ISSN 2518-1726 (Online),
ISSN 1991-346X (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ

# Х А Б А Р Л А Р Ы

# ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

# N E W S

OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN

## ФИЗИКА-МАТЕМАТИКА СЕРИЯСЫ

♦

## СЕРИЯ ФИЗИКО-МАТЕМАТИЧЕСКАЯ

♦

## PHYSICO-MATHEMATICAL SERIES

**1 (317)**

**ҚАҢТАР – АҚПАН 2018 ж.**
**ЯНВАРЬ – ФЕВРАЛЬ 2018 г.**
**JANUARY – FEBRUARY 2018**

1963 ЖЫЛДЫҢ ҚАҢТАР АЙЫНАН ШЫҒА БАСТАҒАН
ИЗДАЕТСЯ С ЯНВАРЯ 1963 ГОДА
PUBLISHED SINCE JANUARY 1963

ЖЫЛЫНА 6 РЕТ ШЫҒАДЫ
ВЫХОДИТ 6 РАЗ В ГОД
PUBLISHED 6 TIMES A YEAR

АЛМАТЫ, ҚР ҰҒА
АЛМАТЫ, НАН РК
ALMATY, NAS RK

*NAS RK is pleased to announce that News of NAS RK. Series of physico-mathematical scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of physico-mathematical in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of physics and mathematics to our community.*

*Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Физика-математика сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Физика-математика сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді физика-математика бойынша контентке адалдығымызды білдіреді.*

*НАН РК сообщает, что научный журнал «Известия НАН РК. Серия физико-математическая» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия физико-математическая в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по физике и математике для нашего сообщества.*

**«ҚР ҰҒА Хабарлары. Физика-математикалық сериясы».**

**ISSN 2518-1726 (Online), ISSN 1991-346X (Print)**

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.)
Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 01.06.2006 ж. берілген **№5543-Ж** мерзімдік басылым тіркеуіне қойылу туралы куәлік

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
www:nauka-nanrk.kz / physics-mathematics.kz



Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

**«Известия НАН РК. Серия физико-математическая».**

**ISSN 2518-1726 (Online), ISSN 1991-346X (Print)**

Собственник: РОО «Национальная академия наук Республики Казахстан» (г. Алматы)
Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан **№5543-Ж**, выданное 01.06.2006 г.

Периодичность: 6 раз в год.
Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел.: 272-13-19, 272-13-18,
www:nauka-nanrk.kz / physics-mathematics.kz



Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

**News of the National Academy of Sciences of the Republic of Kazakhstan. Physical-mathematical series.**

**ISSN 2518-1726 (Online), ISSN 1991-346X (Print)**

Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty)
The certificate of registration of a periodic printed publication in the Committee of information and archives of the Ministry of culture and information of the Republic of Kazakhstan N 5543-Ж, issued 01.06.2006

Periodicity: 6 times a year
Circulation: 300 copies

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
www:nauka-nanrk.kz / physics-mathematics.kz



Address of printing house: ST "Aruna", 75, Muratbayev str, Almaty

**N E W S**
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
**PHYSICO-MATHEMATICAL SERIES**
ISSN 1991-346X
Volume 1, Number 317 (2018), 6 – 13

UDC 372.25

**E.I.Smirnov[1], A.L Zhokhov[1], A.A.Yunusov[3], A.A.Yunusov[4], O.B.Simonova[2]**

[1] K.D. Ushinskiy Yaroslavl State Pedagogical University, Yaroslavl, Russia;
[2] Kirov Regional State Educational Institution, Russia;
[3] KIPUN-Kazakhstan Engineering Pedagogical University of Friendship of Peoples, Shymkent, Republic Of Kazakhstan;
[4]Eurasian humanitarian Institute, Astana, Republic of Kazakhstan,
ya.lvovich2012@yandex.ru *zhal1@mail.ru* Yunusov1951@mail.ru s545231@yandex.ru

# VISUAL MODELING OF THE MANIFESTATION OF THE ESSENCE OF MATHEMATICAL CONCEPTS AND METHODOLOGICAL PROCEDURES

**Abstract.** One of the ways to enhance the effectiveness of mathematical education of schoolchildren is to actualize solutions to complex tasks by adapting modern science. This possibility arises in the identification of "problem areas" of mathematics education and the construction of generalized constructs that are associated with the "problem area". In this article, on the basis of the dialogue of cultures and means of mathematical and computer modeling structured stages of adaptation and technological constructs of actualization synergy in training at the study of the notion of limit of a function. Didactic mechanism of the development of the essence of this construct is the implementation of the model cluster founding, are equipped with the motivation, applied learning situations and tasks at different levels. Longitudinal study of problem areas allows us to effectively develop the intellectual operations of thinking, intercultural communication, creative independence and self-organization of the schoolboy.

**Keywords:** mathematical education, dialogue of cultures, synergy, clusters of a founding, functional literacy activities, computer simulations, solve complex problems, limit of a function.

*Introduction.* Young people of the modern world have become more intolerant of manifestations of established stamps in education, lack of flexibility in teaching influences, have become pragmatic in assessing the emerging circumstances of life, giving priority to building personal preferences and prospects for their future life. At the same time, intellectual operations of thinking (understanding, concretization, abstraction, generalization, modeling, analogy, associations, etc.), which underlie the formation of universal learning activities of trainees, have ceased to develop effectively in school education for various objective and subjective reasons. And in this process, the role of mathematical education is lost as one of the most effective tools for personal development and development of social experience of previous generations, including amidst grandiose applications of mathematics. Suffice it to mention the achievements of fractal geometry (B.Mandelbrot, M.Feigenbaum, M.Barnslow, E.Feder, V.S.Sekovanov, etc.), the theory of chaos and catastrophes (G.Khaken, E.Lorents, A.N. Kolmogorov , V.I. Arnold, G.G. Malinetskii, R. Tom, O. Ressler, etc.), the theory of fuzzy sets and fuzzy-logic (T. Zade, A. Koffman, R. Ronald, etc.), theory coding and encryption (K.Shannon, D.Huffman, L.S. Khill, etc.), the theory of generalized functions (L.Shvarts, L.V. Sobolev, I.M. Gelfand, A.Martino, V.P. Palamodov, etc.), etc. But it is under modern conditions of intensive application of mathematical methods in science, in the humanities, in technology and related sciences, and even in conjunction with information technology, these studies would certainly have to be reflected in the changing programs of school and university mathematical education. First of all, there is a growing need for the actualization of generalized constructions and relations in the content of school and professional mathematical education, connected

primarily with the solution and research of complex problems by means of mathematical and computer modeling. As S.L. Rubinshtein [2] "... the generalization of the relations of objective content is, and then is realized as a generalization of the operations performed on the generalized substantive content; generalization and consolidation in the individual of these generalized operations lead to the formation of the corresponding abilities in the individual. " In such a paradigm, the teacher plays the most important role in improving the quality of teaching mathematics in high school. For example, ideally the future teacher should master the generalized content and methods of activity in the university so that when he comes to school, learn the school subject together with the students at the level of a well-founded entity, thus denying the so-called known "double oblivion" Klein.

Our concept assumes that the teaching of mathematics should take place in an informationally saturated educational environment in the context of a dialogue between the mathematical, informational humanitarian and natural science cultures and the integration of the didactic efforts of the teacher and pupil in the direction of revealing the essences of the basic educational elements (established symbolic forms, concepts, theorems, procedures, algorithms, ideas). And similar processes are directly related to synergetic effects and mechanisms of perception of complex information by the student's personality, the development of his mathematical abilities and creative independence, the construction of special procedures for mastering mathematical sign forms, objects and phenomena. As a result of such cognitive activity, the growth of educational and professional motivation, the development and self-development of thinking, and the expansion of experience and culture in the context of applied and professional orientation will be noticeable. Therefore, the alignment of stages and hierarchies in the process of level identification of the essences of mathematical forms, concepts and procedures by means of visual modeling is the most important mechanism to overcome the formalism in mastering the content of mathematics and represents a serious and far from solved problem in the didactics of mathematics.

*Methodology, theory and technology.* The realization of the announced concept is connected with the mastering of complex knowledge by the means of mathematical and computer modeling in a saturated information and educational environment. An effective tool for mastering complex knowledge can be the research and adaptation to the school or university mathematics of modern achievements in science that are vividly and significantly represented in applications to real life, the development of other sciences, high technologies and industries. The development of the philosophical concept of complexity (I.Kant, G.V.Gegel, I.Prigozhin, G.Khaken, V.V.Orlov, I.S.Utrobin, H.Alven, T.Vasilieva and others) is mediated extensive experimental material, practice and interdependence of integrative processes in science, technology, economics, social transformations and educational paradigms. Polyvalence, multiplicity, multipolarity, unpredictability, emergence and disequilibrium of the modern world cannot be unrelated to the categories of development of the essence of objects, phenomena and processes through the manifestation of the regularities of transitions to higher levels of complexity as components of a concrete general theory of development (V.V. Orlov, St. Bir, N. Winer, G. Neumann, and others). The researchers conclude that complexity is an integrating characteristic of the ability to self-organization when certain critical levels are reached. So French P.A. and Funke D. [8] define the RHC as a multi-step behavioral and cognitive activity aimed at overcoming a large number of previously unknown obstacles between fuzzy, dynamically changing goals and conditions. Psychological features of mastering complex knowledge were studied in detail by A.N. Poddyakov [1]. We further explore the directions of pedagogical support for mastering complex knowledge by students on the basis of adapting modern achievements in science to school and university mathematics with the manifestation of synergistic effects.

1. The basic notion of the presented concept is the concept of foundation as a philosophical category, pedagogical technology and psychological mechanism of personality development [3]. What is the phenomenon of foundation? Funding is the term used in phenomenology (and in other sciences) to describe the relationship of ontological justification. E. Husserl defines the funding relation as follows: A is founded by B, if for existence of A it is essential that B, only in unity with which A can exist. The foundation ratio can be one-way (A is weighted in B) or two-sided (A and B are weighted into each other). According to the phenomenological teaching, all complex high-level acts and objectifications are grounded in the original simple acts and subjects. In pedagogy for the first time the concept of foundation was introduced by V.D. Shadrikov and E.I. Smirnov in 2002 [4] as the process of creating conditions for

the gradual deepening and expansion of school knowledge in the direction of professionalization and the formation of an integral system of scientific and methodological knowledge as the process of forming an integral system of professional and pedagogical activity. In connection with the revealed tendencies, the authors proposed to deepen the theoretical and practical components of the mathematical education of the future teacher of the natural-science profile by changing the content and structure of the natural-science and methodological training in the direction of strengthening the school component of natural-science education, with the subsequent establishment of the knowledge and experience of the individual at different levels. The fundamental difference between the structure-forming principle of foundation is the definition of the basis for a spiral scheme of modeling the basic knowledge, skills, and skills of subject (including mathematical) preparation of students of higher pedagogical universities. School knowledge will become a structure-forming factor, allowing to select theoretical knowledge from the higher-level subject area, through which the knowledge of the school is born.

The problem, however, is connected with the fact that the generalized essence is complex, multilayered, multifunctional and difficult to master by many students. It is clear that such situations in the mastery of mathematics require the introduction of special procedures, stages and methods of cognitive activity of schoolchildren for the maximum possibility of updating the order parameters in this "chaos" of mathematical concepts. It is the dissection of the essence of the means of visual modeling of such "problem zones" in mathematical education that is possible by designing a dialogue of mathematical, information, natural and humanitarian knowledge with the manifestation of synergistic effects.

2. It is this mechanism that serves as a visual modeling [6] as an innovative construct aimed at identifying the essence of mathematical concepts, procedures and situations based on modeling in teaching mathematics, it is necessary to lead to understanding. The main element is the centering of the student, the optimal inclusion of his perceptual, cognitive, reflexive, emotional-volitional, motivational and creative structures in the development of mathematical knowledge. The main thing is the adequacy of the a priori model and the results of students ' mental activity, conscious and leading to understanding. Visual simulation is an interactive triad: the person model – understanding. Necessary attributes of a visual simulation: the mutual transitions of sign systems: verbal, symbolic, figurative and graphic and specific activity; stability of perceptions of mathematical knowledge; the adequacy of the a priori and effective models; the selection and updating of basic educational elements; the sensitivity of the modalities of perception; activity cognitive processes. It is necessary to know the peculiarities of mental development of each student, types and hierarchy of models, means of optimization of logical structures, laws of perception and operation of sign systems, means of diagnosis of personality and intellectual operations, controlling and evaluating procedures, self-improvement and retraining of teachers. Therefore, the actual problem is the organization of the process of learning mathematics, when the views arising in the thinking of students reflect the basic, essential, key aspects of subjects, phenomena and processes, including through adequate modeling of mathematical knowledge. It is the identification and formation in the cognitive process of these nodal, supporting qualities of the object or the process of perception (perceptual model), adequately reflecting the essence of the object or process, and is the essence of the process of visual modeling. At the same time, the models fixing the procedure of mathematical actions in the process of research activity acquire special significance.

Since the essence reveals its reality in the totality of the external characteristics of the object, in its manifestations, revealing the essence through the philosophical categories of the internal, General, content, cause, necessity and law, first of all, we determine the component composition of the content and procedural characteristics of the manifestation of the essence. Content modus: symbolic, verbal, figurative-geometric and tactile-kinesthetic manifestations; procedural modus: historical-genetic, concrete-activity, experimental and applied educational situations and manifestations. Comprehension of the subject matter by students in a certain categorical field of knowledge and methods of activity, sufficient for the success and effectiveness of operating with it, does not necessarily coincide in the content and severity of the essential links. Moreover, it is possible to attach additional links that, together with the necessary links, create the integrity and hierarchy of the entity in this categorical field. This variability and mobility of the subject matter requires updating the step – by-step progress to its cognition and determines the third dimension of the essence-personal-adaptive in its characteristics, and determines the three-component integrity of the subject matter as an object of cognition in the course of cognitive

activity. Thus, we present the following structural and functional model of the essence of mathematical learning elements (Fig.One):

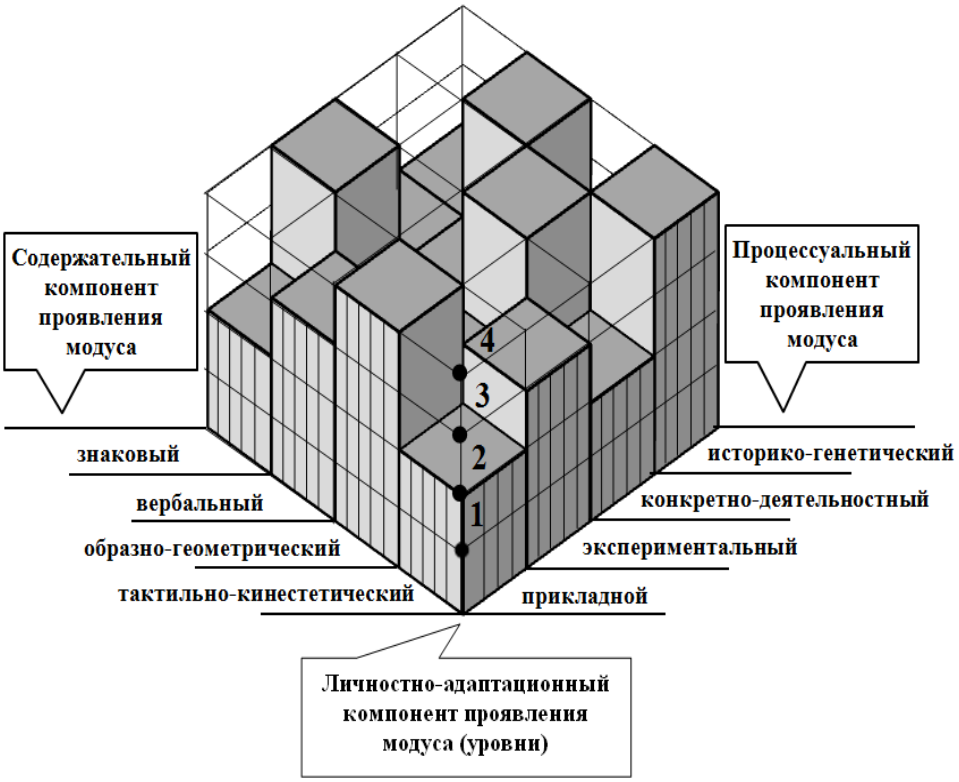



Figure1 - Structural-functional model of the essence of mathematical learning elements

3. Dialogue of cultures is a methodical mechanism: within the framework of this work it is used as a dialogue of cultures in its personal aspect (DCL), as communication of personalities of participants - DCL (Ук - ученик; Ул - учитель), carried out by them on the basis of a work of culture (PC), arisen in a certain facet of culture and / or represented in any of the possible incarnations, including the educational text created, including in the process of the DC. First of all, the DCL presupposes the spiritual communication of specific carriers of individual (personal) culture with the use of all the basic components of each individual. In real execution, the DCL is implemented as a kind of a triad in the field of meanings given by an ordered triple ⟨ "culture of one participant"; "PC culture"; "culture of another participant" ⟩. In the educational process, the teacher (UL) and the students (UC) in their various combinations (one - one, one - group, group - group, etc.) appear as participants in the DCL. The role of the teacher is to organize and manage the DCL until its completion and / or transition to a new DCL based on, preferably, those PCs that were created within the framework of the committed DCL. DCL in the methodical sense is an art (and a kind of technology) of such an organization of learning, in which dialogue participants need an outbreak of understanding, that is, "suddenly" a new (personally new) understanding of the PC under consideration. In other words, the technology of DCL is based on "dialectic as a dialogical art" (M. Mamardashvili), as the creation of own PCs; only then can we assume that there is a "thawing" of dialectics as a dialogical art. In our understanding, the place of DCL (in any of its variants) is the second stage of knowledge of a mathematical object.

It is believed that the DCL was held if, as a result, a new work of culture ($PC_2$) appeared for the participants, created in the process of communication as a result of a joint or individual transformation of the original PC1. Since along with the change in PC1 there are some changes in the participants of the DCL, the latter, if completed, makes sense to present the following scheme: ⟨ $U_l$ - $PC_1$ - $U_k$ ⟩′→ ⟨ $U_l$ - $PC_2$ - $U_k$⟩". The pedagogical mechanism for the inclusion of students in the DCL is the learning situation of "tension and success", organized, for example, on the basis of a personally perceived fragment of educational material, which is a particular example of an educational PC.

In literature, a broader concept is used - a dialogue of cultures, originating from the philosophy of existentialism. In the domestic culture for the first time, the philosopher and philologist M.M. Bakhtin, later - VS. Biblerom, S.Yu. Kurganov and others. Bakhtin defined the architectonics of the Palace of Culture as a responsible act; according to Bakhtin, its structural elements are: I, Other, I-for-Other. Naturally, in the methodological plan, all this acquires corresponding shades and forms of realization [6].

4.Cluster of generalized construct Foundation (for example, the concept of "function limit"):

1 the initial level of entity development - the limit of the function at the intuitive-visual level, the functional stage of awareness and correction of functions, parameters and conditions of the limit process,he area of polyhedral complexes, triangulations lateral surface of regular (layers the same height) of the cylinder or "boot" Schwartz; the Koch snowflake, the Sierpinski napkin (perimeter and area as the limiting constructs); the attractors and basins of attraction in piecewise-linear maps; multiple homothety of the plane and space (the fixed point, polars, basins of attraction).

1 the area of polyhedral complexes, triangulations lateral surface of regular (layers the same height) of the cylinder or "boot" Schwartz; the Koch snowflake, the Sierpinski napkin ( perimeter and area as the limiting constructs); the attractors and basins of attraction in piecewise-linear maps; multiple homothety of the plane and space (the fixed point, polars, basins of attraction).

**Forms and means**: resource and laboratory-calculation classes, work in small groups, lessons-lectures, pedagogical software products, task banks, presentation trainings, ClassPad400, GeoGebra, Web-resources.

2 - partial limits theorem about the coverage, the upper and lower limits of a function; area of polyhedral complexes, triangulations of side surface irregular ( layers of different height) of the cylinder or "boot" Schwartz; multiple homothety plane and space in the conditions of dynamic chaos ( the Sierpinski triangle, the Cantor set, "sponge" Menger).

2 - tree and Feigenbaum constant and transition from order to chaos; the fractal structure of the functions of the van der Waerden (computer and mathematical modeling, approximation curve, continuity and nondifferentiability of curve).

**Forms and means**: resource and laboratory and calculation classes, work in small groups, lecture lessons, pedagogical software products, task banks, presentation trainings, ClassPad400, GeoGebra, Web resources, Qt Creator cross-platform environment, project activities, interactive whiteboards.

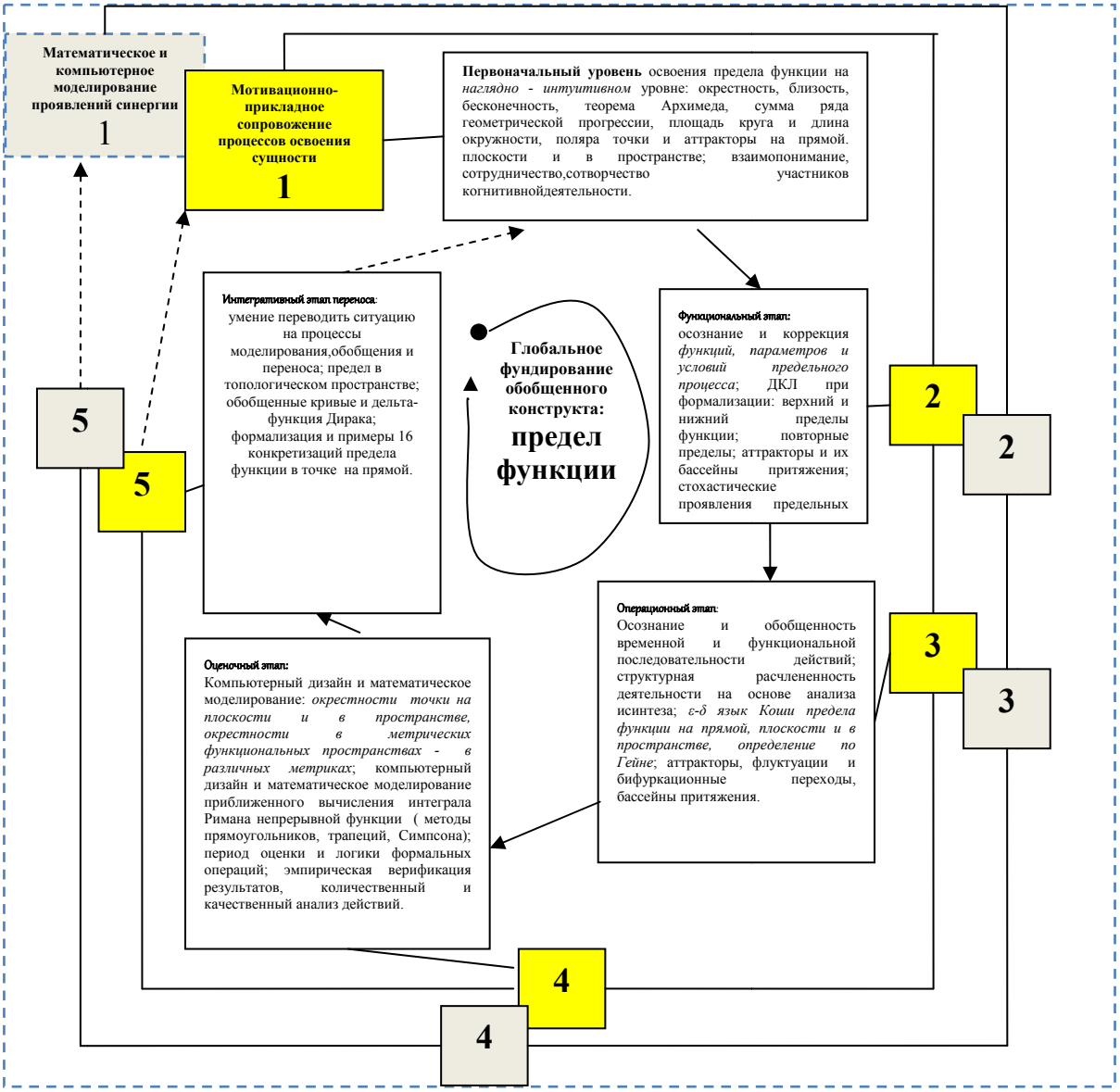
3 - computer simulation ε-δ of the Cauchy language; business game"Finding min N(ε) for the sound sequence"; variation of parameters and computational design of the spatial limit of a sequence; computer design and variations of the fractal sets of Mandelbrot and Julia ( iteration, fixed point, the variation of the polynomial n-th degree, the basins of attraction); the study of attractors of nonlinear mappings (Bernoulli, Hainaut, display "Baker", "cat" Arnold, testoobraznaja function).

3 - strange attractors of the Lorenz and Henon; affine transformation andmaple leaf, Barnslow; dust Sierpinski fractals and art.

**Forms and tools**: resource and laboratory and design classes, work in small groups, lessons, lectures, educational software products, banks jobs, training presentations, ClassPad400, GeoGebra, Web resources, cross-platform environment Qt Creator, projects, business games, interactive whiteboard.

4 - computer-aided design and mathematical modeling of the neighborhood points on a plane and in space for different metrics, universality of pointwise convergence and Euclidean metric; numerical methods for finding the area of curvilinear trapeze ( rectangles, trapezoids, Simpson).

4 - computer and mathematical modeling: transformations Hutchinson, Seth, multifractal, the limit in the Hausdorff metric.




**Forms and tools**: resource and laboratory and design classes, work in small groups, lessons, lectures, educational software products, banks jobs, training presentations, ClassPad400, GeoGebra, Web resources, cross-platform environment Qt Creator, projects, business games, interactive whiteboard.

5 - computer and mathematical modeling of a generalized solution of the wave equation; computer design weird cross – attractors of affine transformations of the plane.

5 - generalized curves and the δ - function Dirac (instantaneous impact and momentum, generalized functions and the limit, the summation of divergent series); the Lebesgue integral (estrogenes, advantages, applications); non-standard analysis by A. Robinson (estrogenes, axioms, theorems).

**Forms and tools**: resource and laboratory and design classes, work in small groups, lessons, lectures, educational software products, banks jobs, training presentations, ClassPad400, GeoGebra, interactive whiteboard, Web-resources, cross-platform environment Qt Creator, projects, business game.

**Innovation**: the potential of synergy is realized by visualizing the dynamics of functional dependences of the parameters of a limit process by means of mathematical and computer modelling (used ClassPad400 and MathCad for the study of the limit of rational and transcendental functions in one-dimensional, two-dimensional and three-dimensional cases). This is the construction of polars, attractors,

pools of attraction, fluctuation of initial parameters; finding min N (ε) and the implementation of the business game scenario in the research activities of small groups. The cluster of Foundation of the essence of the concept of function limit with the continuity of the content, forms, means, methods and technologies in the context of integration of computer and mathematical modeling of the processes of synergy, actualization and unity of mathematical knowledge from different fields, motivic and applied support of the processes of manifestation of the essence.

5. Technological stages of the development of complex knowledge-based implementation of concepts of Tundrovaya experience of self, visual modeling of objects, processes and phenomena of the dialogue of cultures and personalities of the generalized model of cognition suggest a synergetic attributes by means of mathematical and computer modeling. Reliance on the identification of " problem areas "in mathematical education and adaptation of generalized designs of modern achievements in science to school and University mathematics as a means of manifestation of the essence of the" problem zone " is a key idea to improve the quality of mathematical education and the development of intellectual operations of students.

**Results**. The situation of chaos in the processes of mastering mathematical knowledge and procedures by certain categories of students and students is not the last problem in education. This lack of adequate solutions to this problem leads to a formalism of knowledge, a low level of educational and professional motivation, an inadequate level of personal development of students, especially in the context of self-organization and self-development of the individual. In the present study, this problem is proposed to be solved by methods involving students in the dialogue of cultures, building and adapting the generalized constructs of complex knowledge that underlie the "problem zones" of mathematical education. These constructs are the samples of modern achievements in science: fractal geometry, fuzzy sets theory, generalized functions, coding theory, chaos theory and catastrophes, etc., solved by means of mathematical and computer modeling and adapted to the available level of mathematical competence of schoolchildren and students. In this respect, the parameters of order in mathematics education are also technologies of establishing the experience of the individual and visual modeling of objects, procedures and phenomena, actualizing the aspect of theoretical generalization, building hierarchies and stages of understanding the essence of mathematical concepts and procedures that promote the development of intellectual operations and the manifestation of synergetic effects in teaching mathematics. Namely, the concept and technology of mastering complex knowledge in the mathematical education of schoolchildren and students on the basis of adaptation of modern achievements in science to school and university mathematics were developed. The technologies of the identification of the experience of the individual and the visual modeling of objects, processes and phenomena are clarified, characteristics and a structural-functional model of the essence of mathematical educational elements on the basis of hierarchy are developed. The graph of the coordination of the stages of manifestation of the essence in the "problem zone" and stages of the manifestation of synergy of mathematical education as a didactic mechanism and model of cognitive activity in the process of mastering mathematics with a synergetic effect is developed. The pedagogical experience of the pilot implementation of the developed technology of mathematical education shows its effectiveness in the growth of educational and professional motivation, the development of intellectual operations, improving the quality of teaching math students and students.

**REFERENCES**

[1] Podyakov A. Psychology of learning in conditions of novelty, complexity, uncertainty. Psychological research. M .: Higher School of Economics, **2015**. C. 6-10.

[2] Rubinshtein S. About thinking and ways of its research. Moscow: USSR Academy of Sciences, 1958.

[3] Smirnov E.I. Funding of experience in vocational training and innovative activity of the teacher. Monograph: Yaroslavl, Publishing house "Chancellor", **2012**. 654 c.

[4] EI Smirnov Preparation of the teacher of mathematics: Innovative approaches // Ed. V.D. Shadrikova. Moscow: Gardariki, **2002**. 383 pp.

[5] Smirnov E.I. Technology of visual-model training in mathematics. Monograph.: YAGPU Publishing House, Yaroslavl, **1997**.-323 pages.

[6] Simonova O.V., Zhokhov A.L. Conditions for the development of functional literacy of students of the V-VI classes in the process of academic mathematics//"International Kolmogorov Readings - XIV", dedicated to the 100th anniversary of Professor ZA Skopets: Moscow - Koryazhma-Yaroslavl-Arzamas. Editorial staff of the newspaper "Successful". **2017**. P.103-107.

[7] Smirnov E.I. Bogun V.V., Uvarov A.D. Synergy of the teacher's mathematical education: an introduction to the analysis. Monograph. Chancellor, 2016. 308 p.

[8] Funke I., Frensch P.A. Solving complex problems: research in North America and Europe / / Foreign psychology. **1995**. T. 3, No. 5. - P. 42-47.

[9] Zhokhov A.L. Knowledge of mathematics and the foundations of the scientific worldview: the worldview directed learning in mathematics: a Training manual. – Yaroslavl, publishing house of AGPU, **2008**. 1804 c.

[10] Zhokhov, A.L. Formation of the scientific worldview of students in teaching mathematics [Text]. Yaroslavl: publishing house of YarGPU, **2011**. 211 p.

**Е.И Смирнов[1], А. ЛЖохов[1], А.А. Юнусов, А.А. Юнусов[4] , О.В.Симонова[2]**

[1]К.Д.Ушинский атындағыЯМПУ,Ресей, Ярославль;
[2]Киров облыстық мемлекеттік білім орталығы, лицейі, Ресей, Киров;
[3]КИПХДУ Шымкент ,Толеби-32, Казахстан Республикасы;
[4]Евразиялық гуманитарлық институты.Астана. Казахстан Республикасы

## МАТЕМАТИКАЛЫҚ ҰҒЫМДАРДЫҢ ЖӘНЕ ӘДІСТЕМЕЛІК ЖҰМЫСТАРДЫҢ ПАЙДА БОЛУ КЕЗЕҢДЕРІНІҢ МӘН-МАҒЫНАСЫНЫҢ КӨРНЕКІ МОДЕЛДУ

**Аннотация.** Мектеп оқушыларына математикалық білім берудің тиімділігін арттырудың біржолы күрделі есептерді шығру жолдаарын заманауи ғылымның жетістіктеріне лайықты етіп қайта жаңғырту. Мұндай мәселе математикалық білім берудегі «проблеммалық аймақтың» пайда болуы мен «проблемалық аймаққа» байланысты жалпыланған конструктарды құру мүмкіндігі белгілі болуына байланысты туындады. Бұл мақала функцияның шегі ұғымын оқытуды зерттеудес инергияны қайта жаңғыртудағы математикалық және компьютерлік моделдеу құралдары мен технологиялық конструкттың бейімделу кезеңдерінің диалог мәдениеті негізінде құрылған. Мұндағы конструкты меңгерудің дидактикалық механизмінің мән-мағнасы, мативациялық-колдарбалық оқу жағдай атары кешенін фундирлеу кластер моделі және әртүрлі деңгейдегі есептер болып табылады. «Проблемалық аймақты» лонгитюдтік зерттеулер оқушылардың тұлғалық ойлауына, мәдениет араралық коммуникацияға, өзбетінше жасампаздық пен өін-өзі ұйымдастыруды тиімді жүзеге асыруға мүмкіндік береді.

**Тірек сөздер:** математикалық білім беру, диолог мәдениеті, синергия, фундирлеу кластері, іс-әрекеттің функционалдық сауаттылығы, компьютерлік моделдеу, күрделесептерді шығару, функцияның шегі.

УДК372.85

**Е.И Смирнов[1], А.Л.Жохов[1], А.А., Юнусов[3], А.А. Юнусова[4] ,О.В.Симонова[2]**

[1]ФГОУ ВПО «Ярославский государственный педагогический университет им.К.Д. Ушинского», г.Ярославль, Россия;
[2]Кировское областное государственное образовательное учреждение, лицей, г. Киров, Russia;
[3] КИПУДН (160012, Шымкент ,ул .Толеби-32), Республика Казахстан;
[4]Евразийский гуманитарный институт.г. Астана. Республика Казахстан

## НАГЛЯДНОЕ МОДЕЛИРОВАНИЕ ЭТАПОВ ПРОЯВЛЕНИЯ СУЩНОСТИ МАТЕМАТИЧЕСКИХ ПОНЯТИЙ И МЕТОДИЧЕСКИХ ПРОЦЕДУР

**Аннотация.** Одним из путей повышения эффективности математического образования школьников является актуализация способов решения сложных задач путем адаптации современных достижений науки. Возможность этого возникает при выявлении «проблемных зон» математического образования и построении обобщенных конструктов, связанных с «проблемной зоной». В данной статье на основе диалога культур и средствами математического и компьютерного моделирования выстроены этапы адаптации и технологические конструкты актуализации синергии в обучении при исследовании понятия предела функции. Дидактическим механизмом освоения сущности такого конструкта оказывается реализация модели кластера фундирования, оснащенного комплексами мотивационно–прикладных учебных ситуаций и задач разного уровня. Лонгитюдное исследование «проблемных зон» позволяет эффективно развивать интеллектуальные операции мышления, межкультурные коммуникации, творческую самостоятельность и самоорганизацию личности школьника.

**Ключевые слова:** математическое образование, диалог культур, синергия, кластеры фундирования, функциональная грамотность деятельности, компьютерное моделирование, решение сложных задач, предел функции.

**МАЗМҰНЫ**



* * *

**СОДЕРЖАНИЕ**



* * *

**CONTENTS**



* * *

## Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайтах:

www:nauka-nanrk.kz

http://www.physics-mathematics.kz

**ISSN 2518-1726 (Online), ISSN 1991-346X (Print)**

Редакторы *М. С. Ахметова, Т.А. Апендиев, Д.С. Аленов*
Верстка на компьютере *А.М. Кульгинбаевой*

Подписано в печать 15.02.2018.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
9 п.л. Тираж 300. Заказ 1.

*Национальная академия наук РК*
*050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19*