

## МЕТОДИЧЕСКИЕ АСПЕКТЫ ОБУЧЕНИЯ МАТЕМАТИКЕ И ИНФОРМАТИКЕ В СИСТЕМЕ ОБЩЕГО ОБРАЗОВАНИЯ

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DOI: 10.24888/2500-1957-2022-3-8-14

### ON MODERNIZATION OF THE CONTENT OF GENERAL SECONDARY AND UNIVERSITY PEDAGOGICAL EDUCATION AND METHODOLOGICAL ASPECTS OF TEACHING MATHEMATICS

**Abylkasymova A. E.** | Abay Kazakh national pedagogical university  
Dr. Sci. (Pedagogy), professor  
aabylkassymova@mail.ru  
Almaty

**Abstract.** The study is based on a historical analysis of the creation of a national model of education of the Republic of Kazakhstan, aimed at improving the quality of training of human resources, meeting the needs of the individual, society and the state. The focus is on the process of updating the content of education for all levels of the education system, taking into account international trends. The tax of this important and well-known process should be attributed to 2015. During this period, amendments and additions were made to the Law of the Republic of Kazakhstan "On Education". The author pays significant attention to the content aspects of the new model of education, which is focused on the development of the functional literacy of schoolchildren, the skills of independent search, critical analysis and evaluation, initiative, and the ability to find non-standard solutions. A special place in the new model of education is given to the productive component. Expected educational results are defined in six areas and reflect the activity aspect: students "know", "understand", "apply", "analyze", "synthesize", "evaluate". Such a clear formulation of the expected results allows not only to objectively assess the educational achievements of students, but also to increase the motivation of students, improve the quality of the educational process. The main conclusion of the article is that updating the content of school education led to a change in the methodological training of future teachers of mathematics, actualized the issues of comprehensive educational and methodological support for teaching mathematics both at school and at a teacher training university. At the same time, teaching mathematical disciplines in a pedagogical university should be correlated with the methodology of teaching mathematics. For the professional training of a future teacher of mathematics, a balance of special mathematical and methodological training is necessary.

**Keywords:** content of education, teaching mathematics, model of education, modernization, reform.

Modernization of the general secondary education system in Kazakhstan is focused on ensuring equal access to high-quality secondary education for all schoolchildren regardless of their place of residence. It is also aimed at creating a national education model intended to improve the quality of training human resources, meeting the needs of the individual, society and the state. To achieve this goal it was necessary to update the content of general secondary education which

would ensure the intellectual, spiritual, moral and physical development of students (Abylkasymova, 2021).

By the content of general secondary education, most specialists understand a pedagogically adapted system of knowledge, skills and experience, experience of creative activity and experience of emotional-volitional attitude, the assimilation of which is designed to ensure forming a comprehensively developed personality, prepared for the reproduction (preservation) and development of the material and spiritual culture of the society. The content of general secondary education is disclosed in educational standards, programs, curricula and textbooks and should be focused on ensuring personal self-determination, aimed at improving and developing the human resources potential of any country (Abylkasymova, 2012).

It should be noted that by the beginning of the XXI century, the content of education in many states was structured according to 14-18 academic subjects. The differences are explained by the various number of studied foreign languages and the presence or absence of religious topics. Among the subjects common to all countries are language and literature, mathematics, natural sciences, history, geography, art, physical education, technology and a foreign language. There are such subjects as physics, chemistry, biology, social science in the secondary school. The high school has become professionally oriented, but its content differs little from the accepted one, including Kazakhstan. The same tendency was observed among individual academic subjects. According to the researchers' estimates, no less than 70-75% of their content was identical. The greatest differences were in the subjects that reflected the national, state and natural specifics of a particular country.

Despite the difficulties and constraining objective and subjective factors of modernization and reform of the education system, certain conditions have been created in the Republic of Kazakhstan to increase investment in education, improve its quality and reach the international level. Evidence of that is the renewal of the content of education for all levels of the education system with account of international tendencies. This important and necessary process began in 2015, after the introduction of amendments and additions to the Law of the Republic of Kazakhstan "On Education", which legislatively regulated the gradual transition to the updated content of school education. This transition was carried out in 2016 – the 1st grade; 2017 - grades 2, 5, 7; 2018 - Grades 3, 6, 8, 2019 - Grades 4, 9, 10, 2020 - Grade 11 (Государственная программа, 2016; Государственная программа, 2019).

Updating the content of education is, first of all, a revision of the structure and content of programs and teaching methods. In this regard, Kazakhstani pedagogy is faced with the task of fundamental renewal of the content of school education on the basis of advanced world pedagogical experience. The new model of education provides for the further development of the functional literacy of schoolchildren, the skills of independent search, critical analysis and assessment, initiative, the ability to find non-standard solutions. Therefore, the main idea of the new reform for the school lies in the systemic and systematic renewal of the content of general secondary education - the transition to a higher quality of education: personality-oriented education, a variety of educational programs, the development of academic freedoms, the formation of legal, psychological, economic and environmental culture of students. With regard to the school, these guidelines in education are transformed into the tasks of developing versatile creative abilities, skills, self-education, readiness and the ability to adapt in the context of constantly changing social conditions of society, etc.

In our country the renewal of the content of education continues to be successfully introduced into the system of general secondary education. Thus, the compulsory education standards and curricula include STEM elements aimed at expanding the use of new technologies, scientific innovations, mathematical modeling, programming, robotics and initial technological training of students. Additional education programs, extracurricular activities, scientific circles and extracurricular activities are organized to follow innovation tendencies. In high school a number of subjects have been taught in English.

In October 2018 by order of the Ministry of Education and Science of the Republic of Kazakhstan the state compulsory standard of updated content for all levels of education was approved. Compared to previous standards, it focuses on building an outcome-based model that measures student performance and achievement. At the same time, updating the content of education supposes the educational process which is different from traditional and is based on expected results which are determined in 6 educational areas and reflect the activity aspect, i.e. students “know”, “understand”, “apply”, “analyze”, “synthesize”, “evaluate”. A clear formulation of the expected results allows not only to assess the educational achievements of students objectively but also to increase the motivation of students to develop skills in learning, as well as to improve the quality of the educational process.

Our analysis of the modernization of the system of general secondary education in Kazakhstan showed that with each its improvement the content of education in secondary schools is being enhanced and improved. It allows them to teach schoolchildren at a modern level in accordance with the tendencies of the development of the world education system (Abylkassymova, 2020), (Abylkasymova, 2020).

It is known that over the years of independence higher education in Kazakhstan has gone through several stages of improving the content of education. It was due to new requirements for human resources and the development of technology and innovation. In 1991-1996 the legislative base was being actively developed. The main standards of higher education were enshrined in the Law of the Republic of Kazakhstan "On Higher Education" (1993) which in 1999 was integrated with the 1992 Law of the Republic of Kazakhstan "On Education". In 1994 the state compulsory standard of higher education in Kazakhstan was adopted for the first time. In 1995 the first educational standards were adopted for 310 specialties of higher professional education. In 1996 a new edition of the Classifier (list) of specialties of higher education, providing 342 specialties, was approved.

A holistic continuous education system from preschool education and training to higher education in Kazakhstan was first presented in 2000. In 2001 in accordance with the International Classifier of the education system, a new Classifier of areas of training and specialties of higher education was developed and introduced. It contained 283 specialties, 70 Master's and 46 Bachelor's programmes (Abylkasymova, 2017).

Since 2004 the training of personnel in higher educational institutions has begun to rely on a competency model. The introduction of the European Credit Transfer System (ECTS) began in 2009. In the same year a new Classifier of specialties of higher and postgraduate education was adopted to ensure the continuity of undergraduate and graduate programs. New state compulsory standards for higher and postgraduate education were developed in the context of expanding the academic freedom of higher education institutions. The ratio of subjects of a compulsory component and an optional component was revised. Educational programs were developed, taking into account the potential of the teaching staff of higher educational institutions, their teaching and laboratory facilities, as well as the needs of the labor market.

A modern teacher should possess a high level of culture, constantly improve himself, be able to design an educational environment, actively use information and communication technologies, distance learning, act as a creator of favorable conditions for organizing a personality-oriented, individually differentiated learning and education process, instill an interest in self-education and form students' skills of independent work (Abylkasymova, 2019).

When organizing continuous pedagogical education, one should also take into account the fact that with the transition of higher educational institutions of Kazakhstan to the Bologna two-level education system "bachelor - master" fundamental changes were made to our education system to converge with the existing educational systems in Europe. As a result, adequate measures have been taken to achieve compliance of the content and the learning process with the world educational standards.

Nowadays the main principles of the development of continuous pedagogical education in Kazakhstan are — continuity; combination of national educational traditions and the best world

experience; flexibility in responding to social changes and predictability; innovativeness. At the same time the goal of the development of teacher education is still to ensure the reproduction of human capital assets and the intellect of society for the sustainable development of our country through high-quality training of teaching staff for the entire field of education.

In general, pedagogical education in Kazakhstan in the process of improving the quality of teacher training is undergoing serious changes while focusing on the creation of a consistent system of continuous education. The search for optimal solutions, promising models, advanced organizational forms and methods of educational work for all levels of education is being carried out everywhere. In the conditions of a dynamically developing system of pedagogical education (bachelor's, master's), there is objectively a need to create promising types of educational organizations, variable curricula and programs; in the implementation of new content and the latest education technologies, etc. (Abylkasymova, 2017).

The renewal of the content of school education has actualized the issues of determining the content of school mathematics education and accordingly the training of future mathematics teachers. It also concerns the issues of comprehensive educational and methodological support for teaching mathematics both at school and at a teacher training institution. To implement these tasks changes were made to the current didactic tools — educational standards, curricula, programs in mathematics of secondary schools and pedagogical universities. At the same time the need to ensure continuity in teaching mathematics in a general education school and a pedagogical university was taken into account.

With our participation new state educational standards, standard curricula and curriculum with an updated content of school education were developed and approved. It enabled us to organize a comprehensive educational and methodological support of the educational process in primary, secondary and high school, as well as in pedagogical universities.

Along with this, we paid special attention to the methodological aspects of teaching mathematics, namely, the preparation of future mathematics teachers who know the methods of teaching students in secondary and high school according to the updated content. To achieve this goal, under my leadership textbooks were developed on mathematics, algebra for secondary school (grades 5-9), algebra and the principles of analysis for high school (grades 10-11) with corresponding didactic materials, teaching aids for teachers and students – future mathematics teachers. Currently, all these materials are being used in the educational process in organizations of general secondary education and pedagogical universities throughout Kazakhstan (Abylkasymova, 2014).

The Department of Methods of Teaching Mathematics, Physics and Informatics of Kazakh National Pedagogical University named after Abai, headed by me, has been preparing pedagogical personnel in the specialties "Mathematics", "Physics" of educational programs for bachelor's, master's and PhD studies, and since September 1, 2015 — specialties "Mathematics and Physics", "Mathematics and Informatics", "Physics and Informatics" bachelor's degree, as well as for ungraded schools. The educational programs developed by us were aimed at implementing the principle of continuity and interdisciplinary communication of studying the school course of mathematics, physics and computer science in integration with methodological disciplines which made it possible to strengthen the quality of professional and methodological training of future teachers. These educational programs are a good help to compensate for the lack of teachers in remote village schools, since one teacher can simultaneously teach two subjects, for example, mathematics and physics, mathematics and computer science, physics and computer science.

Since 2019 our department began to conduct training in two-year educational programs of a pedagogical profile based on higher education using distance learning technologies in the bachelor's specialties - "Mathematics", "Physics".

In the educational programs "Mathematics and Physics", "Mathematics and Informatics" 56 credits (23%) are allocated for general subjects, 69 credits (28%) for mathematical subjects, and 27 credits (11%) for physics (computer science). In these educational programs both "Methods of teaching mathematics" and "Methods of teaching physics (computer science)", as well as other methodological subjects are studied.

In the 2020-2021 academic year the department began to train pedagogical personnel in seven educational programs in which 1083 students study in the bachelor's program, 247 master's degree students and 8 people obtaining PhD degree.

It should be noted that the programs of mathematical and professional subjects in junior courses are aimed at implementing the principle of continuity of mathematical education. Students are given an opportunity to improve and generalize their basic knowledge of school mathematics. Such courses as "Fundamentals of the school course of mathematics", "Fundamentals of mathematical analysis", "Methods for solving non-standard problems in mathematics", etc., being studied in the first years, are a link between the school and the university. They make it possible for students to fill in the existing gaps in the knowledge of school mathematics. The courses teach the ability to systematize sections of mathematics, to orient students towards their future profession.

Many years of experience in a pedagogical university show that teaching mathematics subjects should be correlated with the methodology of teaching mathematics, i.e. for the professional training of the future teacher of mathematics, a balance of special mathematical and methodological training is required. In this regard, professionally-pedagogically oriented mathematical education should begin with the first courses of study at the university, and then be studied in depth when teaching methodological subjects, such as "Methodological foundations for solving problems in mathematics", "Theory and methods of teaching mathematics", "Workshop on the methodology of teaching mathematics", "Methodological foundations of differentiated teaching of mathematics at school", "Organization of teaching mathematics", "Modern lesson", "History of mathematics", etc.

One of the possible options for constructing a course in teaching methods of mathematics was proposed by us in a textbook for students of pedagogical universities "Theory and methods of teaching mathematics: didactic-methodical aspect" (in Kazakh, Russian and English). This approach has found practical application in the universities of our republic. It gave positive results in teaching mathematics and preparing future teachers for subsequent work at school (Abylkasymova, 2014).

To sum it up, the process of reforming school and university education has been actively and successfully implemented in the context of the updated content of school mathematics education in the Republic of Kazakhstan in recent years.

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УДК  
37.012.2

**О МОДЕРНИЗАЦИИ СОДЕРЖАНИЯ ОБЩЕГО СРЕДНЕГО И  
ВУЗОВСКОГО ПЕДАГОГИЧЕСКОГО ОБРАЗОВАНИЯ И  
МЕТОДИЧЕСКИХ АСПЕКТАХ ОБУЧЕНИЯ МАТЕМАТИКЕ**

**Абылкасымова Алма Есимбековна**  
д.п.н., профессор  
aabylkassymova@mail.ru  
г. Алматы

Казахский национальный педагогический  
университет имени Абая

**Аннотация.** Исследование основывается на историческом анализе создания национальной модели образования Республики Казахстан, направленной на повышение качества подготовки человеческих ресурсов, на удовлетворение потребностей личности, общества и государства. В центре внимания – процесс обновления содержания обучения для всех уровней образовательной системы с учетом международных тенденций. Начало данного важного и значимого процесса следует отнести к 2015 году. В данный период были внесены изменения и дополнения в Закон Республики Казахстан «Об образовании». Автор уделяет значимое внимание содержательным аспектам новой модели образования, которая ориентирована на развитие функциональной грамотности школьников, навыков самостоятельного поиска, критического анализа и оценки, инициативности, способности находить нестандартные решения. Особое место в новой модели образования уделено результативному компоненту. Ожидаемые гарантируемые образовательные результаты определяются по шести областям и отражают деятельностный аспект: учащиеся «знают», «понимают», «применяют», «анализируют», «синтезируют», «оценивают». Подобная четкая формулировка ожидаемых результатов позволяет не только объективно оценивать учебные достижения учащихся, но и повышать мотивацию учащихся, улучшать качество образовательного процесса. Главный вывод статьи заключается в том, что обновление содержания школьного образования повлекло изменение методической подготовки будущих учителей математики, актуализировало вопросы комплексного учебно-методического обеспечения обучения математике как в школе, так и педвузе. При этом обучение математическим дисциплинам в педагогическом вузе должно быть скоррелировано с методикой преподавания математики. Для профессиональной подготовки будущего учителя математики необходима сбалансированность специальной математической и методической подготовок.

**Ключевые слова:** содержание образования, обучение математике, модель образования, модернизация, реформирование.

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