too tied to the academic curriculum». Educational leaders believed that 60 % or more of all public school students lacked the intellectual capacity for college; they lacked the skills for skilled trades, and these students would need a different curriculum to prepare them for everyday life. They needed appropriate high school courses, including mathematics focused solely on practical matters such as consumer purchases, insurance, and taxation. It was proposed to introduce courses in home budgeting, but not to teach children algebra, geometry, or trigonometry. Students taking these courses would become unskilled or semiskilled laborers. These school

graduates, like their wives, would not need an academic education. Instead, they would be taught «home, shop, store, citizenship, and health».

By 1949, the «Life Adjustment Movement» movement had gained considerable support among educators and was actively promoted by numerous federal and state education agencies. Some educators even suggested in order to avoid accusations of unequal distribution of teaching hours and stigmatization of students, extracurricular activities in these programs be made available to all. «Life Adjustment Movement» could meet the needs of all American students (Fallace, 2011).

However, many schools clung tenaciously to academic subjects, even as they offered life adjustment programs. Moreover, parents resisted these changes; they wanted their own children to be educated, not simply adjusted. They were sometimes joined by university professors and journalists who criticized the lack of academic content in progressive programs. Changes in society at large also worked against the acceptance of the Life Adjustment Movement as a guide to action.

During the 1940-1950s, the country witnessed tremendous scientific and engineering advances. By the end of the decade, the advent of cryptography, navigation, radar, atomic energy, and many other technological innovations had transformed the economy and emphasized the importance of mathematics in the modern world. This, in turn, led to a recognition of the importance of mathematics education in schools. By the late 1940s, the public school system was under heavy criticism, and the Life Adjustment Movement had come to naught (Parker & Parker, 1992). Among the critics was Mortimer Smith. Recalling Bagley's 1926 description of «education students», he wrote in his 1949 book «Madly They Teach»: "...those who make up the staffs of the schools and colleges of education, and the administrators and teachers whom they train to run the system, have a truly amazing uniformity of opinion regarding the aims, the content, and the methods of education. They constitute a cohesive body of believers with a clearly formulated set of dogmas and doctrines, and they are perpetuating the faith by seeing to it through state laws and the rules of state departments of education, that only those teachers and administrators are certified who have been trained in the correct dogma". Critics of this period complained about the lack of attention to basic skills. Progressive education was forced to retreat in the 1950s, and even, in some places, became the butt of jokes and spite (Ravitch, 2001).

During the 1900s and 1950s, the number of students taking high school mathematics and other academic subjects steadily declined, at least in part due to progressive education. From 1933 to 1954, not only did the percentage of students taking geometry in high school decline, but the actual number of students who

wanted to take mathematics also declined, despite a rapid increase in the total number of students (see Table 1) (Klein, 2003). Table 1 shows the percentage of high school students taking mathematics in high school in the United States.

Table 1.

The percentage of high school students taking mathematics in high school in the United States in 1909-1955 school years.

School Year	*Algebra*	*Geometry*	*Trigonometry*
1909 to 1910	56.9 %	30.9 %	1.9 %
1914 to 1915	48.8 %	26.5 %	1.5 %
1921 to 1922	40.2 %	22.7 %	1.5 %
1927 to 1928	35.2 %	19.8 %	1.3 %
1933 to 1934	30.4 %	17.1 %	1.3 %
1948 to 1949	26.8 %	12.8 %	2.0 %
1952 to 1953	24.6 %	11.6 %	1.7 %
1954 to 1955	24.8 %	11.4 %	2.6 %

The period of a new era of mathematics in the United States, tentatively called by researchers the «New Mathematics», began in the early 1950s and lasted for a decade until the early 1960s. This period was not characterized by a single monolithic movement in teaching and learning. According to the director of one of the first «New Mathematics» conferences: “The inception of the New Math was the collision between skills instruction and understanding ...The disagreements between different entities of the New Math Movement were profound. Meetings between mathematicians and psychologists resulted only in determining that the two had nothing to say to each other” (Bosse, 1995).

Despite their differences, most of the mathematical education and curriculum projects of the period had some common features. The New Mathematics groups introduced curricula that emphasized logically consistent explanations of mathematical procedures taught in schools; they emphasized cause and effect. The New Mathematics was a clear departure from the anti-intellectualism of the previous half-century of progressivist doctrine. For the first time, mathematicians were actively involved in the development of school mathematics curricula for students from kindergarten to grade 12 (K–12). One example is the work of the Committee on School Mathematics at the University of Illinois, chaired by M. Beberman. This committee began its work in 1951 and was the first major project associated with the New Mathematics era. A group of mathematicians, led by Max Beberman, published a series of high school mathematics textbooks and received financial support from the Carnegie

Corporation and the U.S. Department of Education (Special Collections, 2025; Beberman, 1958; Beberman & et al., 1960; Fehr & et al., 1962; Beberman & et al., 1966).

Max Beberman believed that the problems facing the «New Mathematics» boiled down to several points:

1) The main problem with the «New Mathematics» was the lack of experienced teachers who had both experience in advanced mathematics and the teaching skills to describe concepts in sufficient detail.

2) The influence of the old system continually hindered the development of the «New Mathematics». Many students failed to develop computational and logical skills because the «old system» trained students to memorize and failed to develop critical thinking.

M. Beberman believed that the «New Mathematics» was «has come to stay». He preferred to view mathematics as a language with rules and logic to follow in order to draw conclusions, rather than as something alien to be memorized. Beberman insisted that the emphasis be on the «why» of mathematics, not on how it is taught. Unfortunately, after his death in 1971, the program was discontinued, likely due to the points he outlined above. However, the materials of the «New Mathematics» still exist and constitute a legacy for modern mathematics education.

In 1955, the College Entrance Examination Board established a Commission on Mathematics to study the «mathematical needs of today's American youth». The commission, which consisted of high school teachers, mathematics teachers, and mathematicians, published a report recommending a curriculum to better prepare students for college and produced a model twelfth-grade textbook on probability and statistics (Scheaffer & et al., 2014).

The efforts of these and other early groups received little attention in the press and academia. This continued until the Soviet Union overtook America in the space race and launched the first space satellite «Sputnik», into orbit in the fall of 1957. The American press viewed «Sputnik» as a major humiliation for America and drew attention to the poor quality of mathematics and science instruction in public schools in the United States. Congress responded by passing the National Defense Education Act of 1958 to increase the number of science, math, and foreign language majors, as well as to contribute to school construction (Report № 2157, 1958; Batyuk, 2025).

That same year, the American Mathematical Society established the School Mathematics Study Group (SMSG) to develop a new curriculum for high schools, led by E. Begle, then at Yale University. Of the many scientists' groups and research groups of the New Mathematics period, the SMSG was the most influential. It created mathematics programs for junior and senior high schools, and

later elementary school curricula. The first eight members of the SMSG were appointed by the president of the American Mathematical Society. After that, the two organizations had no formal relationship. The SMSG subsequently appointed a 26-member advisory committee and a 45-member writing group, which included 21 college and university mathematicians and 21 high school mathematics teachers and administrators (Polhill, 2020).

The National Council of Teachers of Mathematics established its own curriculum committee, the Secondary School Curriculum Committee, which published its recommendations in 1959. Many other groups emerged during this period, including the Ball State Project, the University of Maryland Mathematics Project, the Minnesota School Science and Mathematics Center, and the Greater Cleveland Mathematics Program. The late 1950s saw individual high school and college teachers begin to write their own texts based on the principles proposed by the major curriculum groups.

One of the most recent achievements of the New Mathematics movement was the introduction of courses in calculus at the high school level. But despite significant advances during this period, some New Mathematics curricula were formal in nature, with little attention to basic skills or applications of mathematics. Programs that included treatment of the basics of arithmetic other than decimal, as well as programs that placed a strong emphasis on set theory or more serious topics, confused and discouraged even the most interested parents of their students (Loveless, 2001; Schoenfeld, 2007). Many teachers were not well-prepared to handle the complex content of the New Mathematics curricula, which later led to growing criticism from the community. In 1962, a letter entitled «On the Mathematics Curriculum of the High School» signed by 64 prominent mathematicians, was published in the American Mathematical Monthly and The Mathematics Teacher. The letter criticized the New Mathematics movement and offered some general recommendations and principles for future curricula.

By the early 1970s, the New Mathematics movement had virtually ceased to exist. The National Science Foundation had stopped funding such programs. There was a call to «go back to basics» in mathematics as well as other subjects (Ravitch, 2001). However, this educational trend was not ignored. Progressive education had finally recovered from the stagnation of the 1950s, and by the late 1960s and early 1970s it was gaining momentum again.

Published in 1960, A. Neill's Summerhill, one of the most influential books on education of the decade, was a new movement and the story of an ultra-progressive school in England. Founded in 1921 in Suffolk, England, as a boarding school for relatively wealthy children, the school allowed its students to determine completely what and when they studied. By 1970, some 200,000 copies of

Summerhill were being sold annually; the book had become required reading for 600 university courses. Following Summerhill's example, and supported by the power structure in both education and society, «free schools» spread and eventually gave rise to the «Open Education Movement». This educational trend was not new; it was merely a repetition of the progressive agendas promoted in the 1920s, of allowing children to decide daily what they would study, at play tables, in play corners, or in reading centers.

But this «Open Education Movement» had a negative and destructive impact on children with limited resources because they lacked access to home tutoring or tutoring in basic skills outside of school. This particularly affected African American and Hispanic children who had illiterate parents at home who could not provide them with any help with the basics of reading, writing, or math. A very famous example was the results of the California standardized test in the fall of 1974 at Bennett Elementary School, which had only first to three grades (K-3). In 1974, Bennett's third-grade students ranked in the third percentile in the state, almost the absolute bottom. The school was then in its fourth year of the «Open Structure Program» and the student body was nearly 100 % minority and low-income. Reacting with shock and outrage to the test results, school principal Nancy Ichinaga turned to her teachers, who admitted that program was not working. All the students were illiterate, and the student-centered math program was simply terrible.

With the help of her teachers, Nancy Ichinaga implemented clearly defined and well-structured reading and math programs; programs that included the practice of basic skills. Within a few years, test scores rose well above the 50th percentile, and by the end of the 20th century, the school had gained national recognition and become a model for others to follow (Carter, 2000; Klein, 2003).

As with previous reforms and programs, this program met with widespread opposition. Most states had implemented minimum proficiency tests in basic skills. By the mid-1970s, nearly half of the nation's states required students to take these tests as a requirement for high school graduation. Due to the influence of urbanism and public demand, some school districts had established «foundational schools» which emphasized traditional academic skills and maintained strict student discipline. Although basic skills tests were a deterrent to the «Open Education Movement», by their nature they could not be used to hold students to very high standards or to raise existing standards. Standardized test scores declined steadily throughout the 1970s, reaching a low in the early 1980s.

The period of the 1980s-1990s of the 20th century became outstanding for the dynamics of the development of American school education. It was characterized by a rethinking of the traditional vectors of educational activity for

American society, paradigms and concepts of school education, directions for the development of higher education and universities, which, on the other hand, significantly influenced state educational policy (Batyuk, 2025).

In the early 1980s, it was recognized by the U.S. government, policymakers, educators, and the public that the quality of mathematics and science education was deteriorating. A 1980 presidential commission report noted low enrollment rates in higher mathematics and science courses, as well as a general decline in school expectations and college entrance requirements. Among the various reports and commissions that examined school education (K-12) in the United States in the early 1980s, the most prominent was the «An Agenda for Action» published by the National Council of Teachers of Mathematics (Hill & et al., 1980). The report called for new directions in mathematics education, which were later recognized and codified in 1989 in the form of national standards. The «An Agenda for Action» recommended that problem-solving be the focus of school mathematics in the years to come, along with new teaching methods. The report argued that «requiring complete mastery of skills before allowing participation in challenging problem solving is counterproductive» and that «difficulty with paper-and-pencil computation should not interfere with the learning of problem-solving strategies». Technology would make problem-solving accessible to students without basic skills. According to the report, «all students should have access to calculators and increasingly to computers throughout their school mathematics program». This included calculators «for use in elementary and secondary school classrooms». The report also warned, «It is dangerous to assume that skills from one era will suffice for another» and called for «decreased emphasis on such activities as...performing paper and pencil calculations with numbers of more than two digits». This would be possible because «the use of calculators has radically reduced the demand for some paper-and-pencil methods». The report also recommended that «team efforts in problem solving should be common place in elementary school classrooms» and encouraged «the use of manipulatives, where suited, to illustrate or develop a concept or skill». The «An Agenda for Action» also called for «a wider range of measures than conventional testing». All of these areas later became the subject of controversy in the math wars of the 1990s (Schoenfeld, 2004; Schoenfeld, 2007).

The need to improve the quality of school education and the country's competitiveness in the world market prompted the Federal Government, the White House, the US Presidential Administration, the US government and business circles to take active steps to reform school education. The greatest resonance during this period, in the USA, and throughout the educational environment of leading countries, was received by the report of the National Commission of the US Congress on the Quality of School Education, created by President R. Reagan

in 1981, which was published in 1983 under the title «A Nation at Risk: The Imperative for Educational Reforms» (Gardner & et al., 1983). According to the authors, the goal of the school education system «should be to maximize the development of everyone's abilities. To achieve this goal, it is necessary that we demand work from students while maximizing their capabilities and help them in this. We must demand that schools set truly high, not minimal, standards of knowledge and that parents help and encourage their children to make the most of their learning abilities». The Commission highlighted four components of the schooling process that determine the quality of school graduates. These components include: 1) the nature of the content of education; 2) the level of knowledge of secondary school graduates; 3) the amount of time allocated for classes and homework; and 4) the professional training and personal characteristics of the teacher. As noted in the report, all students who wish to receive a secondary education certificate must master five «core subjects», studying each of them for at least four years in secondary school. These include: English, mathematics, natural sciences, social sciences and programming. The different perspectives and prescriptions for change in the «Action Plan» and «A Nation at Risk» reports became, to some extent, the main building blocks in the math wars of the 1990s.

The activities of the presidential commission and the document prepared by it led to the intensification of efforts to modernize school education in the country. In the report of the then US Secretary of Education, E. Boyer (in which the main vector devotes himself to issues of improving the quality of education), the minister expresses the opinion that it is necessary to eliminate unequal flows in the education and training of all students according to unified programs (Boyer, 1983), (Wendling, 2020). Among the most important goals of education, E. Boyer identifies the following:

1) developing the ability to think critically and effectively participate in communicative processes through mastering the language;

2) knowing oneself, the world, and the heritage of humanity;

3) preparing for the world of work and continuing education;

4) developing social responsibility and readiness to fulfill the duty of a citizen.

E. Boyer recommended that, due to the impossibility of organizing high-quality vocational courses in schools that would meet modern educational needs, such courses be replaced by a general introduction of students to the world of work. It was proposed to introduce such vocational training courses that would contribute to the development of students' intellectual and educational abilities. The report emphasized the need to increase the requirements for the level of

training of graduates, and to pay special attention to the last two years of schooling.

In September 1983, a report of the US National Science Council commission was published, devoted to the issues of studying mathematics, natural sciences, and technical disciplines in schools. This report emphasized that by the end of the century mathematics, natural sciences, and technical disciplines would occupy a prominent place in the educational program of American schoolchildren. In the developments that appeared in subsequent years, these ideas were further developed, which later made it possible to implement STEM education in the educational process. STEM education is no longer just a question of substantiating the need to provide a full-fledged natural science, mathematics and humanities education to all students without exception, but also an attempt to determine the minimum mandatory knowledge in school subjects that is necessary for all young people, regardless of their interests and plans for the future, which meets the needs of society and the needs of economic development. Thus, the problem of standardization of school education was actually raised to the surface of the educational environment and initiated. In numerous publications and documents on the reform, a tendency towards a more precise definition of the mandatory minimum of knowledge, towards the development of uniform requirements for the knowledge, skills and abilities of school graduates is clearly traced. The vector is traced towards improving the quality of general educational training of all students. Of course, not all proposals and recommendations of educational programs and proposals began to be implemented, which was primarily due to problems that arose due to various difficulties, in particular, financial ones. Education leaders and teachers were unprepared and unwilling to change established pedagogical practices and teaching methods. However, school reform reached 45 states. In the state of Texas, for example, at the government level, the amount of time allocated daily in elementary schools for studying each subject was legally established. The government determined in detail the content of education, the direction and content of the courses to be mastered. A decision was made that provides that the transfer of students to the next grade will be carried out only if they master the school curriculum of the previous grade. In the state of Tennessee, the reform was carried out on the basis of a law adopted by the state legislature in 1984, which reflected the ideas expressed in the report «A Nation in Danger». In particular, the implementation of the programs «First Basic Skills» and «Then Computer Literacy» began here. In accordance with the decision made by the Tennessee legislature, $ 10 million was allocated to create special centers designed to help improve the quality of secondary and higher education. A study was conducted of the impact of class size on academic performance and educational results (Boyd,

1986), (Hunter & Aiken, 1984). Data collected by the basic skills training center confirmed that class sizes of 15 people have a significant pedagogical and educational effect: students in such classes treat each other better, come to the rescue more quickly, take an active part in collective activities, and are interested in joining together to work in groups.

The state of California actively participated in the implementation of educational reform, where in 1983, in order to support the vector of educational development, the state government allocated an additional $800 million. A special state commission developed the main criteria for evaluating curricula in such disciplines as English, history and social studies, mathematics, natural sciences; foreign language, fine arts. These criteria were approved by the California Department of Education in January 1985. According to the law, school districts in the state were required to compare the content of their programs with the proposed education model provided by the department once every three years and make the necessary changes to them. Thus, in the period from 1982 to 1984, 53% of American schools increased the requirements for the level of student knowledge, especially in such disciplines as mathematics, English, and natural sciences. In 69% of the country's schools, a struggle was waged to increase the length of the school day, and in 20 states laws were passed that strengthen the requirements for the level of teacher training. The attention paid in the USA to the problems of the quality of school education is evidenced, for example, by the fact that President R. Reagan took part in the award ceremony for the heads of 271 exemplary schools that achieved the best results (Reagan, 1987). The implementation of the main goal of the school reform of the 80s was aimed at improving the quality of education, and allowed not only to stop the decline in educational indicators that characterized the state of the school education system, but also in a number of cases to ensure their growth. In California, the number of high school students who studied mathematics for three years increased to 15%, the number of high school students who studied natural sciences increased to 20%. According to Professor T. Bell, former US Secretary of Education, quality reform had a positive effect on 70% of students (Bell, 1988). At the same time, it was noted that the problem of student dropout, the level of which had increased to 30% by 1988, remains unresolved which, according to researchers, was influenced by the proposed reduction of federal spending on education by the Reagan administration.

The geopolitical changes of 1989, with the arrival of President G. Bush in the White House, led to a new campaign for school reform in the United States, where the main role of the steering committee was transferred to the federal and state governments. In 1989, an emergency meeting was held in Charlottesville, Virginia, attended by President George W. Bush, state governors, the Secretary of

Education, and members of the President's Cabinet. The final statement spoke of the need to develop national criteria for the level of knowledge and skills of students. The agenda of the meeting brought to the fore national goals of education in the United States and proposed a program to improve the quality of the educational environment in the country, which at that time had 110,000 schools. At this stage, state decision-making on educational issues went beyond the traditional state-local school district relationship. What a school does in terms of curriculum, personnel policies, disciplinary procedures, and resource allocation is no longer a school-only matter and has gone beyond the boundaries of the local school district.

In April 1991, the US Government published the document «America 2000: Strategies in the Field of Education», which described a long-term program for the development of education in the country (America 2000: An Education Strategy, 2000). America 2000 is a national strategy (not a federal program) designed to achieve six national education goals within nine years. The main purpose of the document was to confirm the need for further improvement of school education in the direction of increasing its quality, accessibility and comprehensiveness. The main six goals were defined:

1. All children in America will enter school prepared for study in it.

2. At least 90% of students will graduate from high school.

3. American students, graduating from grades IV, VIII and XII, will demonstrate successful mastery of a serious program that includes English, mathematics, natural sciences, history, geography. Every school in America will ensure that all students make wise use of their abilities so that they become responsible citizens, continue their education and productively participate in the modern economy.

4. American students will be the first in the world in terms of success in natural sciences and mathematics.

5. Every adult in America will be literate and will master the knowledge and skills necessary for competitiveness in the global economy and for the exercise of civil rights and responsibilities.

6. All schools in America will be free from drugs and violence, and the discipline-based environment will be conducive to learning.

The above strategic guidelines identified the need to improve the level of general education, functional literacy, its accessibility, emphasized the importance of school in implementing the continuous nature of education. Special emphasis was placed on defining the main disciplines (the «core» of school education), introducing a national exam after graduation that meets world educational standards, establishing presidential awards for the best teachers and principals in

the state, strengthening the differentiation of teacher pay, and stimulating innovative pedagogical searches.

The document clearly states that a large-scale national goal requires the efforts of the entire nation and school education should become the concern of the whole society. The development by the US government of a national program for the development of school education at the turn of the century contributed, according to the president of the country, to a «crusade» for high quality general education training for students in mass schools. This vector of education development in the US was supported by the 42nd US President B. Clinton. His election campaign included the following words: "The future of the nation depends on our ability to make education better…".

Democratic President B. Clinton came up with a domestic policy program of investing 700 billion dollars in education, combating unemployment and other social needs by reducing military spending and increasing taxes. However, due to the fact that Republicans demanded a reduction in state spending on social needs, B. Clinton had difficulty in agreeing on the country's annual budget in Congress. Therefore, the Clinton administration, acting in the spirit of neoliberalism, did not go the way of direct assistance to the «lower strata» of society, but by creating conditions for their professional training and retraining.

Back in 1989, in the United States, President G. Bush and the nation's governors met at the historic Educative Summit (How the 1989 Education Summit Reshaped American Public Schools, 2025). They announced six National Education Goals in early 1990 and created the «National Education Goals Panel» to measure progress toward these goals in 1991. Two of these goals focused on improving student achievement in challenging subjects. In 1991, Congress of country and the «National Education Goals Panel» created the National Council on Educational Standards and Testing to consider setting world-class academic standards in the United States (Report to accompany H.R. 2435, the National Council on Education Standards and Testing Act, 1991). The Council on Advancing Standards in American Education reported that standards were desirable and appropriate and recommended the creation of a new agency to promote standards (Koretz, et al., 1992). In April 1993, the Clinton administration introduced legislation before Congress to create such an agency, the National Educational Standards and Improvement Council (NESIC). In anticipation of the creation of such a council, the Goals Group convened a Technical Planning Group to propose background recommendations for the council's consideration (Wurtz, et al., 1993). The group developed this report to provide practical initial steps for reviewing and certifying educational standards currently being developed by independent professional organizations.

The development by the US government of a national program for the development of school education at the turn of the two centuries (1994), its approval by Congress in the form of the law «Goal 2000 – Education in America» contributed to the unification of the actions of federal and local authorities for the high quality of general educational training of students in mass schools (H.R.1804 – Goals 2000: Educate America Act103rd, 2025). Analysis of the structure of the national educational goals and objectives formulated in the law «Goal 2000 – Education in America» allows us to group them into the following main areas: increasing the number of Americans who have completed secondary education and have basic literacy skills; creating an attitude towards lifelong learning; improving the quality of education: revising curricula for the study of mathematics, natural sciences, developing and implementing common academic standards in schools, strengthening preschool training, improving the skills of teachers, strengthening partnerships with parents; increasing the safety of the educational process: preventing and combating drug use, stopping attempts to bring weapons to school and use them (Earley, 1994). Thus, the goals of mastering current culture by young people and developing mental abilities on this basis, forming qualities necessary for life in a rapidly changing world, for active social and creative activity with the aim of improving personal and social life, have come to the fore.

To take a course to improve general education not only and not so much for the intellectual elite, who will continue their studies in prestigious universities, but mainly for 35 million schoolchildren, from low-income strata of society, families with only one parent, children of the colored population, indigenous people of America – Indians, these are the points emphasized in the program with which B. Clinton ran for president (The Clinton-Gore Administration A Record of Progress, 2025). The president, like the public, spoke out against vouchers, seeing them as a dangerous path to the collapse of the public-school structure. Nevertheless, he supported the idea of introducing elements of competition into school education and advocated for «charter» schools and classes in the state system.

To maintain a contingent of students from low-income families in high school, Clinton intended to pay 5% of graduating students, if they have high performance, $ 1,000 to pay for further education in college (President Bill Clinton: Meeting America’s Challenge of Providing Educational Opportunities for the New Century, 1996). High school students were encouraged to earn money for further education through the Corps of America programs. Young people were involved in community service work (in hospitals, nursing homes, schools, child care centers, and so on) (Jastrzab, et al., 1997; Spring, et al., 2008). As president, B. Clinton shared public concerns about school discipline and linked improved

school quality to consistent discipline. He said, “We must do more to make schools safe for children and teachers.” His proposals in this area included further federal funding for the Safe and Drug-Free Schools program and the Gun Violence Exclusion Program (Creating Safe and Drug-Free Schools An Action Guide, 1996; Keeping America’s School Children Safe. Clinton Administration Accomplishments, 1998; Sherman, 2000). A comparison of the programs for the development of school education of President G. Bush Jr. with the positions of B. Clinton indicates their continuity. In general, there is an attempt to correlate the adopted model of decentralized education management with the implementation of the principle of egalitarianism. The democratic mentality of Americans influenced the formation of strategic goals for improving the quality of school education based on the ideas of social equality and freedom.

In 1986, the National Council of Teachers of Mathematics (NCTM) created the Commission on Standards for School Mathematics, which was a major event in the genesis of the development of mathematics in the US education sector in the second half of the 20th century (National Research Council,1997). The Curriculum and Evaluation Standards for School Mathematics were developed in the summer of 1987 and revised in 1988 by four working groups appointed by John Dossey, then-NCTM president (Kirsner, et al., 1993; Klein, 2003).

The 1989 NCTM Curriculum and Evaluation Standards for School Mathematics consist of sections devoted to general standards for grade groups: K-4, K-5-8, and K-9-12; another section is devoted to Evaluation Standards. The 1989 NCTM standards promoted the previous Action Plan (An Agenda for Action), but with greater detail. The grade level groups provided lists of topics designated for increased focus and others identified for reduced focus. For instance, in the K-4 grade range, the Standards emphasized areas such as understanding the meanings of operations, developing operation sense, practicing mental computation, utilizing calculators for complex calculations, gathering and organizing data, recognizing and describing patterns, working with manipulative materials, and engaging in cooperative group work. Conversely, less focus was recommended on tasks like complex paper-and-pencil computations, long division, manual fraction calculations, estimating using rounding, rote practice, memorization of rules, and traditional methods of teaching by direct instruction. For grades 5-8, the changes were even more significant. The list of de-emphasized practices included relying solely on external authority (like teachers or answer keys), symbol manipulation, memorizing rules and algorithms, performing lengthy manual computations, and obtaining exact answers in rigid formats.

The 1989 NCTM Standards, much like the earlier Agenda for Action, emphasized the importance of integrating calculators into mathematics education

across all grade levels. On page 8, the Standards highlighted how advancements in technology had not only simplified calculations and graphing but also transformed the fundamental nature of mathematics itself. As a result, the NCTM recommended that calculators should be readily available to all students at any time. While the document acknowledged that the presence of calculators did not negate the necessity for students to learn algorithms and acquire some proficiency with paper-and-pencil methods, these acknowledgments were inconsistently reflected in classroom applications or other sections of the Standards. The NCTM Standards aligned closely with the principles of progressive education, which had been prominent since the 1920s. They promoted a student-centered, discovery-based approach to learning mathematics. The focus on practical applications was so strong that both fundamental skills and general mathematical concepts were largely to be taught through «real-world» problems, with little encouragement for studying mathematics purely for its intellectual value. This educational philosophy, known as «constructivism», underpinned the NCTM's approach during this period and shaped how the Standards were advocated and implemented (Bosse, 1995).

The release of the NCTM Standards came at an opportune moment. The nation was actively seeking benchmarks to enhance education, and the publication of the NCTM Standards effectively positioned them as the de facto national model. These standards quickly received widespread support, gaining formal endorsements from prestigious organizations like the American Mathematical Society, the Mathematical Association of America, and the Council of Scientific Society Presidents. In the years that followed, the NCTM expanded its contributions with two additional documents that complemented its standards. The first, released in 1991, concentrated on pedagogy, while the second, published in 1995, focused on assessment practices. By 1997, the majority of state governments had implemented mathematics standards closely aligned with the NCTM Standards (Raimi & Braden, 1998; Klein & et al., 2005).

During the mid-1990s, national discussions prominently highlighted international comparisons of student performance in mathematics. In November 1996, the initial findings from the Third International Mathematics and Science Study (TIMSS) were published (National Research Council, 1996; Introduction to TIMSS, 1997). These results indicated that U.S. eighth graders performed slightly below the international average in mathematics. A subsequent report, released in June 1997, assessed fourth-grade students, showing that U.S. fourth graders performed slightly above the international average among the participating countries. The final TIMSS report, published in 1998, examined students at the end of high school, revealing that U.S. twelfth graders ranked among the lowest in mathematics achievement compared to other nations. While the TIMSS data offered

valuable insights, its influence on policy debates was limited, as opposing sides selectively used findings to support their arguments. Nonetheless, TIMSS researchers expressed alignment with the principles outlined in the NCTM Standards.

Mathematics education in the United States exhibits significant variation not only across different states but also within individual states. Since the implementation of the Common Core Standards in 2010 by most states and the District of Columbia, there has been greater alignment in mathematics curricula at each grade level nationwide (Carmichael & et al., 2010; Common Core State Standards for Mathematics, 2010; Office of the State Superintendent of Education, 2025). While most school teachers base their lessons on the core curriculum, they don't always follow it to the letter. Many also use additional resources not provided by their school districts. In 2002, President G. Bush signed the No Child Left Behind Act, which held schools accountable for their students' test scores. The law was repealed in 2015 with the passage of Every Student Succeeds Act, which returned authority to the states and led to a loosening of standards (Common Core State Standards: Frequently Asked Questions, 2015).

As of 2024, 27 states require students to complete three math courses to graduate from high school (grades 9–12, typically ages 14–18), while 17 states and the District of Columbia mandate four courses. A common secondary-school math sequence includes Pre-Algebra (7th or 8th grade), Algebra I, Geometry, Algebra II, Pre-Calculus, and then Calculus or Statistics. Some students pursue integrated programs, yet many graduate high schools without taking Calculus or Statistics (Bressoud, 2022; OECD, 2024; Morgan & et al., 2022).

Counselors frequently encourage motivated students to take Calculus to boost their chances of acceptance into prestigious universities. Parents often support this by enrolling their children in math enrichment programs.

Secondary-school algebra remains a notable challenge for many students, often hindering their progress. This struggle leaves a significant number unprepared for college-level STEM (science, technology, engineering, and mathematics) programs or highly skilled careers. A 1997 report from the U.S. Department of Education found that completing rigorous high school math courses is a strong indicator of success in university programs, regardless of major or socioeconomic status. However, enrollment in Algebra I among eighth-graders has declined from the early 2010s to the early 2020s. Compounding these issues is a nationwide shortage of qualified math teachers. Both teachers and parents may unintentionally pass on their own math anxiety, while many parents overestimate their children's mathematical abilities. By 2025, 35% of American adults were unable to apply mathematical reasoning when assessing the validity of statements.

Although most people value the importance of mathematics, a significant portion – especially younger individuals – lacks confidence in their math skills. Meanwhile, high-performing schools often provide accelerated tracks, including opportunities to take college-level math after Calculus, and prepare students for competitive math events. At the post-secondary level, interest in STEM fields has grown significantly. However, many college students require remedial math courses and may abandon STEM programs due to inadequate math preparation.

In comparison to other developed nations within the Organization for Economic Co-operation and Development (OECD), the overall average mathematical literacy of American students is mediocre. As seen globally, math scores in the U.S. declined during the COVID-19 pandemic. However, Asian-American and European-American students perform above the OECD average in math proficiency (Education at a Glance, 2024, 2025).

Students pursuing STEM fields, particularly disciplines such as mathematics, physics, chemistry, computer science, and engineering, are generally required to complete single-variable calculus unless they possess Advanced Placement (AP) credits or their equivalents, like IB Math HL (Mathematics, 2025). Following this, majors in mathematics, the physical sciences, and engineering advance to topics like multivariable calculus, linear algebra, complex variables, ordinary differential equations, and partial differential equations.

Mathematics majors often begin with a course that rigorously introduces modern mathematics concepts before progressing to subjects such as abstract algebra, number theory, real analysis, advanced calculus, complex analysis, probability theory, and statistics. They may also explore advanced areas including set theory, mathematical logic, stochastic processes, integration and measure theory, Fourier analysis, functional analysis, differential geometry, and topology. Additionally, they have the option to dive into applied mathematics fields like mathematical modeling, numerical analysis, game theory, or mathematical optimization. Elective topics may include the calculus of variations, the history of mathematics, or areas of theoretical or mathematical physics such as classical mechanics, electrodynamics, nonlinear dynamics, fluid mechanics, quantum mechanics, or general relativity (Sochi, 2017; Granville, 2019; Hamkins, 2020).

Computer science students focus on discrete mathematics (including combinatorics and graph theory), information theory, theory of computation, and cryptography. Those combining computer science with economics might study algorithmic game theory. For students in the biomedical and social sciences, elementary probability and statistics are essential subjects. Meanwhile, students in the physical sciences and engineering are required to grasp error analysis for laboratory work and coursework. Advanced undergraduates or early graduate

students in physics may take specialized courses in advanced mathematical methods for physics. Such courses could include contour integration, the theory of distributions (generalized functions), Fourier analysis, Green's functions, special functions (like Bessel functions or Legendre polynomials), asymptotic series expansions, the calculus of variations, tensors, and group theory. Specific course offerings and requirements vary by institution (Zee, 2016; Roughgarden, 2016).

The latest PISA results, released in December 2023 and based on 2022 data, show that the mathematics performance of 15-year-old US students has declined significantly. The US average score was 465, 13 points lower than the previous estimate. Although the US score fell by 13 points, the country's international ranking improved from 29th to 26th place (out of 81 participating countries), as other countries such as Singapore, Macau and Taiwan saw significant declines. The results are a harbinger of further declines in low-performing students that were observed even before the COVID-19 pandemic. In addition, the PISA results revealed serious problems in the teaching of mathematics in the US. The reason is the shift in the vector of US education from mathematics and natural sciences to the humanities (PISA 2022 Results (Volume I), 2025).

A RAND study found that only about one-quarter of middle and high school students find math engaging most of the time, while nearly half admitted losing interest at least half the time (Darling-Hammond & Fitz, 2025).

In the 2022 Program for International Student Assessment, American teenagers performed relatively well in both reading, ranking 7th among participating countries, and science. However, in math, American students ranked lower than other countries and well below the international average. In contrast to the highest-achieving countries, U.S. scores are lower for both high- and low-achieving students and show wider achievement gaps related to students' socioeconomic status, which national data shows have widened since the pandemic.

Discussion. In recent decades, the much-publicized «reading crisis» has been a major driver of «fixing» education in the United States. According to the survey, most students are afraid of math, and very few are interested in continuing to study math-intensive subjects. Some students reported that math rarely excites them. Many students decide they are not "mathematicians" before they enter high school. As a result, this will manifest itself in a future shortage of technical workers. Attempts to create in US a curriculum focused on a deeper understanding of mathematical concepts, as they did 50 years ago, have run into the status quo of academic mathematics disciplines, which favor rote memorization of basic mathematical facts and the use of algorithms to solve any problems. This direction of obtaining math education is reinforced by textbooks and tests tied to the

curriculum in each grade, without delving deeply into any of the curricula. In addition, decades of shortages of high school math teachers have resulted in many vacancies being filled by people with backgrounds unrelated to math, or by people with insufficient training in math, pedagogy, or both. Events caused by Russia's war in Ukraine, again raised the issue of reform of mathematics education, which is inextricably linked to the economic and military sectors of the United States, and have found renewed support. Several states are seeking to update their math requirements with a greater emphasis on computer science and data science; the country's master strategy for K-12 schools is aimed at modernizing math education so that it meets the interests, abilities, needs, and goals of students, engaging educators, policymakers, and learners in a wide range of mathematical tasks, from budgeting to estimating population growth.

Conclusions. Researchers like D. Doz, J. Barnett, J. Lodder, T. Hausberger, and H. Sorensen, in their work exploring the theory and methodologies of education and mathematics teaching, as well as the evolution of education and its societal influence, align with N. Abel's perspective, that emphasized that to make progress in mathematics, one must delve into its history, tracing its development and formation, which remains deeply intertwined with the contributions of key figures in this scientific and educational domain (Doz, 2021), (Barnett & Lodder, 2016), (Radford, et al., 2016), (Sørensen, 2010). At the same time, special attention should be paid to the study of processes, not products of mathematical creativity, the development of learning strategies, the path of development and formation of necessary skills in students, not to forget about scientific and historical awareness, to have knowledge about the historical origin of mathematical concepts, to identify cultural, social conditions and traditions that caused their emergence.

The obtained data make it possible to analyze the general characteristics of the scientific-methodological and historical vector of the development of mathematical education, the state of pedagogical thought in the USA, and the main directions of school reform in educational institutions in the USA, which began in the late 1950s to the present day. The study and generalization of data on scientific-pedagogical and historical experience in the USA over the centuries is of great scientific and practical importance, as it opens up important opportunities for determining effective ways of developing schools and pedagogy in general and using valuable foreign experience to update domestic education. The study of the process of formation and development of mathematical education as part of the US educational system allows us to better understand the essence of modern ideas, theories and approaches, and to some extent involve the obtained scientific and pedagogical experience in predicting the future state of the mathematical educational environment in Ukraine.

ЛІТЕРАТУРА:

Батюк Л. В. Історико-педагогічні та компаративні аспекти виникнення та розвитку STEM-освіти. *Вісник Державного університету "Київський авіаційний інститут". Серія: Педагогіка. Психологія*, 2025. Том 1, № 26. С. 20–41. DOI: https://doi.org/10.18372/2411-264X.26.20172

Батюк Л. В. Різноманітність вищої освіти в США: доступ, вступ та тенденції зарахування. *Теорія та методика навчання та виховання*. 2024. № 57. С. 193-217.

Варга Н. І. Формування дослідницької компетентності викладача вищої школи США : дис. …д-ра філософії за спец. 011; Державний вищий навчальний заклад «Ужгородський національний університет». Ужгород, 2022. 45 с.

Жерновникова О. А., Чібісов О. Д., Дейніченко Т. І., Дейниченко Г. В. Вступ до математичного аналізу : навч.-метод. посіб. для бакалаврантів спец. 014.04 Середня освіта (математика) пед. ЗВО. Харків. нац. пед. ун-т ім. Г. С. Сковороди. Харків : ХНПУ ім. Г. С. Сковороди, 2025. 101 с.

Пилипенко О. С. Формування STEM-компетентностей студентів закладів фахової передвищої освіти у навчанні математики : дис. …д-ра філософії за спец. 015; Криворізький державний педагогічний університет. Кривий Ріг, 2023. 45 с.

Про затвердження плану заходів щодо реалізації Концепції розвитку природничо-математичної освіти (STEM-освіти) до 2027 року, 2021. URL: https://www.kmu.gov.ua/npas/pro-zatverdzhennya-planu-zahodiv-sh-a131r

Про реалізацію інноваційного освітнього проєкту на всеукраїнському рівні за темою «Науково-методичне забезпечення STEM-освіти в закладах освіти» у вересні 2024 – грудні 2027 років, 2024. URL: https://mon.gov.ua/npa/pro-realizatsiiu-innovatsiinoho-osvitnoho-proiektu-na-vseukrainskomu-rivni-za-temoiu-naukovo-metodychne-zabezpechennia-stem-osvity-v-zakladakh-osvity-u-veresni-2024-hrudni-2027-rokiv

Про підписання Протоколу про внесення змін і продовження дії Угоди між Урядом України та Урядом Сполучених Штатів Америки про співробітництво у сфері науки та технологій, 2024. URL: https://zakon.rada.gov.ua/laws/show/307-2024-%D1%80#Text

Рахманіна А. С. Підготовка майбутніх педагогів у закладах вищої освіти України засобами STEM-технологій : автореф. дис. …д-ра філософії за спец. 015; Національний університет біоресурсів і природокористування України. Київ, 2024. 45 с.

Слуцький Я. С. Теорія і практика соціально-педагогічного супроводу іноземних студентів у системі вищої освіти США : автореф. дис. …д-ра пед. наук за спец. 13.00.01, 13.00.05; Державний вищий навчальний заклад «Донбаський державний педагогічний університет». Слов'янськ, 2022. 44 с.

Сіра І. Т. Конспекти лекцій з курсу «Історія математики»: навчальний посібник. Харків, ХНПУ імені Г. С. Сковороди, 2022. 72 с.

Угода про позику (Програма «Підвищення доступності та стійкості освіти в умовах кризи в Україні») між Україною і Міжнародним банком реконструкції та розвитку, 2024. URL: https://zakon.rada.gov.ua/laws/show/996_011-24/sp:dark#Text

Угода між Урядом України та Урядом Сполучених Штатів Америки про створення Американсько-українського інвестиційного фонду відбудови, 2025. URL: https://zakon.rada.gov.ua/laws/show/840_001-25#Text

America 2000: An Education Strategy. (2000). Institution Department of Education, Washington, DC. 52 p. URL: https://files.eric.ed.gov/fulltext/ED327009.pdf

Barnett J., Lodder J. Teaching and Learning Mathematics from Primary Historical Sources. *Problems, Resources, and Issues in Mathematics Undergraduate Studies*. 2016. Vol. 26, № 1. P. 1–18. DOI: https://doi.org/10.1080/10511970.2015.1054010

Batyuk L. Education strategy "G.I. Bill of Rights" (1944–2025): US experience for the Ukrainian educational space. *Innovative Pedagogy*. 2025. Vol. 82, № 1. P. 9–19. DOI: https://doi.org/10.32782/2663-6085/2025/82.1.1

Batyuk L. Major aspects of STEM education based on U.S. government initiatives. *Educational Challenges*. 2025. Vol. 30, № 1. P. 88–105. DOI: https://doi.org/10.34142/2709-7986.2025.30.1.06

Batyuk L., Masych V. Features of Modern Higher Education in the USA: STEM Education. *Educological Discourse*. 2025. Vol. 50, № 3. P. 26–39. DOI: https://doi.org/10.28925/2312-5829/2025.3.3

Beberman M. An Emerging Program of Secondary School Mathematics. Harvard University Press, US. 1958. 56 p.

Beberman M., Sawyer W. W., Wortz R. W., Botel M. Math Workshop Level D Teacher's Guide. Encyclo Britannica Press. 1996. 198p.

Beberman M., Vaughan, H. E. High school mathematics. Vol. 2. *Generic*. 1960. 190 p.

Beilinson O. The History of Secondary Education in Europe. *Education*. 2025. P. 1–11. DOI: https://doi.org/10.1093/acrefore/9780190264093.013.1966

Bell T. H. The thirteenth man: a Reagan cabinet memoir. New York: Free Press; London: Collier Macmillan. 1988. 195 p.

Bosse M. J. The NCTM Standards in Light of the New Math Movement: A Warning! *Journal of Mathematical Behavior*. 1995. Vol. 14, № 2. P. 171–201.

Boyd P. G. The basic skills movement in Tennessee and its impact on standardized test scores in mathematics in Rutherford County, Tennessee. ETD Collection for Tennessee State University. 1986. 24p. URL: https://digitalscholarship.tnstate.edu/dissertations/AAI8802613

Boyer E. L. High school: a report on secondary education in America. Carnegie Foundation for the Advancement of Teaching New York: Harper & Row. 1st ed. 1983. 363 p.

Bressoud D. The Decline of High School Calculus. Math Values. 2025 Mathematical Association of America, 2022. URL: https://maa.org/math-values/the-decline-in-high-school-calculus/

Canzoneri K. Math Education in the U. S.: A Discussion of History, Principles, and Practice. Thesis for the Special Major in Educational Studies and Mathematics With Advisors Ann Renninger and Ralph Gomez Swarthmore College. 2017. 45 p.

Carmichael S. B., Martino G., Porter-Magee K., Wilson W. S., et al. The State of State Standards – and the Common Core – in 2010. Thomas B. Fordham Institute, 2010. 373 p.

Carter S. C. No Excuses: Lessons from 21 High-Performing, High-Poverty Schools. Heritage Foundation, Washington, DC. 2000. 131 p.

Cervantes A., Creusere M., McMillion R., McQueen C., Short M., Steiner M., Webster J. Opening the Doors to Higher Education: Perspectives on the Higher Education Act 40 Years Later. Texas Guaranteed Student Loan Corporation. 2005. 72 p.

Clark K., Kjeldsen T. H., Schorcht S., Tzanakis C., Wang X. History of mathematics in mathematics education: Recent developments. In Radford, L., Furinghetti, F., Hausberger, T. (Eds.). Proceedings of the 2016 ICME Satellite Meeting of the International Study Group on the Relations Between the History and Pedagogy of Mathematics (pp. 135–179). Publisher: IREM de Montpellier. 2016. URL: https://www.researchgate.net/publication/306017944_History_of_Mathematics_in_Mathematics_Education_Recent_developments

Common Core State Standards for Mathematics. 2025 Common Core State Standards Initiative. 2010. 93p. URL: https://corestandards.org/wp-content/uploads/2023/09/Math_Standards1.pdf

Common Core State Standards: Frequently Asked Questions. Congressional Research Service. 2015. 13 p.

Creating Safe and Drug-Free Schools An Action Guide. U.S. Department of Education World Wide Web site at: http://www.ed.gov. 1996. URL: https://www.ojp.gov/pdffiles/safescho.pdf

Darling-Hammond L., Fitz J. It's Time to Change the Math Calculus: How the U.S. can Finally get Math Education Right. 2025. URL: https://learningpolicyinstitute.org/blog/its-time-change-math-calculus-how-us-can-finally-get-math-education-right

Doz D. Using the History of Mathematics as a Motivational Factor in Teaching Math. Science, teaching, learning in a changed social context. Conference materials, Užice, October 2021, pp. 471–482. 2021. DOI: https://doi.org/10.46793/NNU21.471D

Earley P. M. Goals 2000: Educate America Act: Implications for Teacher Educators. American Association of Colleges for Teacher Education, Washington, D.C. 1994. URL: https://files.eric.ed.gov/fulltext/ED367661.pdf

Education Act 1944. legislation.gov.uk. 2025. URL: https://www.legislation.gov.uk/ukpga/Geo6/7-8/31/enacted

Education at a Glance 2024. OECD Indicators. 2025. URL: https://www.oecd.org/en/publications/education-at-a-glance-2024_c00cad36-en.html

Education Reform Act. 284 p. 1988. URL: https://www.legislation.gov.uk/ukpga/1988/40/pdfs/ukpga_19880040_en.pdf

Fallace, T. D. The Effects of Life Adjustment Education on the U.S. History Curriculum, 1948-1957. *The History Teacher Volume*. 2011. Vol. 44, № 4. P. 569–590. URL: https://www.societyforhistoryeducation.org/pdfs/Fallace.pdf

Fehr H. F., Carnahan W. H., Beberman M., Park T. Author Algebra, First Course. D. C. Heath and Company. 1962. 214 p.

Franzen C. G. F. Life Adjustment Education. *Pi Lambda Theta Journal*. 1951. Vol. 29, № 4. P. 207–210. JSTOR. URL: http://www.jstor.org/stable/42918535.

Gardner D. P., Larsen Y. W., Baker W. O., Campbell A., Crosby E. A., Foster Jr C. A., et al. A Nation at Risk: The Imperative for Educational Reform. An Open Letter to the American People. A Report to the Nation and the Secretary of Education. National Commission on Excellence in Education (ED), Washington, DC. 1983. 71 p.

Granville A. Number Theory Revealed: A Masterclass. Rhode Island: American Mathematical Society. 2019. 587 p.

Hamkins J. D. Proof and the Art of Mathematics. MIT Press. 2020. 24 p.

Hill S. A., Sobel M. A., Burkhart S. M., Dalton LeRoy C., Edwards Jr. E. L., et all. An Agenda for Action. The National Council of Teachers of Mathematics, Inc. 1980. 29 p. URL: https://www.nctm.org/flipbooks/standards/agendaforaction/html5/index.html

How the 1989 Education Summit Reshaped American Public Schools. Education and Society Program. Education & Society. Aspen Institute. 2025. URL: https://www.aspeninstitute.org/programs/education-and-society-program/how-the-1989-education-summit-reshaped-american-public-schools/

Hunter B., Aiken R. Computer Literacy in Vocational Education: Perspectives and Directions. State-of -the -Art Paper. Tennessee Univ., Knoxville. 1984. 80 p.

H.R.1804 – Goals 2000: Educate America Act103rd. Congress (1993-1994). USA.gov. 2025. URL: https://www.congress.gov/bill/103rd-congress/house-bill/1804

Introduction to TIMSS: The Third International Mathematics and Science Study. TIMSS as a Starting Point To Examine U.S.Education. Institution Office of Educational Research and Improvement (ED), Washington, DC. Report № ORAD-97-1016. 1997. 99 p. URL: https://files.eric.ed.gov/fulltext/ED410123.pdf

Jastrzab J. A., Blomquist J., Masker J., Orr L. Youth Corps: Promising Strategies for Young People and Their Communities. 1997. 35 p.

Keeping America's School Children Safe. Clinton Administration Accomplishments. The White House. Office of the Press Secretary. 1998. URL: https://clintonwhitehouse6.archives.gov/1998/03/1998-03-19-school-safety-accomplishments.html

Kirsner S. A., Zeuli J. S., Alford L., Michell M. J. The Teaching Mathematics for Understanding. A Professional Development Guide. National Center for Research on Teacher Learning, East Lansing, MI. 1993. 136 p.

Klein D. A Brief History of American K-12 Mathematics Education in the 20th Century. Mathematical Cognition: A Volume in Current Perspectives on Cognition, Learning, and Instruction. Mass., Information Age Publishing, Inc. 2003. P. 175–225.

Klein D., Braams B. J., Parker T., Quirk W., Schmid W., Wilson W. S. The State of State MATH Standards. Thomas B. Fordham Institute. 2005. 130 p.

Koretz D., Madaus G.F., Haertel E., Beaton A. E. National Education Standards and Testing: A Response to the Recommendations of the National Council on Education Standards and Testing. Institute on Education and Training. 1992. URL: https://www.rand.org/content/dam/rand/pubs/testimonies/2006/CT100.pdf

Loveless T. The Great Curriculum Debate: How Should We Teach Reading and Math? Brookings Institution Press. 2001. 369 p.

Mathematics. International Baccalaureate Organization. 2025. URL: https://www.ibo.org/programmes/diploma-programme/curriculum/mathematics/

Morgan P. L., Hu E. H., Farkas G., Hillemeier M. M., Oh Y., Gloski C. A. Racial and Ethnic Disparities in Advanced Science and Mathematics Achievement During Elementary School. *Gifted Child Quarterly*. 2022. Vol. 67, № 2. P. 151–172. DOI: https://doi.org/10.1177/00169862221128299

National Research Council. Mathematics and science education around the world: What can we learn from the Survey of Mathematics and Science Opportunities (SMSO) and the Third International Mathematics and Science Study (TIMSS)? Washington, DC: National Academy Press. 1996. 24 p. DOI: https://doi.org/10.17226/5508.

National Research Council. Improving Student Learning in Mathematics and Science: The Role of National Standards in State Policy. Washington, DC: The National Academies Press. 1997. 56 p. DOI: https://doi.org/10.17226/5844.

OECD. An Evolution of Mathematics Curriculum: Where It Was, Where It Stands and Where It Is Going, OECD Publishing, Paris. 2024. 166 p. DOI: https://doi.org/10.1787/0ffd89d0-en.

Office of the State Superintendent of Education. 2025. URL: https://osse.dc.gov/service/common-core-state-standards

Parker F., Parker B. J. Educational Historian Lawrence A. Cremin (1925-90) and U.S. Education Direction. Historical Materials. 1992. URL: https://files.eric.ed.gov/fulltext/ED352305.pdf

PISA 2022 Results (Volume I). The State of Learning and Equity in Education. Organization for Economic Co-operation and Development. 2025. URL: https://www.oecd.org/en/publications/pisa-2022-results-volume-i_53f23881-en.html

Polhill M. E. The School Mathematics Study Group: Lessons in Mathematics Education. 2020. URL: https://scholarship.richmond.edu/cgi/viewcontent.cgi?article=1045&context=as-student-symposium

President Bill Clinton: Meeting America's Challenge of Providing Educational Opportunities for the New Century. 1996. URL: https://nara-media.s3.amazonaws.com/presidential-libraries/clinton/foia/2013-1078-S/2013-1078-S-PDF/Box_010/42-t-7422548-20131078S-010-003-2015.pdf

Public Law 88-204. Act on the Development of Higher Education. 1963. 17 p. URL: https://www.congress.gov/88/statute/STATUTE-77/STATUTE-77-Pg363-2.pdf

Radford L., Furinghetti F., Hausberger T. (Eds.) Proceedings of the 2016 ICME Satellite Meeting of the International Study Group on the Relations Between the History and Pedagogy of Mathematics. Montpellier, France: IREM de Montpellier. 2016. 793 p.

Raimi R. A., Braden L. S. State Mathematics Standards: An Appraisal of Math Standards in 46 States, the District of Columbia, and Japan. *Fordham Report*. 1998. Vol. 2, № 4. P. 1–72.

Ravitch D. Left back: a century of failed school reforms. New York: Simon & Schuster. 2001. 560 p.

Reagan R. Remarks at a White House Ceremony Honoring the Winners of the Secondary School Recognition Program and the Exemplary Private School Recognition Project. National Archives. 1987. URL: https://www.reaganlibrary.gov/archives/speech/remarks-white-house-ceremony-honoring-winners-secondary-school-recognition-0

Report to accompany H.R. 2435, the National Council on Education Standards and Testing Act National Council on Education Standards and Testing. Congress of the U.S., Washington, D.C. House. Committee on Education and Labor. 1991. 13p. URL: https://files.eric.ed.gov/fulltext/ED335403.pdf

Report № 2157. National Defense Education Act of 1958. 1958. 49 p. URL: https://www.cia.gov/readingroom/docs/CIA-RDP78-06365A000200060019-5.pdf

Roman P. J. *Eisenhower and the Missile Gap*. Ithaca, N.Y.: Cornell University Press. 1995. 264 p.

Roughgarden T. Twenty Lectures on Algorithmic Game Theory. Cambridge University Press. 2016. 14 p.

Schoenfeld A. H. The math wars. *Educational Policy*. 2004. Vol. 18, № 1. P. 253–286. DOI: https://doi.org/10.1177/0895904803260042

Schoenfeld A. H. Assessing Mathematical Proficiency. Mathematical Sciences Research Institute. 2007. 411 p.

Schoenfeld A. H. Problem solving in the United States, 1970-2008: Research and theory, practice and politics. *ZDM: the international journal on mathematics education*. 2007. Vol. 39, № 5. P. 537–551. DOI: https://doi.org/10.1007/s11858-007-0038-z

Scheaffer R. L., Jacobbe T. Statistics Education in the K-12 Schools of the United States: A Brief History. *Journal of Statistics Education*. 2014. Vol. 22, № 2. P. 1–14. URL: www.amstat.org/publications/jse/v22n2/scheaffer.pdf

Sochi T. Introduction to Differential Geometry of Space Curves and Surfaces. Create Space. 2017. 260 p.

Special Collections. Archives and Manuscript Holdings Databases. (2025). Illinois Library 2022. URL: http://www.library.illinois.edu/archives/archon

Spring K., Grimm Jr. R., Dietz N. Community Service and Service-Learning in America's Schools. Corporation for National and Community Service, Office of Research and Policy Development Washington, DC. 2008. 44 p.

Sørensen H. K. The Mathematics of Niels Henrik Abel: Continuation and New Approaches in Mathematics During the 1820s. RePoSS: Research Publications on Science Studies 11. Århus: Department of Science Studies, University of Aarhus. National Education Goals Panel, Washington, DC. 2010. 470 p. URL: https://www.ivs.au.dk/reposs

The Clinton-Gore Administration A Record of Progress. 2025. URL: https://clintonwhitehouse5.archives.gov/WH/Accomplishments/eightyears-05.html

The Letter of Admiral Nimitz. Taylor & Francis. 212–214. 2018. DOI: https://doi.org/10.1080/00029890.1942.11991208

Wendling L. Valuing the Engaged Work of the Professoriate: Reflections onErnest Boyer's Scholarship Reconsidered. *Journal of the Scholarship of Teaching and Learning*. 2020. Vol. 20, № 2. P. 127–142. DOI: https://doi.org/10.14434/josotl.v20i2.25679

William L. S. The Safe and Drug-Free Schools Program. *Brookings Papers on Education Policy*. 2000. Vol. 2000, № 1. P. 125–156. DOI: https://doi.org/10.1353/pep.2000.0020

Wurtz E., Malcom S., Kugler E., Miller S., Walter C., Stratoudakis J., et al. Report on the Review of Education Standards from the Goals 3 and 4 Technical Planning Group to the National Education Goals Panel. 1993. 78 p. URL: https://govinfo.library.unt.edu/negp/reports/promises.pdf

Zee A. Group Theory in a Nutshell for Physicists (Illustrated ed.). Princeton University Press. 2016. 633 p.

REFERENCES:

Batyuk, L. & Masych, V. (2025). Features of Modern Higher Education in the USA: STEM Education. *Educological Discourse*, 50(3), 26–39. DOI: https://doi.org/10.28925/2312-5829/2025.3.3

Batyuk, L. (2025). Istoriko-pedagogichni ta komparativni aspekti viniknennya ta rozvitku STEM-osviti [Historical, pedagogical and comparative aspects of the emergence and development of STEM education]. *Derzhavnogo universitetu "Kiïvskii aviatsiinii institut". Seriya: Pedagogika. Psikhologiya*, 1(26), 20–41. DOI: https://doi.org/10.18372/2411-264X.26.20172 (in Ukranian)

Batiuk, L. V. (2024). Riznomanitnist vyshchoi osvity v SShA: dostup, vstup ta tendentsii zarakhuvannia. [The diversity of higher education in the US: access, admissions and enrolment trends]. *Teoriia ta metodyka navchannia ta vykhovannia*. № 57. S. 193-217. (in Ukranian)

America 2000: An Education Strategy. (2000). Institution Department of Education, Washington, DC. 52 p. URL: https://files.eric.ed.gov/fulltext/ED327009.pdf

Barnett, J., Lodder, J. (2016). Teaching and Learning Mathematics from Primary Historical Sources. *Problems, Resources, and Issues in Mathematics Undergraduate Studies*, 26(1), 1–18. DOI: https://doi.org/10.1080/10511970.2015.1054010

Batyuk, L. (2025). Education strategy "G.I. Bill of Rights" (1944–2025): US experience for the Ukrainian educational space. *Innovative Pedagogy*, 82(1), 9–19. DOI: https://doi.org/10.32782/2663-6085/2025/82.1.1

Batyuk, L. (2025). Major aspects of STEM education based on U.S. government initiatives. *Educational Challenges*, 30(1), 88–105. DOI: https://doi.org/10.34142/2709-7986.2025.30.1.06

Batyuk, L. & Masych, V. (2025). Features of Modern Higher Education in the USA: STEM Education. *Educological Discourse*, 50(3), 26–39. DOI: https://doi.org/10.28925/2312-5829/2025.3.3

Beberman, M. (1958). An Emerging Program of Secondary School Mathematics. Harvard University Press, US.

Beberman, M., Sawyer, W. W., Wortz, R. W., Botel, M. (1996). Math Workshop Level D Teacher's Guide. Encyclo Britannica Press. 198 p.

Beberman, M., Vaughan, H. E. (1960) High school mathematics. Vol. 2. Generic. 190 p.

Beilinson, O. (2025). The History of Secondary Education in Europe. *Education*. 1–11. DOI: https://doi.org/10.1093/acrefore/9780190264093.013.1966

Bell, T. H. (1988). The thirteenth man: a Reagan cabinet memoir. New York: Free Press; London: Collier Macmillan. 195 p.

Bosse, M. J. (1995). The NCTM Standards in Light of the New Math Movement: A Warning! *Journal of Mathematical Behavior*, 14(2), 171–201.

Boyd, P. G. (1986). The basic skills movement in Tennessee and its impact on standardized test scores in mathematics in Rutherford County, Tennessee. ETD Collection for Tennessee State University. 24 p. URL: https://digitalscholarship.tnstate.edu/dissertations/AAI8802613

Boyer, E. L. (1983). High school: a report on secondary education in America. Carnegie Foundation for the Advancement of Teaching New York: Harper & Row. 1st ed. 363 p.

Bressoud, D. (2022). The Decline of High School Calculus. Math Values. 2025 Mathematical Association of America. URL: https://maa.org/math-values/the-decline-in-high-school-calculus/

Canzoneri, K. (2017). Math Education in the U. S.: A Discussion of History, Principles, and Practice. Thesis for the Special Major in Educational Studies and Mathematics With Advisors Ann Renninger and Ralph Gomez Swarthmore College, Spring 2017. 45 p.

Carmichael, S. B., Martino, G., Porter-Magee, K., Wilson, W. S. & et al. (2010). The State of State Standards – and the Common Core – in 2010. Thomas B. Fordham Institute. 373 p.

Carter, S. C. (2000). No Excuses: Lessons from 21 High-Performing, High-Poverty Schools. Heritage Foundation, Washington, DC. 131 p.

Cervantes, A., Creusere, M., McMillion, R., McQueen, C., Short, M., Steiner, M. & Webster, J. (2005). Opening the Doors to Higher Education: Perspectives on the Higher Education Act 40 Years Later. Texas Guaranteed Student Loan Corporation. 72 p.

Clark, K., Kjeldsen, T. H., Schorcht, S., Tzanakis, C. & Wang, X. (2016). History of mathematics in mathematics education: Recent developments. In Radford, L., Furinghetti, F., Hausberger, T. (Eds.). Proceedings of the 2016 ICME Satellite Meeting of the International Study Group on the Relations Between the History and Pedagogy of Mathematics (pp. 135–179). Publisher: IREM de Montpellier. URL: https://www.researchgate.net/publication/306017944_History_of_Mathematics_in_Mathematics_Education_Recent_developments

Common Core State Standards for Mathematics. (2010). 2025 Common Core State Standards Initiative. 93 p. URL: https://corestandards.org/wp-content/uploads/2023/09/Math_Standards1.pdf

Common Core State Standards: Frequently Asked Questions. (2015). Congressional Research Service. 13 p.

Creating Safe and Drug-Free Schools An Action Guide. (1996). U.S. Department of Education World Wide Web site at: http://www.ed.gov. URL: https://www.ojp.gov/pdffiles/safescho.pdf

Darling-Hammond, L. & Fitz, J. (2025). It's Time to Change the Math Calculus: How the U.S. can Finally get Math Education Right. URL: https://learningpolicyinstitute.org/blog/its-time-change-math-calculus-how-us-can-finally-get-math-education-right

Doz, D. (2021). Using the History of Mathematics as a Motivational Factor in Teaching Math. Science, teaching, learning in a changed social context. Conference materials, Užice, October 2021 (pp. 471–482). DOI: https://doi.org/10.46793/NNU21.471D

Earley, P. M. (1994). Goals 2000: Educate America Act: Implications for Teacher Educators. American Association of Colleges for Teacher Education, Washington, D.C. URL: https://files.eric.ed.gov/fulltext/ED367661.pdf

Education Act 1944. (2025). legislation.gov.uk. URL: https://www.legislation.gov.uk/ukpga/Geo6/7-8/31/enacted

Education at a Glance 2024. (2025). *OECD Indicators*. URL: https://www.oecd.org/en/publications/education-at-a-glance-2024_c00cad36-en.html

Education Reform Act. (1988). 284 p. URL: https://www.legislation.gov.uk/ukpga/1988/40/pdfs/ukpga_19880040_en.pdf

Fallace, T. D. (2011). The Effects of Life Adjustment Education on the U.S. History Curriculum, 1948-1957. *The History Teacher Volume*, 44(4). 569–590. URL: https://www.societyforhistoryeducation.org/pdfs/Fallace.pdf

Fehr, H. F., Carnahan, W. H., Beberman, M. & Park, T. (1962). Author Algebra, First Course. D. C. Heath and Company. 214 p.

Franzen, C. G. F. (1951). Life Adjustment Education. *Pi Lambda Theta Journal*, 29(4), 207–210. JSTOR. URL: http://www.jstor.org/stable/42918535.

Gardner, D. P., Larsen, Y. W., Baker, W. O., Campbell, A., Crosby, E. A., Foster, Jr C. A. & et al. (1983). A Nation at Risk: The Imperative for Educational Reform. An Open Letter to the American People. A Report to the Nation and the Secretary of Education. National Commission on Excellence in Education (ED), Washington, DC. 71 p.

Granville, A. (2019). Number Theory Revealed: A Masterclass. Rhode Island: American Mathematical Society. 587 p.

Hamkins, J. D. (2020). Proof and the Art of Mathematics. MIT Press. 24 p..

Hill, S. A., Sobel, M. A., Burkhart, S. M., Dalton, LeRoy C., Edwards, Jr. E. L. & et all. (1980). An Agenda for Action. The National Council of Teachers of Mathematics, Inc. 29 p. URL: https://www.nctm.org/flipbooks/standards/agendaforaction/html5/index.html

How the 1989 Education Summit Reshaped American Public Schools. (2025). Education and Society Program. Education & Society. Aspen Institute. URL: https://www.aspeninstitute.org/programs/education-and-society-program/how-the-1989-education-summit-reshaped-american-public-schools/

Hunter, B., Aiken, R. (1984). Computer Literacy in Vocational Education: Perspectives and Directions. State-of -the -Art Paper. Tennessee Univ., Knoxville. 80 p.

H.R.1804 – Goals 2000: Educate America Act103rd. (2025). Congress (1993-1994). USA.gov. URL: https://www.congress.gov/bill/103rd-congress/house-bill/1804

Introduction to TIMSS: The Third International Mathematics and Science Study (1997). TIMSS as a Starting Point To Examine U.S.Education. Institution Office of Educational Research and Improvement (ED), Washington, DC. Report № ORAD-97-1016. 99p. URL: https://files.eric.ed.gov/fulltext/ED410123.pdf

Jastrzab, J. A., Blomquist, J., Masker, J., Orr, L. (1997). Youth Corps: Promising Strategies for Young People and Their Communities. 35 p.

Keeping America's School Children Safe. Clinton Administration Accomplishments. (1998). The White House. Office of the Press Secretary URL: https://clintonwhitehouse6.archives.gov/1998/03/1998-03-19-school-safety-accomplishments.html

Kirsner, S. A., Zeuli, J. S., Alford, L. & Michell, M. J. (1993). The Teaching Mathematics for Understanding. A Professional Development Guide. National Center for Research on Teacher Learning, East Lansing, MI. 136 p.

Klein, D. (2003). A Brief History of American K-12 Mathematics Education in the 20th Century. Mathematical Cognition: A Volume in Current Perspectives on Cognition, Learning, and Instruction. Mass., Information Age Publishing, Inc. 175–225.

Klein, D., Braams, B. J., Parker, T., Quirk, W., Schmid, W. & Wilson, W. S. (2005). The State of State MATH Standards. Thomas B. Fordham Institute. 130 p.

Koretz, D., Madaus, G.F., Haertel, E. & Beaton, A. E. (1992). National Education Standards and Testing: A Response to the Recommendations of the National Council on Education Standards and Testing. Institute on Education and Training. URL: https://www.rand.org/content/dam/rand/pubs/testimonies/2006/CT100.pdf

Loveless, T. (2001). The Great Curriculum Debate: How Should We Teach Reading and Math? Brookings Institution Press. 369 p.

Mathematics. (2025). International Baccalaureate Organization. URL: https://www.ibo.org/programmes/diploma-programme/curriculum/mathematics/

Morgan, P. L., Hu, E. H., Farkas, G., Hillemeier, M. M., Oh, Y. & Gloski, C. A. (2022). Racial and Ethnic Disparities in Advanced Science and Mathematics Achievement During Elementary School. *Gifted Child Quarterly*, 67(2), 151–172. DOI: https://doi.org/10.1177/00169862221128299

National Research Council. (1996). Mathematics and science education around the world: What can we learn from the Survey of Mathematics and Science Opportunities (SMSO) and the Third International Mathematics and Science Study (TIMSS)? Washington, DC: National Academy Press. 24 p. DOI: https://doi.org/10.17226/5508.

National Research Council. (1997). Improving Student Learning in Mathematics and Science: The Role of National Standards in State Policy. Washington, DC: The National Academies Press. 56 p. DOI: https://doi.org/10.17226/5844.

OECD. (2024). An Evolution of Mathematics Curriculum: Where It Was, Where It Stands and Where It Is Going, OECD Publishing, Paris. 166 p. DOI: https://doi.org/10.1787/0ffd89d0-en.

Office of the State Superintendent of Education. (2025). URL: https://osse.dc.gov/service/common-core-state-standards

Parker, F. & Parker, B. J. (1992). Educational Historian Lawrence A. Cremin (1925-90) and U.S. Education Direction. Historical Materials. URL: https://files.eric.ed.gov/fulltext/ED352305.pdf

PISA 2022 Results (Volume I). (2025). The State of Learning and Equity in Education. Organisation for Economic Co-operation and Development. URL: https://www.oecd.org/en/publications/pisa-2022-results-volume-i_53f23881-en.html

Polhill, M. E. (2020). The School Mathematics Study Group: Lessons in Mathematics Education. URL: https://scholarship.richmond.edu/cgi/viewcontent.cgi?article=1045&context=as-student-symposium

President Bill Clinton: Meeting America's Challenge of Providing Educational Opportunities for the New Century. (1996). URL: https://nara-media.s3.amazonaws.com/presidential-libraries/clinton/foia/2013-1078-S/2013-1078-S-PDF/Box_010/42-t-7422548-20131078S-010-003-2015.pdf

Pro pidpisannya Protokolu pro vnesennya zmin i prodovzhennya diï Ugodi mizh Uryadom Ukraïni ta Uryadom Spoluchenikh Shtativ Ameriki pro spivrobitnitstvo u sferi nauki ta tekhnologii. (2024). [On the signing of the Protocol on Amendments and Extension of the Agreement between the Government of Ukraine and the Government of the United States of America on Cooperation in Science and Technology]. URL: https://zakon.rada.gov.ua/laws/show/307-2024-%D1%80#Text (in Ukranian)

Pro realizatsiyu innovatsiinogo osvitnogo proektu na vseukraïnskomu rivni za temoyu «Naukovo-metodichne zabezpechennya STEM-osviti v zakladakh osviti» u veresni 2024 - grudni 2027 rokiv. (2024) [On the implementation of an innovative educational project at the all-Ukrainian level on the topic «Scientific and methodological support of STEM education in educational institutions» in September 2024 – December 2027]. URL: https://mon.gov.ua/npa/pro-realizatsiiu-innovatsiinoho-osvitnoho-proiektu-na-vseukrainskomu-rivni-za-temoiu-naukovo-metodychne-zabezpechennia-stem-osvity-v-zakladakh-osvity-u-veresni-2024-hrudni-2027-rokiv (in Ukranian)

Pro zatverdzhennya planu zakhodiv shchodo realizatsiï Kontseptsiï rozvitku prirodnicho-matematichnoï osviti (STEM-osviti) do 2027 roku (2021). [On approval of the action plan for the implementation of the Concept for the Development of Science and Mathematics Education (STEM Education) until 2027]. URL: https://www.kmu.gov.ua/npas/pro-zatverdzhennya-planu-zahodiv-sh-a131r (in Ukranian)

Public Law 88-204. (1963). Act on the Development of Higher Education. 17 p. URL: https://www.congress.gov/88/statute/STATUTE-77/STATUTE-77-Pg363-2.pdf

Pylypenko, O. S. (2023). *Formuvannya STEM-kompetentnostei studentiv zakladiv fakhovoï peredvishchoï osviti u navchanni matematiki* [Formation of STEM-competences of students of institutions of professional higher education in teaching mathematics] (Abstract of Doctor's thesis, Kryvyi Rih State Pedagogical University). Kryvyi Rih, Ukraine (in Ukranian).

Radford, L., Furinghetti, F., & Hausberger, T. (Eds.) (2016). Proceedings of the 2016 ICME Satellite Meeting of the International Study Group on the Relations Between the History and Pedagogy of Mathematics. Montpellier, France: IREM de Montpellier 793 p.

Raimi, R. A. & Braden, L. S. (1998). State Mathematics Standards: An Appraisal of Math Standards in 46 States, the District of Columbia, and Japan. *Fordham Report*, 2(4), 1–72.

Rakhmanina, A. S. (2024). *Pidgotovka maibutnikh pedagogiv u zakladakh vishchoï osviti Ukraïni zasobami STEM-tekhnologii* [Training of future teachers in higher education institutions of Ukraine using STEM technologies]. (Abstract of Doctor's thesis, National University of Life and Environmental Sciences of Ukraine). Kyiv, Ukraine (in Ukranian).

Ravitch, D. (2001). Left back: a century of failed school reforms. New York: Simon & Schuster. 560 p.

Reagan, R. (1987). Remarks at a White House Ceremony Honoring the Winners of the Secondary School Recognition Program and the Exemplary Private School Recognition Project.

National Archives. URL: https://www.reaganlibrary.gov/archives/speech/remarks-white-house-ceremony-honoring-winners-secondary-school-recognition-0

Report to accompany H.R. 2435, the National Council on Education Standards and Testing Act (1991). National Council on Education Standards and Testing. Congress of the U.S., Washington, D.C. House. Committee on Education and Labor. 13p. URL: https://files.eric.ed.gov/fulltext/ED335403.pdf

Report № 2157. (1958). National Defense Education Act of 1958. 49 p. URL: https://www.cia.gov/readingroom/docs/CIA-RDP78-06365A000200060019-5.pdf

Roman, P. J. (1995). Eisenhower and the Missile Gap. Ithaca, N.Y.: Cornell University Press, 264 p.

Roughgarden, T. (2016). Twenty Lectures on Algorithmic Game Theory. Cambridge University Press. 14 p.

Schoenfeld, A. H. (2004). The math wars. *Educational Policy*, 18(1), 253–286. DOI: https://doi.org/10.1177/0895904803260042

Schoenfeld, A. H. (2007). Assessing Mathematical Proficiency. Mathematical Sciences Research Institute. 411 p.

Schoenfeld, A. H. (2007). Problem solving in the United States, 1970-2008: Research and theory, practice and politics. *ZDM: the international journal on mathematics education*, 39(5), 537–551. DOI: https://doi.org/10.1007/s11858-007-0038-z

Scheaffer, R. L. & Jacobbe, T. (2014). Statistics Education in the K-12 Schools of the United States: A Brief History. Journal of Statistics Education, 22(2), 1–14. URL: www.amstat.org/publications/jse/v22n2/scheaffer.pdf

Sira, I. T. Konspekti lektsii z kursu «Istoriya matematiki»: navchalnii posibnik [Lecture notes for the course «History of Mathematics»: a textbook]. Kharkiv, KhNPU imeni G. S. Skovorodi, 2022. 72 s. (in Ukranian)

Slutskyi, Y.S. (2022). *Teoriya i praktika sotsialno-pedagogichnogo suprovodu inozemnikh studentiv u sistemi vishchoï osviti SShA* [Theory and Practice of Social and Pedagogical Support of Foreign Students in the US Higher Education System]. (Abstract of Doctor's thesis, State Higher Educational Institution «Donbas State Pedagogical University»). Dnipro, Ukraine (in Ukranian).

Sochi, T. (2017). *Introduction to Differential Geometry of Space Curves and Surfaces*. CreateSpace. 260 p.

Special Collections.Archives and Manuscript Holdings Databases. (2025). Illinois Library 2022. URL: http://www.library.illinois.edu/archives/archon

Spring, K., Grimm, Jr. R. & Dietz, N. (2008). Community Service and Service-Learning in America's Schools. Corporation for National and Community Service, Office of Research and Policy Development Washington, DC. 44p.

Sørensen, H. K. (2010). The Mathematics of Niels Henrik Abel: Continuation and New Approaches in Mathematics During the 1820s. RePoSS: Research Publications on Science Studies 11. Århus: Department of Science Studies, University of Aarhus. National Education Goals Panel, Washington, DC. 470 p. URL: https://www.ivs.au.dk/reposs

The Clinton-Gore Administration A Record of Progress. (2025). URL: https://clintonwhitehouse5.archives.gov/WH/Accomplishments/eightyears-05.html

The Letter of Admiral Nimitz. (2018). Taylor & Francis. 212–214. DOI: https://doi.org/10.1080/00029890.1942.11991208

Ugoda mizh Uryadom Ukraïni ta Uryadom Spoluchenikh Shtativ Ameriki pro stvorennya Amerikansko-ukraïnskogo investitsiinogo fondu vidbudovi (2025). [Agreement between the Government of Ukraine and the Government of the United States of America on the Establishment of the American-Ukrainian Reconstruction Investment Fund]. URL: https://zakon.rada.gov.ua/laws/show/840_001-25#Text (in Ukranian)

Ugoda pro poziku (Programa «Pidvishchennya dostupnosti ta stiikosti osviti v umovakh krizi v Ukraïni») mizh Ukraïnoyu i Mizhnarodnim bankom rekonstruktsiï ta rozvitku (2024). [Loan

Agreement (Program «Enhancing Access and Resilience of Education in Crisis Conditions in Ukraine») between Ukraine and the International Bank for Reconstruction and Development]. URL: https://zakon.rada.gov.ua/laws/show/996_011-24/sp:dark#Text (in Ukranian)

Varga, N. I. (2022). *Formuvannya doslidnitskoï kompetentnosti vikladacha vishchoï shkoli SShA* [Formation of research competence of a teacher of a higher school in the USA]. (Abstract of Doctor's thesis, State higher educational institution "Uzhgorod National University"). Uzhgorod, Ukraine (in Ukranian).

Wendling, L. (2020). Valuing the Engaged Work of the Professoriate: Reflections onErnest Boyer's Scholarship Reconsidered. *Journal of the Scholarship of Teaching and Learning*, 20(2), 127–142. DOI: https://doi.org/10.14434/josotl.v20i2.25679

William, L. S. (2000). The Safe and Drug-Free Schools Program. *Brookings Papers on Education Policy*, 2000(1), 125–156. DOI: https://doi.org/10.1353/pep.2000.0020

Wurtz, E., Malcom, S., Kugler, E., Miller, S., Walter, C., Stratoudakis, J. & et al. (1993). Report on the Review of Education Standards from the Goals 3 and 4 Technical Planning Group to the National Education Goals Panel. 78 p. URL: https://govinfo.library.unt.edu/negp/reports/promises.pdf

Zee, A. (2016). Group Theory in a Nutshell for Physicists (Illustrated ed.). Princeton University Press. 633 p.

Zhernovnykova, O. A., Chibisov, O. D., Deynichenko, T. I. & Deynichenko, G. V. Vstup do matematichnogo analizu : navch.-metod. posib. dlya bakalavrantiv spets. 014.04 Serednya osvita (matematika) ped. ZVO [Introduction to mathematical analysis: teaching and methodical manual for bachelors of special 014.04 Secondary education (mathematics) pedagogical higher educational institution]. Kharkiv : KhNPU im. G. S. Skovorodi, 2025. 101 p. (in Ukranian)

Інформація про авторів:

Батюк Лілія Василівна: ORCID: https://orcid.org/0000-0003-1863-0265; кандидат біологічних наук, доцент, доцент кафедри фізики і хімії, Харківський національний педагогічний університет імені Г.С. Сковороди, вул. Алчевських, 29, м. Харків, Україна, 61002.
e-mail: l.batyuk@hnpu.edu.ua

Жерновникова Оксана Анатоліївна: ORCID: https://orcid.org/0000-0002-5383-4493; доктор педагогічних наук, професор, завідувач кафедри математики; професор кафедри математики; Харківський національний педагогічний університет імені Г.С. Сковороди, вул. Алчевських, 29, м. Харків, Україна, 61002.
e-mail: oazhernovnykova@hnpu.edu.ua

Information about the authors:

Batyuk Liliya Vasylivna: ORCID: https://orcid.org/0000-0003-1863-0265; Candidate of Biological Science (PhD), Associate Professor, Associate Professor of the Department of Physics and Chemistry, H. S. Skovoroda Kharkiv National Pedagogical University, 29 Alchevskykh Str, Kharkiv, Ukraine, 61002.
e-mail: l.batyuk@hnpu.edu.ua

Zhernovnykova Oksana Anatoliivna: ORCID: https://orcid.org/0000-0002-5383-4493; Doctor of Pedagogical Sciences, Professor, Head of the Department of Mathematics, H.S. Skovoroda Kharkiv National Pedagogical University, 29, Alchevskykh Str., Kharkiv, Ukraine, 61002.
e-mail: oazhernovnykova@hnpu.edu.ua

Цитуйте цю статтю як: Батюк Л. В., Жерновникова О. А. Ґенезис математичної освіти в Сполучених Штатах Америки в другій половині XX століття – 20-х роках XXI століття. *Теорія та методика навчання та виховання*. 2025. № 59. С. 38-73.
DOI: https://doi.org/10.34142/23128046.2025.59.03

Дата надходження статті до редакції: 17.10.2025
Стаття прийнята до друку: 01.11.2025