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Historical evolution of mathematics education in Kazakhstan: from the middle ages to independence

Abstract. Over the past three centuries, Kazakhstan has been part of various states. It was initially a part of the Russian Empire; from 1920 to 1991, it was among the republics that formed the Soviet Union; and since 1992, it has existed as an independent country. In this context, it is important for the public of Kazakhstan to understand how mathematics was taught to the population at different stages of historical development. The subject of this study is the historical evolution of mathematics education in Kazakhstan from the Middle Ages to the present day. The main focus is on the teaching of mathematics in national schools. This study represents the first research conducted in this direction; its scientific and methodological significance is undeniable, and it also has practical value for specialists in the field of mathematics education.

The primary attention is devoted to the study of literary sources and materials from state archives. Since many authors were subjected to repression in the 1940s, their works were removed from libraries and remained inaccessible for a long period. An in-depth methodological and mathematical analysis of these materials was conducted.

During the period of the Russian Empire, the first mathematics textbooks in the Kazakh language were written by S. Gramenitsky (1897) and M. Dulatuly (1914). In the first fifteen years of Soviet rule, mathematics textbooks were authored by mathematicians associated with the national movement "Alash". However, in 1935, the country transitioned to instruction in the Russian language across schools nationwide, and national schools began using translated Russian textbooks. This policy remained in effect until the collapse of the Soviet Union.

Following the independence of Kazakhstan, all mathematics textbooks in the country began to be published in the Kazakh language. The results of the study, based on authentic archival materials, reveal the actual state of mathematics teaching in the Kazakh language. These materials can be incorporated into modern mathematics textbooks and teaching methodologies, taking into account the importance of the historical evolution of mathematics education among the Kazakh population.

Keywords: mathematics education, historical evolution, textbooks, school, pedagogical university, Bologna process.

Introduction

In the process of training mathematics teachers at the leading pedagogical university of Kazakhstan, both students and faculty members raised numerous questions about the history of mathematics education in the past. This situation prompted us to undertake a comprehensive study of the historical development of mathematics education in Kazakhstan, including the teaching of mathematics to Kazakh youth in their native language. The primary materials for this research were obtained from state archives, which revealed that a several mathematics textbooks had been written using Latin or Arabic script.

Prior to our research, this issue had not been systematically studied by mathematics educators, and no scientific publications addressing this topic were available. In this regard, the materials obtained in this study can be considered new. Their relevance is beyond doubt, and the theoretical and practical significance of the analyzed materials is substantial for modern mathematics teachers, as well as for educators involved in the training of mathematics teachers at pedagogical higher education institutions.

Based on specific archival materials, this study demonstrates the evolution of mathematics education in the past and outlines the methods of teaching mathematics during the first fifteen years of Soviet

rule. At present, the historical materials identified in this research have begun to be used in departments of mathematics teaching methodology at pedagogical institutes and universities throughout the country.

The subject of this study includes literary sources from pre-revolutionary Kazakhstan (before 1917), as well as mathematics textbooks and problem books in the Kazakh language discovered in archives and published between 1914 and 1935. These works were primarily authored by mathematics teachers associated with the national movement "Alash." An important objective of the study was to determine the scientific and practical value of their works.

From 1935 to 1991, the overwhelming majority of educational institutions in Kazakhstan used mathematics textbooks and problem books published in Russia. In Kazakh schools, as well as in Kazakh-language departments of pedagogical institutes and universities, mathematics instruction was conducted using translated Russian textbooks and problem books. An analysis of selected mathematics textbooks from this period indicates that they differ to some extent from textbooks authored by Kazakh scholars, both in terms of content and methodological approaches. Therefore, the study of mathematics textbooks published in the Kazakh language between 1914 and 1935 is of not only historical but also scientific and methodological importance.

Materials and Methods

The materials for this study include the works of the prominent medieval scholar Abu Nasyr al-Farabi (10th century) and one of the first educators of the Kazakh people, Ybyrai Altynsarin (second half of the 19th century). These works were selected because they contain information related to the study and teaching of mathematics during the corresponding historical periods. At the same time, other scientific works completed before the October Revolution of 1917 addressed mathematics instruction exclusively in Russian schools.

The only mathematics teacher who authored a textbook in the Kazakh language during this period was S. M. Gramenitsky, a graduate of the Faculty of Physics and Mathematics at St. Petersburg University. While serving as an inspector of public schools in the Syrdarya region, he published in 1897 the problem book "Collection of Problems and Examples for Elementary Teaching of Arithmetic."

The primary materials for the analysis also include mathematics textbooks and problem books written by the first mathematics teachers during the period when the government of the Russian Soviet Federative Socialist Republic permitted national minorities, including Kazakhs, to produce textbooks in their native languages for use in national schools.

During the Soviet period in Kazakhstan, mathematics textbooks and works on methods of teaching mathematics in the native language were generally not published, with the exception of the teaching manual by A. Bidosov, "Methods of Teaching Mathematics" (1989).

The most significant development of mathematics teaching in the Kazakh language, including teaching methodologies, occurred after Kazakhstan gained independence on December 16, 1991. In this regard, a leading role has been played by the Department of Methods of Teaching Mathematics, Physics, and Informatics at Abai Kazakh National Pedagogical University. Faculty members of this department have published numerous mathematics textbooks for comprehensive schools and teaching manuals, including works devoted to the history of mathematics education in Kazakhstan.

Literature Review

The research problem was primarily addressed through the analysis of literature preserved in state archives and rare book collections of libraries in Kazakhstan, Kyrgyzstan, and Russia.

Among the materials created prior to the October Revolution of 1917, this study examined the mathematical treatises of Abu Nasyr al-Farabi, the works of Ybyrai Altynsarin, and the first mathematics textbook in the Kazakh language authored by M. Dulatuly. Particular attention was given to the analysis of mathematics textbooks and problem books written by the first Kazakh teachers for use in Kazakh schools between 1923 and 1935, as well as to methodological articles authored by M. Dulatuly, K. Zhalenuly, A. Kasymuly, E. Omaruly, S. Kozhanuly, T. Kuraluly, Z. Kysatayuly, A. Ermekuly, S. Bokayuly, I. Akbergenuly, T. Shonanuly, and others. These works were written in the Kazakh language using Arabic or Latin script.

In addition, mathematics textbooks and teaching aids authored by domestic scholars in the period following the Great Patriotic War and up to the collapse of the Union of Soviet Socialist Republics were analyzed, including works by A. Bidosov, A.K. Kobesov, A. Sobalakov, and others.

The most substantial development of mathematics teaching in the Kazakh language occurred after Kazakhstan gained independence, when national mathematicians published numerous mathematics textbooks for comprehensive schools, along with a significant number of scientific and methodological works. Notable contributors include A.E. Abylkassymova, S.A. Ayapbergenov, B.S. Zhanbyrbayev, O.A. Zhautykov, Z.A. Zhumagulova, V.E. Korchevsky, B.M. Kosanov, R.V. Kudakova, T.P. Kucher, E.A. Tuyakov, and others.

It should be noted that the historical development of mathematics education in Kazakhstan has not been the subject of systematic research by foreign mathematicians.

Results and discussion

The history of the development of mathematics education in Kazakhstan can be divided into three periods: from the Middle Ages to 1935; from 1935 to 1991; and from 1992 to the present day [1].

According to historical sources, during the 8th–13th centuries, several large cities existed on the territory of modern Kazakhstan, where significant achievements were made in education, science, culture, and technology in accordance with the level of development of that era. Many scholars who worked in medieval cities between the 9th and 14th centuries made substantial contributions to the development of various sciences, including philosophy, mathematics, physics, and astronomy. However, their works were written in Arabic and Persian and therefore remain largely inaccessible to the general public of the country.

One of the most prominent scholars of the 9th–10th centuries, who exerted a profound influence on the subsequent development of world science and culture, was Abu Nasyr al-Farabi (870–950), a prominent scholar of Kazakh origin, widely known as the "Aristotle of the East."His extensive and diverse scientific treatises encompass almost all fields of knowledge, including mathematics, which he regarded as one of the fundamental pillars for understanding the world.

The trigonometric chapters from the Book of Supplements to the Almagest constitute a unique manuscript preserved in the British Museum (London). One of al-Farabi's major achievements was his classification of branches of knowledge. In his work "Classification of the Sciences," he examined each of the known sciences of his time separately, providing a detailed description of their content. In particular, he divided mathematical science into seven sections: (1) arithmetic; (2) geometry; (3) optics; (4) astronomy; (5) music; (6) the science of equilibrium (statics); and (7) mechanics as the science of motion. Al-Farabi systematized the content of each of these disciplines in terms of their meaning, structure, and interrelationships, distinguishing between theoretical and practical aspects of arithmetic and geometry. He regarded arithmetic, geometry, astronomy, and music as pedagogical sciences, emphasizing their educational significance. Moreover, he argued that a comprehensive mastery of the natural sciences is impossible without a solid foundation in mathematics. Al-Farabi's most valuable ideas concerning the teaching of mathematics are presented in his treatise "Comments on the Difficulties in the Introductions to the First and Fifth Books of Euclid" [2].

The issue of establishing schools for Kazakh children in the "Kazakh steppe" began to be addressed after 1731, following the incorporation of Kazakhstan into the Russian Empire. The first Tatar school in which mathematics was taught was founded in 1744 in Orenburg. In 1920, Orenburg became the first capital of the Kazakh Autonomous Soviet Socialist Republic (KazASSR); today, this city is part of the Russian Federation.

The first school established to prepare Kazakh children for admission to Russian educational institutions was founded in 1841 in the Bukeyevskaya Orda, located in the western part of Kazakhstan. After the 1860s, the tsarist government decided to extend its control not only over Southern Kazakhstan but also over the territories of the present-day Central Asian republics. This marked the beginning of systematic efforts to create a network of schools for the indigenous population, including Kazakhs, Kyrgyz, Uzbeks, and others, in which mathematics became one of the core subjects of the curriculum [1].

The first school of this type in the "Kazakh steppe" was opened on January 8, 1864, in the Turgay fortress, where Ybyrai Altynsarin, one of the earliest Kazakh educators, was appointed as a teacher. At that time, the school system operated under regulations for steppe schools, with particular emphasis placed on the study of the Russian language. Arithmetic was introduced only after pupils had mastered the basic elements of Russian.

Y. Altynsarin attached great importance to problem solving in mathematics instruction. He believed that the content of problems should be

accessible to Kazakh children and closely connected with events familiar to them. He advocated teaching problem solving according to the principle of progression from simple to complex and from easy to difficult. Of particular importance is his contribution to the development of mathematical terminology in the Kazakh language. He was the first to compile a Kazakh–Russian dictionary of numerical terms up to one million. His works include such terms as arithmetic, minute, kilometer, pood, and arshin, among others [3].

On March 26, 1870, the Ministry of Public Education of the Russian Empire issued the first law concerning national schools, entitled "Measures for the Education of Indigenous Peoples Living in Russia." From that point onward, Russian–Kazakh schools began to spread widely throughout the territory of Kazakhstan.

One of the major shortcomings of mathematics instruction in national schools during this period was the lack of consistency and coherence in the presentation of material in textbooks, which made the development of new school textbooks necessary. This task was assigned to the inspector of public schools in the Syrdarya region, S. M. Gramenitsky, a graduate of the Faculty of Physics and Mathematics at St. Petersburg University. As a result, in 1897 he published the textbook "Collection of Problems and Examples for Elementary Teaching of Arithmetic,"

which by 1916 had been reprinted 13 times and was widely used as the main textbook in Russian-native schools in Kazakhstan and Central Asia. In the early years following the establishment of Soviet power in the Turkestan region, this textbook was reprinted again [4].

By the end of the 19th century, the expansion of the network of Russian-native schools created a need for pedagogical educational institutions in Kazakhstan to train teachers. Consequently, in 1883 the first teacher training school was established in Orsk and later transferred to Orenburg.

In 1902, the "Regulations on Native Public Schools" were adopted, under which teacher training seminaries were established in several cities of Kazakhstan, including Semipalatinsk (1903), Aktyubinsk (1913), Uralsk (1913), Verny (1913), and Akmolinsk (1916). In these seminaries, students first studied the theoretical foundations of arithmetic for lower grades and were subsequently taught methods of teaching mathematics at higher levels [1].

On the eve of the October Revolution of 1917, Kazakhstan had numerous educational institutions, including pedagogical classes, pedagogical courses, and teacher training schools, where considerable attention was devoted to the teaching of arithmetic (Table 1). In these pedagogical institutions, methods of teaching arithmetic were delivered in the Russian language.

Table 1 – Pedagogical Educational Institutions in Pre-Revolutionary Kazakhstan (Before 1920)

Educational institutions	Duration of study	Location
Teachers' seminaries	3-4 years	Orenburg, Tashkent, Semipalatinsk, Aktyubinsk, Uralsk, Verny, Akmolinsk
Pedagogical classes	1-3 years	Kostanay, Ust-Kamenogorsk, Uralsk, Aktyubinsk
Pedagogical courses	Short-term	Semipalatinsk, Aktyubinsk, Uralsk, Akmolinsk, Verny
Teacher training schools	1 year	Orsk (later transferred to Orenburg)

The first mathematics textbook, "Textbook for Teaching Elementary Mathematics," was published in 1914 in Orenburg in two volumes, each with a print run of 3,000 copies [5]. Its author was Myrzhakyp Dulatuly (1885–1935), one of the leaders of the national movement "Alash."

The publication of the first mathematics textbook in the Kazakh language was regarded by educators as a progressive achievement, marking the beginning of mathematics education in Kazakhstan conducted

in the native language. Subsequently, this work became the foundation for the further development of mathematical and methodological science in the Kazakh language.

After the October Revolution of 1917, the textbook was reissued twice (1921 and 1922) and was used as the main textbook for the first two grades of Kazakh schools until 1925. A new, revised, and expanded edition of M. Dulatuly's textbook was published in 1927 in Tashkent, which at that time

was the administrative center of the Turkestan region. This edition was used for many years in both Kazakh and Kyrgyz schools [6].

To provide a comprehensive understanding of the first mathematics textbooks and problem books intended for Kazakh schools, several key aspects should be emphasized. First, the authors of these materials were among the first Kazakh teachers, many of whom were active participants in the national movement "Alash." However, this advanced segment of the Kazakh intelligentsia was subjected to political repression, and many were executed in the mid-1940s. Second, the content of their works was systematically structured, based on the principle that students should progress from previously acquired knowledge to more complex problems and new mathematical topics. Considerable attention was paid to the specific features of teaching Kazakh children, taking into account their mentality, everyday life, and conditions of upbringing. The authors also emphasized continuity in mathematics education across all levels, including primary and secondary schools, specialized secondary institutions, and higher pedagogical education. These features become evident through an analysis of their methodological manuals, textbooks, and problem books. Unfortunately, these works were later removed from libraries and banned from use in national educational institutions.

The revised "Mathematics Manual" by M. Dulatuly consisted of two volumes containing a large number of worked examples. One of the main features of these textbooks was that they were developed in accordance with the Soviet comprehensive program for teaching mathematics. Another distinguishing feature was the inclusion not only of arithmetic problems and examples, but also material related to fractions, ratios, and percentages. In addition, the manual introduced basic elements of geometry and algebra, as well as quantities and problems related to their measurement. A further characteristic of the textbook was that, in line with the educational objectives of the Soviet school, mathematics instruction was closely connected with the everyday life of ordinary people and with the realities of socialist society as a whole [7].

Myrzhakyp Dulatuly was a proponent of the most advanced methodological and mathematical ideas of his time. He was distinguished by a high level of methodological competence and the ability to apply it effectively in textbook development. For this reason, he is rightly regarded as the founder and author of the first mathematics textbooks in the Kazakh language

and as one of the pioneers of mathematics teaching methodology in Kazakhstan [1].

The systematic establishment of continuity in mathematics education for Kazakh children can also be observed in the first mathematics curriculum published in the Kazakh language in 1923, entitled "The Mathematics Knowledge Project," authored by the mathematician and methodologist Karim Zhalenuly (1888–1938).

K. Zhalenuly addressed a wide range of pressing issues related to the mathematics education of Kazakh children. He emphasized that teachers should not attempt to explain the principles and laws of mathematical science in a dry and purely formal manner. Instead, he advocated an approach in which students, guided by the principles of mathematical science, gradually but independently and persistently acquire new knowledge and skills [8].

"The Mathematics Knowledge Project" was the first mathematics curriculum developed with consideration of the national, psychological, and other characteristics of Kazakh children. It played a crucial role in shaping the content of mathematics education in all schools where Kazakh was the language of instruction.

In the same year, K. Zhalenuly published the first task book in the Kazakh language in Tashkent entitled "Arithmetic. Fractions." This textbook covered a wide range of topics, including divisors, common fractions, decimal fractions, percentages, and metric units of measurement [9]. It was written using an Arabic script adapted to the Kazakh language, translated into Kyrgyz in 1928, and subsequently used as the main mathematics textbook in Kyrgyz schools.

One of the developers of this system of mathematics instruction was Almagambet Kasymuly (1889–1937), the author of three textbooks published under the general title "Mathematics Textbooks" for Kazakh schools [10].

The scope of knowledge presented in these teaching aids was considerably broader than that found in modern textbooks. This approach was explained in the preface to the "Four-Year Manual," which stated: "After completing this stage of education, students proceed to the next level. Many may leave the educational system at this point. Therefore, the content should be deeper and include more complex calculations."

A significant contribution to the further development of methodological and mathematical science in Kazakhstan was made by the textbook

"Geometry," authored by E. Omaruly (1892–1937), a prominent participant in the national movement "Alash." He was a versatile scholar and educator, as well as a publicist and translator, who contributed to various fields of knowledge, including linguistics, physics, mathematics, and others. His works on the methodology of teaching mathematics include the textbooks "Geometry" (Books I and II) and the "Mathematics Manual."

The "Geometry" manual was published in 1928 in Kyzylorda using the Kazakh alphabet based on Arabic script. The textbook covered all topics of plane geometry, and the list of chapters and themes included many previously unfamiliar definitions, including international mathematical terms [11].

The first mathematics textbook intended to provide theoretical and methodological support for students of secondary pedagogical educational institutions in Kazakhstan was the "Arithmetic Handbook" authored by Sultanbek Kozhanuly (1894–1938). This textbook was developed on the instructions of the Kazakh–Kyrgyz Educational Commission of the Turkestan Commissariat of Public Education and was published in 1924 in Tashkent [12].

The first textbook devoted to the fundamentals of mathematical statistics was published in 1929 in Kyzylorda by T. Shonanuly under the title "Diagrams and Graphs: How to Represent Them?" He was also a member of the national movement "Alash." His materials were later used in the preparation of mathematics textbooks in subsequent years [13].

At the beginning of the 20th century, various secondary pedagogical educational institutions for teacher training operated in Kazakhstan, where instruction was conducted primarily in Russian. One such institution was the Teachers' Institute in Orenburg, where considerable attention was devoted to the study of the methodology of arithmetic as an academic discipline.

After the October Revolution of 1917, the first decrees of the Soviet government concerning public education were adopted, serving as catalysts for the development of teacher training in Kazakhstan. In particular, on August 2, 1918, the People's Commissariat of Education of the Russian Soviet Federative Socialist Republic issued a resolution on higher education.

In the Kazakh Autonomous Soviet Socialist Republic, a significant role in teacher training was played by educational institutions known as Institutes of Public Education, which did not possess the full status of higher education institutions. In the 1925–1926 academic year, four such institutes operated in Kazakhstan: the Institute of Practical Public Education (founded in 1919 in Orenburg; three-year program), the Kazakh Institute of Public Education (founded in 1920 in Tashkent; four-year program), the Kazakhstan Institute of Public Education (founded in 1925 in Kyzylorda; four-year program), and the Zhetysu Institute of Public Education (founded in 1925 in Alma-Ata; four-year program) [14].

At these institutes, mathematics and methods of teaching mathematics were studied as specialized disciplines. Faculty members teaching these subjects made a substantial contribution to the development of methodological and educational mathematical literature in the native language. For example, M. Dulatuly taught at the Orenburg Institute of Practical Public Education from 1922 to 1926, while A. Kasymuly (1925–1929) and T. Shonanuly (1926–1929) taught at the Kazakhstan Institute of Public Education.

The activities of the faculty of the Kazakh Institute of Public Education in Tashkent merit particular attention. Among its members were notable figures such as M. Tynyshbayuly, the first Kazakh railway engineer and a distinguished scholar of Kazakh history, as well as K. Zhalenuly, S. Kozhanuly, and E. Omaruly. Overall, the content of instructional materials on the methodology of teaching mathematics at the institutes of public education was more advanced than that offered in pedagogical technical schools.

In addition to textbooks and problem books for schools and secondary pedagogical educational institutions, a large number of methodological articles on the teaching of mathematics were published in the Kazakh language during this period. These works were authored primarily by teachers affiliated with the national movement "Alash" and addressed the aims, structure, content, sequencing, and continuity of mathematics education across different stages and levels of education, including schools, colleges, and institutes [1].

At the same time, efforts were intensified in Kazakhstan to conduct scientific research aimed at addressing issues related to the development of scientific terminology in the native language. Consequently, questions of scientific terminology were placed on the agenda of the "Talap" Society, established on December 4, 1922, in Tashkent. These issues were also discussed at the First Congress of Kazakh Scientists (June 12–18, 1924) in Orenburg and at the First Congress of Turkologists (February

26–March 6, 1926) in Baku. At the latter congress, E. Omaruly presented a report entitled "Problems of Scientific Terminology in the Native Language" [15].

The resolutions of the Congress of Turkologists were regarded as mandatory for the formation of scientific terminology in the Turkic-speaking republics. However, it should be noted that during the first fifteen years of Soviet rule, research on terminology in Kazakhstan was accompanied by constant scrutiny for perceived hidden national meanings, and Kazakh scholars were frequently accused of "pan-Turkism" and "pan-Islamism." Beginning in the mid-1940s, following the widespread adoption of translated Russian textbooks, the previously established Kazakh terminology was gradually abandoned in favor of direct translations of mathematical terms from Russian.

In the late 1930s and early 1940s, intensive efforts were undertaken in Kazakhstan to prepare new primary school mathematics textbooks in the Kazakh language adapted to the Soviet educational context. This process was driven by two main factors. First, toward the end of the second decade of Soviet rule, repression against the leaders of the national movement "Alash" intensified, ultimately resulting in a ban on their works. During this period, the Central Committee of the Communist Party issued new directives for schools, including decisions aimed at gradually unifying the educational process across all Soviet schools through a standardized curriculum. Second, the Kazakh alphabet based on Arabic script, which had been used previously, was replaced in 1929 by the Latin script and later by the Cyrillic script.

Among the textbooks produced during this period were Gali Begaluly's (1888–1966) "Textbook of Mathematics for Small Schools," published in 1929 in Kyzylorda, and "Textbook of Mathematics" by T. Kuraluly, published in 1932 in Tashkent. These textbooks were written using the Latin alphabet, in accordance with the requirements of the Soviet educational system [16, 17].

In the early 1930s, secondary educational institutions were established in various cities of Kazakhstan. Most of them were agricultural technical schools, including those founded in Semipalatinsk (1921), Tashkent (1921), Akmola (1923), Uralsk (1924), Shymkent (1925), and Alma-Ata (1925). In 1933, one of the first mathematics textbooks written specifically for these institutions, "Mathematics Manual" by Zeken Kysatayuly, was published in Tashkent [18].

As noted earlier, during the 1930s mathematics teachers for seven- and nine-year schools were trained primarily at institutions known as Institutes of Public Education. These institutions focused mainly on teaching future teachers elementary mathematics and, to a lesser extent, on developing their professional and methodological competencies.

During the same decade, several Institutes of Public Education began to be reorganized into pedagogical institutes. In particular, in 1926 the Kazakh Pedagogical Institute, known as "Kazpedvuz," was established on the basis of the Tashkent Institute of Public Education. Its primary mission was to train teachers for seven- and nine-year schools for Kazakh youth, as well as for pedagogical colleges. The institute operated under the authority of the People's Commissariat of Education of the Turkestan region, with a four-year program of study.

In 1928, Kazpedvuz was relocated from Tashkent to Alma-Ata, and on November 10 of the same year it was renamed the Kazakh State University. Initially, a single pedagogical faculty was established, comprising departments of physics and mathematics, linguistics, literature, and chemical and biological sciences. At that time, the total number of students enrolled was only 20.

In 1930, the university was reorganized into the Kazakh Pedagogical Institute (hereinafter KazPI), and the department of physics and mathematics was transformed into a separate faculty. Alikhan Ermekov was appointed as the first dean of the Faculty of Physics and Mathematics. The faculty included the chair of Technology, Physics, and Mathematics, which employed nine instructors. In accordance with the demands of the period, the faculty operated under an accelerated training model, and on December 15, 1931, its first cohort of 17 teachers graduated.

During this period, work also began in Kazakhstan on translating mathematics textbooks published in Russia for Soviet schools into the Kazakh language.

With the rapid development of key industrial sectors in the 1940s, the demand for mathematics teachers in the country increased significantly. KazPI alone was unable to meet this growing need. As a result, additional pedagogical institutes were established, including the Ural Pedagogical Institute (1932), the Kyzylorda Pedagogical Institute (1937), and the Kazakh State University in Alma-Ata (1934).

In pedagogical institutes, alongside theoretical disciplines in mathematics, elementary mathematics and methods of teaching mathematics were also studied. During this period, the first Soviet

methodological guidelines on the teaching of mathematics in secondary schools began to be published. These guidelines typically divided teaching methodology into two parts. The first part focused on the analysis of curricula and general principles of mathematics teaching, while the second part addressed specific methodological issues related to instruction.

As a result of extensive efforts to improve curricula and academic programs for the physics and mathematics faculties of pedagogical institutes throughout the Soviet Union, a unified curriculum for all educational institutions was approved in 1935. Consequently, all higher education institutions in Kazakhstan transitioned to instruction in accordance with this standardized curriculum [1].

A. Ermekuly, S. Bokayuly, and I. Akbergenuly played a leading role in the formation of methodological and mathematical education in higher educational institutions in Kazakhstan. They were among the first mathematics teachers with higher education and stood at the origins of training national scientific personnel in mathematics. They also became the founders of the Physics and Mathematics and Mechanics and Mathematics faculties at Abai Kazakh Pedagogical Institute (KazPI) and the Kazakh State University (KazSU).

Alikhan Ermekuly (1891–1970) published the book "Course of Higher Mathematics" in 1935, which became the first textbook on analytical geometry written in the Kazakh language [18].

Saduakas Bokayuly (1907–1942) graduated from the Faculty of Astronomy and Mathematics at Moscow State University named after M.V. Lomonosov. From June 1932, he taught at Abai Kazakh Pedagogical Institute, delivering courses in higher algebra, trigonometry, mathematical analysis, differential geometry, as well as differential and integral equations. While holding various academic and administrative positions at the two leading higher educational institutions in Kazakhstan at that time, S. Bokayuly was actively engaged in scientific research and, in 1935, defended his PhD dissertation in the field of mathematics. He was also the author of a mathematics textbook designed for correspondence courses (a two-year lecture program) [19].

One of the mathematicians who played a decisive role in the development of higher-level pedagogical education in Kazakhstan was Ibadulla Akbergenuly (1907–1938). In 1931, he graduated from the Central Asian State University, and from 1932 to 1934 he pursued postgraduate studies at

the same institution. In 1935, he defended his PhD dissertation in mathematics [20]. In the same year, the People's Commissariat of Education of the Kazakh Autonomous Soviet Socialist Republic invited him to serve as the head of the Department of Mathematics at Kazakh State University (KazSU)..

Thus, the first positive results in mathematics teaching in Kazakh schools in Kazakhstan emerged in the 1930s. During the period from 1921 to 1935, the Kazakh intelligentsia achieved significant progress in developing their own approaches to teaching mathematics in national schools, ensuring continuity in mathematics education, and establishing the methodology of teaching mathematics as an academic discipline [21, 22].

By the mid-1940s, the goals and objectives of mathematics teaching in Kazakh schools, associated with reforms of the national education system, had changed fundamentally. This transformation led to substantial changes in the content of mathematics education. In the 1935–1936 academic year, not only Kazakh schools but also schools of all nationalities across the Soviet Union were transferred to a unified mathematics curriculum developed by the People's Commissariat of Education of the Russian Soviet Federative Socialist Republic for Russian schools. Consequently, mathematics textbooks previously used in schools with Kazakh as the language of instruction were deemed unsuitable for a socialist society, and translated mathematics textbooks prepared by Moscow-based scholars for Russian schools were introduced instead. The transfer and implementation of mathematical content developed for Russian schools were carried out in Kazakh schools without modification. As a result, the use of Russian mathematics textbooks became firmly established in Kazakhstan and continued until the late 1990s [23].

Since the early 1940s, work in the field of mathematics teaching methodology has been primarily undertaken by faculty members of Abai Kazakh Pedagogical Institute (KazPI), established in 1935. In the formation and development of mathematics teaching methodology in Kazakhstan as both an academic discipline and a branch of mathematical science, a leading role was played by the Faculty of Physics and Mathematics of this institute. For many decades, it has served–and continues to serve–as a central hub of pedagogical and methodological-mathematical thought in Kazakhstan.

In 1941, faculty members of Abai Kazakh Pedagogical Institute in Alma-Ata published the first

methodological collection entitled "Methodological Materials: Selected Issues of Mathematics Teaching Methods." In 1942, the Department of Mathematics Teaching Methods was established within the Faculty of Physics and Mathematics of the institute.

The most intensive development of mathematics teaching began in the post-war period. In 1949, the first republican scientific and practical conference of mathematics teachers, entitled "Prevention of Academic Failure in Mathematics," was held in Alma-Ata. In 1950, the second republican scientific and practical conference, "Formation of Practical Skills in Mathematics Lessons," took place, followed in 1953 by pedagogical readings entitled "From the Experience of Mathematics Teachers in Kazakhstan."

Since the 1950s, systematic scientific research has been conducted in Kazakhstan on pressing issues of pedagogy with methodological significance, including those relevant to mathematics education. For instance, the Academic Council of the Abai Kazakh Pedagogical Institute established a specialized dissertation council that, until June 1975, oversaw the defense of dissertations in the methodology of teaching mathematics. During this period, dozens of mathematics teachers from higher educational institutions in Kazakhstan and other republics of the Union of Soviet Socialist Republics defended their candidate dissertations. Throughout the Soviet era, the number of pedagogical higher education institutions in the country steadily increased, and by the 1980s, Kazakhstan had two universities and twenty pedagogical institutes [1].

On December 16, 1991, the Law of the Republic of Kazakhstan entitled "On the State Independence of the Republic of Kazakhstan" was adopted. Following the achievement of independence, mathematics education in the Kazakh language was recognized as one of the key priorities of the state's ideological policy. This recognition was reflected in state programs for the development of the education system adopted by the Government of the Republic of Kazakhstan, as well as in the mandatory standards of school education, including mathematics. From that time onward, the systematic development and implementation of national curricula, textbooks, and teaching materials in mathematics for secondary schools and pedagogical universities began. Simultaneously, the didactics of mathematics, as a branch of pedagogical science, experienced significant growth. This led to a substantial increase in the number of scientific publications and the defense

of numerous dissertations related to the theory and methods of teaching mathematics [23, 24].

The new state program for the development of education and science in Kazakhstan, oriented toward the European educational space, defined directions for establishing a new level of post-secondary professional education and introduced a three-tier system of professional training: bachelor's degree, master's degree, and doctoral degree (PhD).In higher and postgraduate education, a transition was made to a three-cycle model based on credit technology, which ensured program flexibility, international recognition of diplomas awarded by universities in Kazakhstan, and the democratization of the educational process.

A significant contribution to the further development of mathematics education in Kazakhstan was made by the first national Congress of Mathematics Teachers, held in Astana on May 11–12, 2011. At this congress, the issue of "Development of Mathematics Education in Schools of Kazakhstan: Current State and Prospects" was discussed. The convening of the congress was prompted by the need to address accumulated challenges related to the quality of mathematics education, to identify ways to improve it, and to analyze the results achieved over twenty years of Kazakhstan's independent development.

In accordance with the plan for implementing the recommendations of the First Congress of Mathematics Teachers of Kazakhstan, the National Academy of Education named after Y. Altynsarin organized and conducted a republican seminar entitled "Problems of Continuity in the Content of the Mathematics Course in Schools and Pedagogical Universities." In addition, following amendments and additions to the Law "On Education" dated October 24, 2011, a new state compulsory standard of secondary education (primary, basic secondary, and general secondary education) was developed and approved by a government decree in August 2012. According to this standard (GOSO-2012), Kazakhstan began training teaching staff in the bachelor's degree program "5B010900–Mathematics," the master's degree program "6M010900–Mathematics," and the PhD program "6D010900–Mathematics" [23].

It should be noted that the course "Methodology of Teaching Mathematics" has become a core compulsory subject in the training of future mathematics teachers. Its instructional and methodological support–including textbooks, teaching aids, and supplementary materials developed by national methodologists, particularly

faculty members of the Department of Methodology of Teaching Mathematics, Physics, and Informatics at Abai Kazakh National Pedagogical University (KazNPU after Abai)–has contributed to the effective organization of the educational process at physics and mathematics faculties of pedagogical higher education institutions in Kazakhstan and has had a positive impact on the quality of mathematics teacher training.

Over the past decade, the widespread integration of digital technologies into the educational process has begun to play a significant role in the education system of Kazakhstan. With the development of the digital educational environment, the focus has shifted from merely teaching mathematics to teaching through mathematics, emphasizing the use of mathematics as a tool for developing thinking, problem-solving skills, and interdisciplinary competencies [25, 26].

In connection with Kazakhstan's transition to the European model of education and science, which took place on March 11–12, 2010, at the Second Bologna Forum of Ministers of Education of the countries participating in the Bologna Process, Kazakhstan became the 47th member state of the Bologna Process. As a result, from January 1, 2011, the activities of the former dissertation councils were terminated, and a transition was made to the defense of dissertations, including in mathematics education, for the degree of Doctor of Philosophy (PhD) [23].

Kazakhstan's integration into the European Higher Education Area has had a positive impact on the national education system. This integration has influenced not only the development of science across various fields, but also the training of teaching staff, including mathematics teachers. Many higher education institutions and research organizations in Kazakhstan have established academic and professional partnerships with leading universities in European countries, as well as in the United States, Canada, Japan, South Korea, and Singapore. This process of international cooperation continues to expand

Thus,This study made it possible to achieve several important results. First, previously unknown literary and archival sources concerning the development of mathematics education in Kazakhstan in the native language during the period of the country's incorporation into the Russian Empire and its subsequent inclusion in the Union of Soviet Socialist Republics were identified and introduced into scientific circulation. Second, the works of the prominent medieval scholar Abu Nasyr

al-Farabi were examined with respect to the state of mathematical science of his time and his understanding of mathematics as a fundamental cognitive academic discipline. Third, the three-volume collected works of one of the first Kazakh educators, teacher, and public figure Ybyrai Altynsarin were analyzed, and his role in the organization of Russian–Kazakh schools and in the education of Kazakh children in various disciplines, including mathematics, during the period of Kazakhstan's incorporation into the Russian Empire was determined.

However, the most significant scientific, historical, and methodological findings were obtained through the analysis of mathematics textbooks and problem books written in the Kazakh language by the first mathematics teachers for Kazakh children studying in Russian–Kazakh and Kazakh schools, as well as in pedagogical courses, teacher seminaries, pedagogical technical schools, and institutes of public education. The overwhelming majority of these textbooks and methodological articles were written between 1914 and 1935 using Latin or Arabic script by teachers, many of whom were associated with the national movement "Alash."

The analysis of these works demonstrates that they were written in clear and precise language, adapted to the cognitive level of students who were just beginning to master knowledge in various disciplines, including mathematics. The instructional material was presented in a logical and sequential manner, enabling students to progress from previously acquired knowledge to more complex problems and new sections of mathematics. The textbooks and problem books contained a substantial amount of illustrative material related to the life, culture, traditions, and everyday practices of the Kazakh people, which facilitated a more concrete and practical understanding of mathematical concepts. Particular attention was devoted to mathematical terminology, with authors initially relying on terms already present in the Kazakh lexical tradition. Only later did mathematics teachers increasingly adopt international and Russian versions of mathematical terms.

The study also examined the formation and development of educational institutions established for the education of Kazakh children. The tsarist government was extremely slow in organizing this process. The first Tatar school in which mathematics was taught was opened in 1744 in Orenburg, while the first school aimed at preparing Kazakh children for admission to Russian educational institutions was established only in 1841. It was not until the

1860s that Russian–Kazakh schools began to appear, with the first such school opened in 1864 by Ybyrai Altynsarin. In order to regulate this process, on March 26, 1870, the Ministry of Public Education of the Russian Empire issued the law "Measures for the Education of Turkic-Speaking and Other Peoples Living in Russia." The official objective of establishing national schools was to promote the rapprochement of indigenous peoples with the Russian population and to instill loyalty to the Russian Empire. Nevertheless, this process progressed slowly, as many Kazakh families preferred to educate their children in Muslim schools operating at mosques, where mathematics instruction relied on centuries-old national traditions and methods.

At the same time, a notable contribution to the education of Kazakh children in the late 19th and early 20th centuries in the Syrdarya region was made by the mathematics teacher S. Gramenitsky, who authored four mathematics textbooks that were reprinted numerous times and widely used in educational practice.

At the beginning of the 20th century, the need to expand the training of teachers for Russian–Kazakh schools became increasingly evident, prompting the People's Commissariat of Education of the Russian Empire to adopt the regulation "On Public Schools for Natives." On the eve of the October Revolution of 1917, the number of such educational institutions was steadily increasing.

Particular attention should be given to the first mathematics textbook published in Orenburg in 1914 by M. Dulatuly, which marked the beginning of mathematics education in Kazakhstan in the native language and laid the foundations for the emergence of methodological and mathematical science in the country.

In the early years of Soviet rule, various types of secondary educational institutions began to be established in the republic, including technical schools–most of which were agricultural in profile (1921–1925)–institutes of public education (1920–1925), and, beginning in 1928, higher education institutions. It was during this period that mathematics textbooks and problem books authored by Kazakh teachers began to appear. This process was largely facilitated by the decision of the Ministry of Public Education of the RSFSR to prepare and publish textbooks in native languages for national schools in the union republics.

Since 1928, the training of teachers with higher education, including mathematics teachers, has been carried out at the Kazakh Pedagogical Institute (KazPI). Over time, the number of pedagogical institutes increased, and by the mid-1980s, Kazakhstan had 20 pedagogical institutes and two universities engaged in teacher training. Although many of these institutions had Kazakh-language departments, mathematics instruction was predominantly conducted using translated textbooks.

The education and science system of Kazakhstan experienced its most significant development after the country gained independence. This progress was closely linked to the training of teachers and scientific-pedagogical personnel, including specialists in mathematics. The publication of textbooks and problem books, as well as scientific and methodological articles, monographs, and the defense of dissertations in the field of mathematics in the Kazakh language, became a regular practice. A leading role in this process was–and continues to be–played by the staff of the Department of Methodology of Teaching Mathematics, Physics, and Informatics at Abai Kazakh National Pedagogical University (KazNPU after Abai).

During the years of independence, several major reforms were implemented in the education and science system of Kazakhstan that significantly influenced the training of mathematics teachers. These included the introduction of credit-based education technology in 2005, Kazakhstan's accession to the Bologna Process in 2010, the transition in 2011 to a three-tier system of professional training (bachelor's, master's, and PhD degrees), and the abolition of the former system of awarding the academic degrees of Candidate and Doctor of Sciences in favor of master's and Doctor of Philosophy (PhD) dissertation defenses.

Thus, this study has provided a comprehensive analysis of the historical evolution of mathematics education in Kazakhstan. The materials obtained have begun to be actively used in the training of future mathematics teachers at departments specializing in the methodology of teaching mathematics within higher pedagogical education institutions of the country.

Conclusions

The analysis of the historical evolution of mathematics education in Kazakhstan presents a comprehensive and multifaceted picture of the contributions made by individual Kazakh scholars and educators to the methodology of teaching

mathematics at various stages of the nation's history. Through their efforts, a sustainable and effective system of mathematics education was established, which continues to develop successfully in the context of Kazakhstan's independence. This development reflects the enduring significance of mathematics in understanding the world and in shaping social and intellectual progress.

The historical experience of Kazakhstan highlights the importance of preserving national cultural and linguistic identity within the education system. In particular, it underscores the necessity of maintaining and developing mathematics education in the native language as an essential component of both national heritage and contemporary educational advancement.

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