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VALUE PARADIGMS OF CHARACTER EDUCATION*

Ruben G. Apressyan

The Institute of Philosophy of the Russian Academy of Sciences, Moscow, Russian Federation

When speaking about the value component of character education, one usually means, first and foremost, the value *content* of education associated with educational goals. A look at the current network resources only confirms this impression. For example, the authors of online publications deal mainly with the problems of patriotic, civic, ecological, and democratic education; to a lesser extent, also with moral (which is often reduced to patriotic and civic education) and esthetic (artistic, musical); there are also publications on Christian, especially Orthodox education.

There is no reason to believe that diversified education can be effective. However, as a preparatory intellectual elaboration on ideologically heterogeneous content to be incorporated into character education, such an approach, analogous to subject-differentiated learning, may have practical significance.

The relationship between values and character education has two aspects. One concerns the value content of character education. Here, it is appropriate to discuss the values of education programs. The other concerns the value bases, the value component of the educational activity itself, and the ethos of education. The theme of the value paradigms of character education, mentioned in the title of this article, emerges here. The educator implements a specific value system in their activity. However, the particular educational activity is not always directed at forming the underlying value system.

The basis of axiological reconstruction

In the most general sense, values are generalized, stable ideas about what is significant[1] for individual objects (material or ideal), or, in other words, they are ideas about something that is essentially and fundamentally preferred as something good, i.e., about what corresponds not only to some needs, interests, intentions, goals, plans of the individual, but expresses his or her ideas about the ideal, perfect. From an empirical point of view, the value reflects the individual's attitude towards an object, an event, or a phenomenon, i.e., a relationship in which the latter is recognized and to which certain importance is attributed. In this sense, the value attitude differs from the indifferent attitude. Just as needs and interests are different, so is the weight of the various values and their importance in an individual's life. Nevertheless, the very characteristic of value as something through which and based on which value is given points to something else – the individual's attitude toward an object, an event, or a phenomenon is predetermined by value consciousness; something recognized as significant because it appeals to certain inner feelings.

An essential methodological question that arises here is what is the starting point, and what is the initial data of the axiological analysis? Various approaches are possible here. Relatively speaking, the metaphysical approach hypostasizes a certain realm of values that exists in itself,

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[1] For a detailed interpretation of the concept of meaning and value, see [1].

transcends reality, and is grasped by a person with direct discretion (N. Hartmann) [2]. In the existential-anthropological approach, values derive from the conditions of human existence and the primary needs that arise from these conditions (E. Fromm) [3]. In the sociological approach, values are derived from the conditions of the community's existence and the community's needs for its own reproduction and stable development (E. Durkheim) [4]. Here, a normative approach is proposed, which is subordinate to the above one because it starts from a certain cultural reality, which is directly given to a person and may have been created by the interaction of the factors mentioned in the above approaches. As such a reality, we define the givenness of moral practice expressed in a rule that is widespread in all historically known and relatively developed cultures – a rule we call the *golden rule* of morality.

Its most familiar form reads, "Do to others as you would have them do to you" (Luke 6:31). However, in the broader normative context of developed morality, this rule has a double projection that expands its potential ethical content.

The inverse projection of the Golden Rule leads to the Talion Law. Strictly speaking, the Golden Rule in its negative formulation ("Do to others as you would have them do to you") is the result of rethinking in the form of the initial principle of the Talion Law; just as in its positive formulation, it is the result of rethinking in the form of the initial principle of the Rule of *Gratitude*[1]. In its most detailed form, talion is presented in the Book of Exodus, and its key formula is "eye for eye, tooth for tooth, hand for hand, foot for foot, burn for burn, wound for wound, bruise for bruise." (Exodus 21:24–26)[2]. In later moral philosophy, the analysis of the talion is carried out taking into account its refined and generalized formulation, in which the principle of reversible equality is expressed quite clearly: "Behave toward others (strangers) as they behave toward you and your relatives."[3]

The progressive projection of the Golden Rule leads to the *Commandment of Love*, known in Christian doctrine as the double commandment of love of God and love of man: "You shall love the Lord your God with all your heart, with all your soul, with all your strength, and with all your mind," and, "You shall love your neighbor as yourself." (Luke 10:27). There are various interpretations of the relationship between the Golden Rule and the Commandment of Love, but in all approaches, the Commandment of Love correlates with the Golden Rule rather than with the Old Testament. The distinctive feature of the Commandment of Love is that it is complex. It combines two commandments from the Pentateuch: the commandment to love God (Deuteronomy 6:5) and the commandment to love one's neighbor (Leviticus 19:18, 33–34).

Talion, the Golden Rule, and the Commandment of Love constitute the primary normative content of value consciousness, especially morality, and are characterized as follows. First, all of these rules regulate the *relationship of one person to another*: The Talion limits the degree of retribution that is permissible in response to the Other's evil; the Golden Rule establishes equality and reciprocity in all respects for the Other and establishes the source of the standard by which the Other must be treated; the Commandment of Love indicates the need for a caring and loving attitude toward the Other. Thus, in the continuum of internal normative dynamics, attitudes toward the Other(s) should be built under a set of principles ranging from "*Do no harm to the Other*" (pro-actively) to "*Be fair, respect the Other*" to "*Show care for the Other, treat the Other*

[1] For more on the transformation of talion and gratitude into Golden Rule formulas, see [5, pp. 73–85].

[2] See also Leviticus 19:21; 24:19-20; Deuteronomy 19:21. In other Old Testament books, the severity of the sanctions imposed with talion is increasingly relaxed. See Numbers 35:19; Ruth 2:20; Proverbs 24:29; Psalm 18:15; Isaiah 41:14; Ecclesiasticus 27:24-29; Wisdom 11:16; 12:22. The pattern of such dynamics is confirmed by the similar evolution of the talion in the Koran: 2:178−179,194; 4:92; 5:45; 16:126; 17:33; 22:60; 42:40-43.

[3] This formulation is by A.A. Huseynov, see [6, p. 65]. Huseynov, see [6, p. 65].

with love[1].” The second, the Golden Rule and the Commandment of Love relate to a person’s *relationship with themself*: The latter appears as the standard for the relationship with the Other. Third, in the Commandment of Love, the relationship to the Other and the relationship to oneself is ultimately determined by the *relationship to the highest principle*, to God, or the ideal.

The sphere of value, then, is formed by the relationship of a person’s attitude to oneself, to others, and the highest – in the above specifications.

Limited diversity of basic value orientations

The two main internal opposites of value consciousness: “*universal* (*general*) – *particular* (*private*)” and “*I – others,*” can be considered as the foundation on which the whole edifice stands, its fundamental imperative values or ethical systems. If these opposites are represented as coordinates, then the fundamental values or principles are formed at the intersection of the coordinates – pleasure, benefit, personal perfection, and merciful love.

The Ethical Square can illustrate this.

Table 1

	Particularism	Universalism
I	*Hedonism – ethics of pleasure*	*Perfectionism – ethics of personal perfection*
the Other(s)	*Utilitarianism – ethics of benefit*	*Agapism – ethics of humanity*

From Table 1, we can see that the combination of a priority attitude towards oneself with the dominance of private interests characterizes *hedonism*, i.e., such a value system according to which good is pleasure and evil is suffering. In hedonism, one’s highest value and goal is pleasure, and all man’s duties are ultimately subordinated to the desire for pleasure.

The combination of a priority attitude toward others with the dominance of private interest characterizes *utilitarianism*. What helps achieve a specific goal is recognized as valuable, i.e., helpful, and a person should perform useful actions and strive for success.

The combination of a priority attitude towards oneself with the dominance of a common interest characterizes *perfectionism*, according to which the highest value is perfection, and everyone should strive to achieve it.

The combination of a priority attitude towards the other(s) with the dominance of a common interest characterizes *agapism*[2], according to which the highest value is a person and the duty of each is to contribute to the good of the Other.

This classification of values and the moral positions resulting from their primary preference and corresponding normative programs is based on primary values’ assignment. The *ethics of happiness* is not included within because, in further analysis, one or another idea of happiness is reduced to one of the most essential Primary values. Likewise, the so-called *ethics of duty* has no place in it because the idea of duty specifies the nature of the motivation for action (as opposed to, for example, coercion, obedience, or arbitrariness) and specifies the subject of duty implies certain value specifications.

The above table represents the basic view of value consciousness and, as a diagram, does not claim to convey the entire variety and the entire completeness of this content. Nevertheless, some

[1] In the ethical sense, the love relationship is expressed in the recognition of the Other . The depth of love depends on the degree of recognition of the Other.

[2] From Agape (Greek αγαπη – love < αγαπαω – lovingly receiving, showing love – αγαπαζω). Agape is a term that expresses the concept of Christian love (mercy) in the Scriptures and patristic literature.

explanatory remarks must be made. Particularity reveals itself, in other words, as Private Interest, but in the context of axiological reasoning, particularity first manifests itself in isolation, and alienation.

Moreover, this alienation is expressed in the person's rejection of both the higher – the ideal – and the alongside – others, sometimes oneself. In hedonism, a person cherishes their desires, but this benevolence toward one's yearning may well be mediated by harmonious relationships with others – with partners and support in satisfying their desires. In perfectionism, the priority of attitude toward oneself is expressed in a personal striving toward the ideal and thus a focus on changes in oneself to get closer to the ideal. In agapism, turning toward others also means, in a sense, turning away from them – turning away from their lower aspirations in the name of their spirituality.

If we try to present the selected positions as models of behavior, then the Ethical Square can be modified as follows:

Table 2

	Particularism	Universalism
I	Hedonism: *people promote their own goals based on their understanding of the good*	Perfectionism: *people promote their own goals based on the fact that any reasonable person would consider this a blessing*
the Other(s)	Utilitarianism: *people promote their own goals based on the happiness of the greatest number of people in a society or a group*	Agapism: *People contribute to the good for others based on the fact that any reasonable person would consider this a blessing*

These descriptive sentences can easily be reformulated into imperative statements. The possible extremes in each position can be expressed as follows:

Table 3

	Particularism	Universalism
I	Hedonism: Sublimation – *in creativity.* Deviation – *in sadism*	Perfectionism: Sublimation – *in asceticism.* Deviation – *in pride*
the Other(s)	Utilitarianism: Sublimation – *in charity.* Deviation – *in self-interest and group selfishness*	Agapism: Sublimation – *in selfless devotion.* Deviation – *in paternalism*

Of course, the Ethical Square as a schematic representation of morality does not reflect all intramoral differences and specifications. It should also be borne in mind that none of the derived principles in themselves guarantees that a person will fulfill the moral law and ensure the path to true perfection by his or her choice. Perfection consists of a person embodying all the principles in his or her actions and way of thinking. When a person has a high ideal and strives for its realization, he finds means for practical realization appropriate to the goals and suitable to the situation.

The value paradigms of character education are consistent with the identified general value positions. This can be seen in the rich material of *pedagogical literature*. However, one can see that it is not special pedagogical literature but artistic and pedagogical, for example: *Philosophy in the Boudoir* by D.A.F. de Sade, *The Brothers Karamazov* by F.M. Dostoevsky, *The Glass Bead Game* by G. Hesse, *The Pedagogical Poem* by A.S. Makarenko. The composition of the selected exemplary works should not seem strange or arbitrary. In fact, only one is considered canonically pedagogical in this selection, namely Makarenko's novel. The inclusion of *The Glass Bead Game* is also understandable. This novel is often treated as a kind of pedagogical utopia; but according

to the plot, the protagonist of the novel, Joseph Knecht, who is at the peak of his career, leaves both his ordination and his Castalia to become the educator of a young man who is the son of his friend, confused and out of control.

Furthermore, it is impossible to overlook the pedagogical component in Dostoevsky's last novel, perhaps his most ideological of all ideological works. The novel can be easily interpreted ideologically as a kind of panorama of the practice of mercy in all its diversity, including deviations from this principle and its desecration. In this respect, the character of the elderly Zosima, who, although not central to the plot, is essential from the ideological content point of view, acts as a kind of tuning fork in the novel. The elder is a righteous man and a spiritual mentor, and in this sense, he represents a certain pedagogical strategy. The author reinforces his mission not through a plot but a composition – like an appendix to the novel "Notes of the Elder Zosima". Finally, Philosophy in the Boudoir is essentially a pedagogical or antipedagogical (if you will) novel, from the epigraph with which the author recommends his book to parents as an indispensable guide for their young daughters, to the composition of the work itself. *Philosophy in the Boudoir* can not help but be a how-to manual. The novel is structured like a lesson that takes place over a long period of time, during which there is a lecture, a training session, and a workshop. The whole process of enlightenment (instruction, education) is led by the mentor Dolmanse, who actively participates in it. He teaches with brutal pleasure, while he is strict in his instructions, but at the same time attentive and caring. It is significant how Roman Viktyuk expresses this pedagogical dimension of the novel in the set design of his production of *Philosophy in the Boudoir*: the foreground of the stage is a classroom with the desks indispensable for the class, and the back part is an alcove with a gigantic bed.

An analysis of these works (unfortunately not within the scope of these notes) should present the value paradigms of education in an expanded form:

Table 4

Hedonism – *"pedagogy of pleasure" Dolmanse (D.A.F. de Sade "Philosophy in the Boudoir")*	Perfectionism: *Josef Knecht's Selfless Pedagogy G. Hesse "The Glass Bead Game")*
Utilitarianism – *Collectivist pedagogy S.A. Makarenko (S.A. Makarenko "The Pedagogical Poem")*	Agapism – *Merciful Pedagogy Elder Zosima (F.M. Dostoevsky "The Brothers Karamazovs")*

Discipline and Excellence

As a separate task, it is of interest to analyze the value composition of each paradigm. Let us take the opposite positions – perfectionism and that kind of utilitarianism expressed in the *social ethics of discipline*.

Discipline is based on the order. The order does not necessarily mean oppression, although it does not exclude it. Obviously, the order can be based on different kinds of discipline and disciplinarity, depending on the organizational space in which they are allowed. In a narrow sense, *discipline* is an order mediated by the restriction of the freedom of choice and will of individuals who are voluntarily or involuntarily, and in the latter case arbitrarily or forcibly, involved in that order. Association, partnership (or private club), corporation, order (or similarly constructed and functioning political or criminal organization), sect (or similarly constructed political or criminal group), fighting unit (or similarly constructed emergency unit), penal institution-such disciplinary spaces, differing in character and functional purpose, necessarily or optionally confer the way of life and thought of the individuals contained within them.

Whatever form of *social ethics* we choose – contractual, communal, or corporate- is all disciplinary. In them, *adaptability* dominates perfection. In disciplinarity, the external order is important in itself. Disciplinarity can be interspersed with authoritarianism. However, there are significant differences between them. In an authoritarian educational strategy, authority itself is a dominant and primary factor, and discipline is a means of enforcing authority; in disciplinarianism, the order itself is important, and authority is used to maintain order. Authoritarian character education requires a high degree of adaptability; adaptability in contractual relationships is lower because it is determined each time by the decision of the participants in these contractual mini-communities themselves, they themselves set the terms of these relationships, and they are usually free to continue or break off these relationships. In contractual relationships, the participants themselves are subjects of discipline; in authoritarian relationships, authority establishes discipline. Character education based on the contractual type of human relations can appear democratic and be democratic. The crucial factor here is the role of liberal democratic principles in contractual relations, which in reality is not determined by the fact of contracting itself, but should be regulated separately.

Discipline restrains, but authoritarian discipline oppresses, add restraint takes the form of oppression. Disciplinary sanctions are predominantly negative, although they can be positive (expressed in the appropriate badges of honor). However, since they do not touch the essence of the thing that constitutes discipline, they are also negative in content: through them, a person is reduced to order as such. Discipline presupposes diligence, but not only diligence but diligence in the sense of obedience – diligence that seems to come *from the heart*. Discipline must be observed in good faith. A breach of discipline places the transgressor in a special position within the group. The transgressor can be condemned both by the educator and by the ordinary members of the group – the students – so that he or she understands their incompatibility with the disciplinary rules. Public condemnation of the transgressor is shameful; public recognition is honorable. Discipline requires an extroverted personality type: the reaction of the educator and other members of the group should be decisive for them. If the attitude toward discipline is not expressed in diligence, the personal, individualized response may be disobedience. Within the limits of exclusive resistance to the order of discipline, disobedience is an expression of obstinacy. From the standpoint of discipline, all disobedience is anarchism. Those who secretly rebel against discipline and secretly disobey have the hope of not being noticed.

The pedagogy of perfection is primarily focused on the Sublimation[1] of the personality. In perfection, there is an elevation above the ordinary and thus a rejection of the routine order of daily life.

It would be foolhardy to see perfectionist motives behind every rejection of the order. This rejection may simply express a nihilistic attitude toward any norms as externally imposed limits on individual behavior. Normativity as a sign of prohibition or punishment (commandment) can also be rejected with moral pathos – the pathos of an individualized, original, critical attitude toward the generally accepted norms of behavior that exist in mores and are spontaneously reproduced. But here, there is a special understanding of personality not only as its inimitability but also as its rebellion against orders (special understanding of inimitability). Personality is thus understood as an opposition to the ordinary, as an opportunity for creative self-realization; virtue is affirmed by the fact that it is not subject to domination but is its own domination.

It is generally recognized that a character education aimed at forming a creative personality is carried out to a greater extent by motivation than by prohibitions. The requirements of the educator are not a threat; their sanction is ideal, and they are addressed to the individual as a

[1] This word (from Latin sublimis) is understood in its direct meaning of elevation, without reference to the Freudian concept.

conscious and free subject. However, this clarification does not free the educational strategy built in this way from its restrictiveness. As soon as a certain norm is established, every rationing, even in the form of an abstractly declared ideal, thus refers to the unacceptable, that is, to the forbidden. In other words, any rationing is a limitation of specific actions by the generalized experience of such actions, in pedagogy – by the axiomatized experience of culture.

Perfectionist resistance to order is itself organized, principled, and thus already ordered. The external, repressive order is here contrasted with the internal order that spiritually elevates the individual. The concept of perfection presupposes the notion of a higher standard. Furthermore, the goals and results of the educational efforts undertaken are related to it. From this, it is clear how important the ideal is to perfectionist-oriented character education. The ideal is an important value-orienting factor in human behavior. The person of perfection devotes himself to the ideal, serves it, and through service attains self-control. By striving for the ideal, man is given the opportunity for independent, personal, creative realization – self-realization. The personality determines its way to the ideal and forces itself to it. It turns toward the ideal as if responding to the Call, which is a kind of Value reaction, but to the extent that this reaction is conscious, unyielding, and unaccountable, it is *initiating*. A perfect man may revere authority, but he is not authoritarian; his authority is internalized and revealed in the voice of conscience, in acts of conscience.

In its content and meaning, perfectionism as an imperative value system is opposed to social ethics. Overcoming the ordinary in perfection begins with resistance, perhaps not so much to the temptations of the flesh but the spontaneity and stereotyping of human social and functional interactions. However, this perfectionist resistance itself manifests itself in the awareness of spontaneity, in the rethinking of habitual life, in the rejection of life as a stream, and the rejection of meanings imposed from without. Perfectionist striving involves personally defined self-realization and self-organization. So the idea of perfection also develops as an idea of how a person organizes his or her own life. Perfectionism of any kind inevitably involves a disciplinary program.

It is clear from what has been said that discipline and perfectionist educational strategies are incompatible only from a superficial view. Discipline is a limitation. Self-perfection (self-improvement) is spiritual elevation. Improvement is understood as personal emancipation and creative self-determination with a humanistic approach. However, with a rigorist-ethical understanding of perfection, elevation also appears as self-limitation from its other possible side. Self-perfection as spiritual elevation of the goal of personal effort not only excludes discipline – external and internal (self-discipline), but also external and internal (self-restriction) limitations. So the contrast between discipline and perfectionism is relative. Perfectionism cannot be other than disciplinary (though, of course, not all disciplinary departments in education necessarily mean improvement in the sense of personal elevation).

The real hardships of the personal path to perfection are reflected in the well-known perfectionist paradox, as formulated by L.P. Karsavin: “Imperfection is the moment of perfection” [7, p. 216]. The active zeal mediates perfection for virtue and the preceding – inner – preparation for it. This preparation is expressed in one form or another of asceticism, which is the individual’s effort at self-transformation: the rejection of the imperfect self in pursuit of the better. The self-perfection of the individual thus presupposes three levels of discipline: discipline in relation to oneself, discipline in communication and interaction with others, and discipline in relation to the highest (whether an appeal to the ideal or an attempt at deification).

Thus, although discipline and perfectionism are word symbols for different pedagogical (educational) programs, they can be accurately combined in their typological description as

aspects of a particular pedagogical practice. Furthermore, they will undoubtedly be combined in the consistent implementation of a particular, namely perfectionist, educational program.

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Ruben G. Apressyan, Dr. Sc., Philosophy, Head of the Department of Ethics, Institute of Philosophy, Russian Academy of Sciences (12/1 Goncharnaya Str., Moscow, 109240, Russian Federation).
E-mail: apressyan@mail.ru

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SEMIOTIC POTENTIAL OF TEACHER EDUCATION*

Michael A. Chervonnyy

Tomsk State Pedagogical University, Tomsk, Russian Federation

Abstract. Despite the considerable number of studies dealing with the semiotic aspects of education, none show the full semiotic potential of pedagogical education. This study presents the hierarchies of sign systems and their application in the training and development of future teachers. The use of A.B. Solomonik's pyramid of sign systems to determine the semiotic potential of pedagogical education is particularly relevant. In this context, two goals of pedagogical training are considered.

The first one is to use the sign systems of the given classification to identify the contents of the subject mastered by future teachers and use them for pedagogical interaction. In this case, semiotic research is developed in three directions: the semiotics of visualization of the content of school subjects; semiotics of visualization of the teaching process based on modern possibilities of technical means of education and information and communication technologies; and semiotics of pedagogical communication (internal and external).

The second goal defines the prospects for using the presented semiotic pyramid for cultivating a general professional culture for student teachers. However, as a science, education does not have formalized first and second-order systems within the given classification. In this study, stereotypes (perceptions, images, behaviors) that determine the dynamics of a future teacher's education and development function as units of sign systems. The development of stereotypes of pedagogical culture in future teachers determines their professional and personal progress, and the emergence and dynamics of innovative solutions.

The characteristics of the four-level sign systems are given 1) Natural Sign Systems. These are elementary representations of interaction between student and teacher, reflecting life experiences made before the beginning of professional education. 2) Image Systems. These are stereotypes about the school education system held by applicants to the pedagogical universities. Stereotypes have both positive and negative characteristics. 3) Linguistic Systems. Verbal texts contain theoretical information about a particular area of professional culture and presuppose that each student acquires it individually (lecture material, traditional learning assignments, homework). A semiotic model of learning is manifested. The teacher gives a theoretical introduction to pedagogical paradigms – meta stereotypes of pedagogical perceptions and behaviors through language systems. 4) Writing systems. This level of sign systems includes written texts (documents) reflecting pedagogical systems and technologies, educational programs, and standards. A certain role in the formation of stereotypes among teachers is played at this level by the lists of competencies and professional functions defined by educational and professional standards.

A different approach to personal and professional development implies a practice-oriented educational system developed through the continuous exercise of job-related tasks. In this sense, teacher training should reflect professional activity with the broader perspectives of synergy.

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Keywords: *sign systems, training of teachers, semiotics of pedagogy, image of professional future, general professional culture of teachers, stereotype.*

Despite a considerable number of studies dealing with the semiotic side of education, the hierarchization of sign and communication systems and their application in the training of future teachers has not yet been thoroughly analyzed. The main semiotic positions of educational systems are recognizable in the approaches: semiotic, competence-oriented, integrative-differentiated, axiological [1]. Let us outline the positions corresponding to the principles of systemness, openness, and non-linearity of the educational process. The selection and justification of the three stages of education, considered an information process, makes it possible to assign an essential property (value, quantity, and quality of information) to each stage. The results of the mechanisms of these stages can be recognized as sign forms that reveal the semiotic essence of education [2, 21–22]. Learning touches all levels of semiotics and reaches its highest level as learning is mainly aimed at processing the increasing complexity of information by learners. Thus, learning is a process in which students build information structures in their minds [3, p. 9]. Semiotics helps students learn different disciplines by analyzing verbal, nonverbal, or visual languages [4, p. 14].

Semiotics of education is a relatively new branch of educational philosophy, but it has great potential to solve the contradictory relations of the educational system [1, p. 456]. According to A.B. Solomonik, the author of the concept of General Semiotics, the concept application would be useful in designing the learning process. First, the author reveals the concept by describing three practical applications of the theory, two of which are shown with examples from mathematics [5, 45–47]. Then, he distinguishes six types of sign systems based on six basic signs (taxons) [6, 76]. Finally, a taxonomy is created based on these six categories that define a hierarchical sequence of signs (Fig. 1).

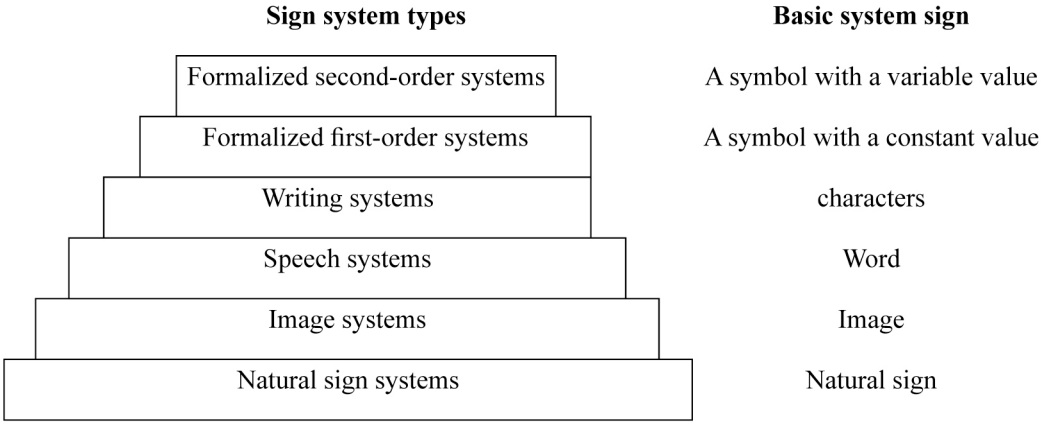

Fig. 1. The pyramid of the sign systems of A. Solomonik

The theory of the semiotic pyramid provides a complete description of the semiotic potential of pedagogical education. Let us consider two educational tasks, the solution of which is in one way or another in the works of pedagogues and philosophers in connection with the types of sign systems highlighted by A. B. Solomonik.

THE FIRST TASK is to use the sign sequence of this classification to identify and apply the content of a subject mastered by future teachers, both for study and for professional and pedagogical interaction. In general, semiotic research related to this problem is determined by *three directions: semiotics of visualization of subject content; semiotics of visualization of the*

learning process (resulting from the possibilities of using modern teaching aids and modern information and communication technologies); and *semiotics of pedagogical communication*, i.e., the study of sign information, which is the basis of pedagogical communication.

In *the first direction*, the research refers to the semiotics of visualization of subject content. Here it is appropriate to consider the application of the semiotic pyramid to the content of a particular group of academic disciplines, particularly the natural sciences and mathematics. For example, the natural sciences, which we consider to be highly theoretical, have a long tradition of using numerous visual resources and representations, such as graphs, drawings, diagrams, three-dimensional models, and more [7]. This is also true for mathematics, which is becoming more accessible with new illustrations of concepts and theorems, especially in the development of computer multimedia technology, which has dramatically expanded the possibilities of modern animation. Thus, in particular, mathematics dealing with precise graphical constructions has greatly benefited from the transition from picture-by-picture drawing to the description of the behavior of vector objects [8, 22].

Detailed semiotics of mathematics learning makes it possible to visualize mathematics learning: the construction of a visual learning environment [9, 297], the search for rational methods of question formation (within the framework of erotetic semiotics), the construction of correct answers through the language of mathematics, its syntax, semantics, and pragmatics [10, 63–64], and much more. The semiotics of physics learning is also prominent in their methods and visualized images: Mental Experiment, Physical Model, Ideal Object, Physical Analogy [11, 242–246]. In fact, it can be said that the determinations of communication and sign systems with a high level of abstraction and formalization of the first and second levels have reached the exact, informational, and natural sciences, which defines them as semiotically oriented in relation to the content of the discipline. Native language and foreign language are represented by such levels of abstraction. For this reason, the theory studied in foreign language teaching overlaps with both native language teaching and the metatheory of natural sciences. This allows for a semiotic approach to the problem of interdisciplinary connections in teaching a linguistic or non-linguistic subject, based on the logical and psychological commonality of the difficulties encountered in their study [12, 185–214].

The *second direction* is *the semiotics of visualization of the learning process*. At the modern level, the studies on the semiotics of visualization of learning processes are based on the possibilities of modern teaching aids and modern information and communication technologies. A good example of the new visualization possibilities is interactive whiteboards, interactive digital boards, and tables, widely used for educational purposes. In addition, students perceive visual material better when they study using interactive maps, drawings, and diagrams [13]. Clearly, the digitization of education, which includes online learning, digital textbooks, and digital educational environments, will significantly change the course of pedagogical education. Thus, new elements of digital didactics of education are emerging – ways of teaching that expand the visualization and sign structure of the teacher education process.

The third direction of pedagogical semiotics (related to the first task) refers to the study of sign information, which is the basis of pedagogical communication: both *external* (dialog) and *internal* (textual and visual thinking) communication.

At its core, *external communication* reflects the knowledge-semiotic component of pedagogical culture. That is, pedagogical communication occurs through the mutual translation of knowledge between the subjects of the educational process, the Lecturers, and the Education Student.

In the theory of pedagogical communication, two types of communication are distinguished: verbal and nonverbal. The first refers to speech (verbal communication, dialogs, monologs); written communication (handwriting, texting, typing); internal communication (thought formation, internal dialog). Text semiotics and its applications in pedagogy are among the basic skills of a successful individual. In particular, it involves finding pedagogical ways to introduce and justify reading in the context of a variety of subjects. [14, 368–370, 374, 377]. In fact, the semiotic approach of teaching school subjects in verbal communication between teacher and student (i.e., based on the text) is quite well developed in home education. Since the teacher's pedagogical communication with the students is essentially limited to the framework of subject teaching, we can consider it as an element for solving the first problem related to the subject matter.

The second type of external pedagogical communication – is non-verbal communication. It is a general means of communication that has an educational and motivational effect on students. Non-verbal communication includes other types of communication than verbal: body language (gestures, facial expressions, and posture); visual (visual evaluation in the first seconds of getting to know each other, determination of gender, age, evaluation of appearance, and facial expression); auditory perception (evaluation of voice – rhythm, timbre, volume, brightness, pauses, coughs, filler words), tactile communication (touch); smells (attractive, unattractive); mobility (low, high, irritating); boundaries of personal space (pleasant or unpleasant transition). In pedagogical educational institutions, nonverbal communication is considered a method of communication that provides the most important information about personality and other success in pedagogical activity [15, 28–33]. At the same time, psychological and educational studies dealing with the formation and development of visual thinking focus on the processes and patterns of nonverbal thinking, the problems of visual perception, and information transmission [9, 298].

When studying visual thinking in pedagogy, it is necessary to refer to the key works of the American psychologist Rudolf Arnheim, who coined the term Visual Thinking [16, 17]. His work laid the foundation for modern ideas reflecting the role of visual phenomena in the thinking operations of school children, illustrated by several examples of cognitive activities in the natural and social sciences. Specifically, "When students view a map not as a set of shapes but as a configuration of visual forces, the knowledge to be gained is appropriately transformed into the play of these forces in other areas of science – physics, biology, economics, and politics" [18, 217]. The nature of visual thinking is also well illustrated by Arnheim's example about the time problem of Peter and Paul [19, 81].

As for the three directions to solve the first problem with the semiotic approach to teacher education, it is important to expand the meaning of the semiotic context of teacher education beyond the subject and the related communicative aspects of the teaching profession to represent the multilevel sign systems of pedagogical education as a whole.

THE SECOND TASK The development and application of sign systems in pedagogical training are related to the application of the semiotic pyramid to systematize and cultivate the general professional culture of pedagogical students in the course of their training. Here we encounter some limitations. Pedagogy as a science does not have higher levels of semiotic formalization, i.e., formalized first and second order systems within the framework of the cited classification. At the same time, the sequential construction of only the first four sign systems of professional teacher activity requires detailed analysis for application in teacher education and investigation of the problems of semiotic influence at each level of sign systems.

To illustrate the sign systems at each level, we use the concept of stereotypes in this article because their role in forming and changing personal perceptions, images, and behaviors in the profession determines the dynamics of the future teacher's development and education.

1. **Natural sign systems.** At this level of representations, students show an elementary understanding of the interactions between a student (children, adolescents) and a supervisor (adults), between a student and a teacher. This level of conception about the pedagogical activity usually reflects the life experience that the applicant has had before starting the professional training.

2. **Image systems.** The classroom-lesson system and its characteristics. The conception of the classroom system as the school's image is typical for applicants to pedagogical universities. This system is quite solid in the initial stage of training and is reinforced in the course of learning in pedagogical training areas and specialties.

This level includes a number of image systems that represent stereotypical attitudes towards the professional activity of a teacher. Often, such ideas come from the students' worldview, supported by irrelevant data from teachers and classmates in the process of acquiring initial academic knowledge about the teaching profession.

At this point, theoretical expertise predominates perceptions about the profession based on practical experience are minimal. When there is a discrepancy between students' previous conceptions and the information they have received in the early stages of their academic and professional careers, there is an increase in their emotional background. Since much of the information received from teachers about the future profession is averaged and standardized, an opinion about the characteristics of people and phenomena is formed, which psychologists call a stereotype, namely "biased, not based on a direct assessment of the phenomenon in question, but derived from standardized judgments and expectations" [20, 188]. Students' perceptions are dominated by fixed attitudes that contain nothing more than stereotypical behavioral dispositions to respond to the situation in a certain way [21, 44–45].

According to the modern definition, a Stereotype is a persistent image or idea that is emotionally colored by prejudice or bias, i.e., a stable evaluation. Stereotypes have both positive and negative characteristics. A separate chapter in the book by I.S. Sergeev [22, 133–125] is devoted to the analysis of positive and negative aspects of stereotypes in educational work, including those based on the context of educational paradigms.

3. Language systems. Verbal texts contain theoretical information about a specific area of professional culture (lecture material, traditional learning tasks, homework). The main unit of influence in relation to students is a speech act. The semiotic teaching model of A.A. Verbitsky and M.D. Ilyasova deals with this level [23, 72, 237–238]. In the course of teaching, students are engaged in traditional academic learning activities, and existing practice conveys ideas about the standard tasks of a teacher. In this way, stereotypes for practical pedagogical activities are formed. The organization of students' activities is focused on mastering the educational information conveyed by the instructor. It is typical for a classical lecture that the lecturer uses a semiotic teaching model. Based on this situation, it can be argued that the lecturer theoretically introduces the student to different educational paradigms (humanitarian, personality-building, competency-based). Thus, at this level of the semiotic model of teacher education, a polyparadigmatic approach is implemented, which is not accompanied by the disclosure of practice-oriented actions of one or another educational paradigm as a complete metastereotype. However, this leads to the formation of stereotypes in a future educator, which is typical for the understanding of a number of educational paradigms. It should be noted that the language systems of certain areas of professional culture produce specific stereotypes while enabling them to reach the next levels of the semiotic pyramid. Teachers have individual constructions of pedagogical culture and form their own stereotypes in which behavioral stereotypes are actualized. When training a young teacher, it is important to develop the ability to change behavioral stereotypes in time.

4. Writing systems. This level of sign systems includes written texts that reflect pedagogical technologies, pedagogical systems, and educational programs and standards in general.

At this level, the lists of competencies of the educational standard and the list of general work functions defined by professional standards play an important role in constructing stereotypes in teachers.

Here, the consideration of the stereotype complex as a high-level sign system should be discussed from two aspects. The first aspect refers to the mastery of pedagogical competencies as a system of stereotypes that define pedagogical activity. The second aspect refers to the study of how the stereotype complex (both in terms of representation and behavior) can be replaced in teachers during their training and development. This may be related to changing the pedagogical paradigm of a given educational system to replacing stereotypes with more advanced ones.

Thus, the first aspect refers to the pedagogical training of students, the formation of their readiness for professional activity, which determines their readiness to solve professional problems. At this level of the sign systems used in the semiotic pyramid, the bearer of a set of stereotypes manifests the leading forms of social consciousness. In describing social stereotypes as leading forms of social consciousness, Yu. S. Chaplygina suggests ten forms social stereotypes: Gender, age, ethnic, cultural-geographical, religious, material, group, individual, occupation [24, 680]. It can be assumed that all listed forms of social stereotypes are relevant for training students in the system of higher teacher education, but we highlight the last three, which we update for this semiotic level of personal-professional development of a future teacher. Note that the first seven forms of social stereotypes relate to the value-forming component of teacher education. For the last three forms of social stereotypes, the following three objects of stereotyping are identified: 1) corporate value characteristics; 2) egocentric value characteristics; 3) metrics of competence and proficiency in professional education.

Achieving a meaningful level of stereotyping and positive effects through its application in a professional activity is possible through the extended interaction of students with professional communities. Representatives of such communities are carriers of professional values and corporate culture, and they act as valuable subjects of interpersonal communication, including informal communication. Such communication makes it possible to understand and accept the profession's values in practice and adjust the individual values of a prospective teacher.

Representatives of professional communities make it possible to actualize real professional tasks. It is important to actively involve prospective teachers in solving current professional problems with the participation of experienced teachers. In our experience, it is possible to accomplish this through various individual pedagogical practices, including voluntary practices [25, 105–106]. We consider such practices as complementary to the field practices carried out within the educational program of universities. In this sense, there is an expansion of the patterns of the practical pedagogical activity, the acquisition of pedagogical stereotypes acquired through interaction with experienced teachers. Moreover, experienced teachers help students gain experience in solving a reverse problem: overcoming one or another pedagogical stereotype. The next aspect of stereotypes in the pedagogical profession is emerging as a semiotic system of recording a teacher's pedagogical culture.

The second aspect is relevant to the training and development of prospective teachers and determines their willingness to change the stereotypes of pedagogical culture and behavior. It is essential for achieving sustainable learning outcomes in students, it is a prerequisite for replacing outdated stereotypes with new ones in the transition from one educational paradigm to another, it is a factor that marks the educational system as innovative. Y.A. Sorokin defines a stereotype as a certain process and result of communication (behavior) in accordance with a certain linguistic

(semiotic) model, which is implemented as a system of Correct communication at the social, socio-psychological level (standard) or at the linguistic, socio-psychological level (norm) [26, 11]. The existence of standard and norm is defined in two ways – as a stamp and as a cliché. A stamp is understood as a redundantly explicated (explained) complex sign, and a cliché is an insufficiently explicated complex sign. The analysis of the scientific literature allowed us to identify the main points that form the theory of stereotypes in pedagogy [27]. In particular, the role of currently existing stereotypes in the formation of distant goals is determined. At the same time, the prevailing stereotypes remain those that were laid in the process of training and education. In this sense, the creation of new stereotypes of pedagogical culture is a promising way to shape a person's professional path. This is by no means a trivial task. Even Pitirim Sorokin, without applying the concept of behavioral stereotype, described the problem of changing behavioral patterns in sociocultural groups, noting that "a momentary, simultaneous, and identical change in the behavioral patterns of all group members ... is almost impossible" [28, 34].

It was logical to conclude the consideration of this level with a set of stereotypes related to pedagogical skills and functions, but this is clearly insufficient for the training of future teachers. The emergence of somewhat different sign structures is determined by the following: the self-determination of the student in professional training, the structure of individual psychological qualities, the acquisition of an individual pedagogical experience that forms qualities significant for professional activity. We believe that this leads to the formation of a special semiotic component in the personality of the subject of the educational process at this level. In determining the personality structure of students, researchers endow them with integrative properties and regulators that ensure the interaction of the internal substructure (norms, values, personal ideas about the profession) with the external substructure (forms of behavior – communicative, active, reflexive) [29, 190]. Under the same aspect of personality formation of future teachers, but in the context of their readiness for social pedagogical activity, the static substructure (cognitive-operational, value-motivational, emotional-volitional components) and the dynamic substructure (readiness for continuous education and professional improvement, social and professional mobility, orientation towards personal self-development) are identified [30, 111]. Static and dynamic personality substructures and their interaction also lead to integrative education, which is essentially semiotic in nature.

E.M. Kharlanova's integrative concept of social educator training, both in terms of social activity and professional readiness, establishes an important semiotic construct of a student's personality – "a picture of the desired professional future and plans for its realization, which represent the subject's inner program" [31, 113]. The manifestation of the Semiotic Construct in the personality of future teachers in the form of the "image of the desired professional future" allows us to assert the completeness of the teacher education process, subject to the manifestation of the stereotyped system of competencies and coordinated professional functions, based on the specific basic educational programs of teacher education at the university. Based on these considerations, we consider the fourth level of the semiotic pyramid as complete, considering that the conditional schema of the "image of the desired professional future" acts as the hieroglyph of this level, i.e., it is the basic sign of the semiotic systems of this level of teacher education.

Thus, the semiotic context of higher pedagogical education allows presenting a system of formation of pedagogical stereotypes and providing a mechanism for their replacement. At the same time, this system's organizational and pedagogical conditions are as follows: Availability of professional communities, the possibility to choose the individual practice-oriented path of the pedagogical activity, and activities within the presented levels of sign systems of pedagogical education. Please note that the first four levels of the presented semiotic systems of teacher

education (in the logic of the six-part classification of A.B. Solomonik) are limited and presented only from the point of view of the role of stereotypes in the education of future teachers. The last two levels of the semiotic pyramid in relation to teacher education, which could be represented as first and second-order formalized systems, are beyond the scope of this study.

One can also conclude that during teachers' personal-professional self-determination and personal development, certain semiotic models of learning are necessary, and their subsystems are complexes of stereotypes that seem to determine the invariance and linearity of unfolding teacher education. However, already in problem teaching (lecture or seminar discussion), the professional and social contexts of future professional activity are outlined and the actions of professionals discussing theoretical, inherently contradictory questions and problems are modeled. Moving from model actions to real actions, one can argue about the increasing role of nonlinear processes in teacher education. This is usually done in the context of a comprehensive pedagogical practice characterized by the performance of non-standard tasks. In other words, considering pedagogical training as a complex system that enables the application of a synergistic apparatus and appropriate semiotic models to the formation of the personality of future teachers is an important research direction. Thus, we consider pedagogical education as an open system aimed at the personal and professional development of future teachers through a continuous solution of professionally oriented tasks. In this sense, teacher education should also reflect the intended personality of students' professional activity from the point of view of synergy.

A synergy of the educational process is a unifying interaction of personal and self-developing factors [32]. As an inherent element of self-organization and development of future teachers, the synergy effect manifests itself in the solution of increasingly complicated pedagogical, quasi-professional, and professional tasks. The most important aspect of solving complex tasks is the creation of a transition hierarchy from basic activity to higher level teaching activity structures. Such an approach is realized in higher education through contextual (sign-contextual) learning [33] by applying semiotic, simulative, and social learning models [23, 72, 231] and constructing a hierarchy of visual models and processes in the disciplines under study [34, 147–148]. Considering the above and our experience of giving students a variety of pedagogical examples, we can assume that the acquisition of professional skills requires the personal experience of solving tasks in the semiotic context of pedagogical education. Updating of professional tasks for students' professional examples is carried out by subjects of different educational systems (general, additional, higher education). The highest level is considered to be the mastering of the stereotypes of the competencies of the educational standard, which form the image of the desired professional future. Therefore, the perspectives of teachers' abilities, including their manifestation in innovative pedagogical activity, should be determined by their ability to change pedagogical stereotypes. The consequence of giving a semiotic context to the process of pedagogical education is reflected in the fact that "... all stages of the information process... whose nature is determined by channels of communication that distribute the roles of educational subjects; the semiotic nature of education determines the sequence of these stages from dogmatics to creativity" [2, 22].

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Michael A. Chervonnyy, Doctor of Education, Professor, Department of Physics and Methods of Teaching Physics, Faculty of Physics and Mathematics; Senior Researcher of the Research Laboratory for the Quality of Scientific and Pedagogical Studies. Tomsk State Pedagogical University
(ul. Kievskaya 60, Tomsk, Russian Federation, 634041).
E-mail: mach@tspu.edu.ru

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CLUSTER-BASED TRANSFORMATION OF REGIONAL EDUCATION*

***Y.V. Kalinyuk*[1], *L.G. Smyshlyaeva*[2], *D.M. Matveev*[3]**

[1] *Department of Vocational Education of Tomsk region, Tomsk, Russian Federation*
[2] *Tomsk State Pedagogical University, Tomsk, Russian Federation*
[3] *Tomsk College of Economics and Industry, Tomsk, Russian Federation*

Abstract. The article deals with the development trends of the modern Russian system of secondary vocational education (SVE). The current state of SVE in the Tomsk region is described. Regional peculiarities and strategic goals of transformation of SVE in the context of socioeconomic development of the region are presented. A theoretical rationale for the cluster approach to the development of the SVE system is provided. The need for productivity changes in the regional SVE system using the cluster approach is demonstrated. A project for updating the SVE infrastructure in the Tomsk region, reflecting the principles and mechanisms of cluster policy, is proposed. The basic characteristics of two clusters – educational clusters and educational-industrial clusters – are presented. Scientifically justified hypotheses about the regularities and the effective functioning of these clusters are formulated. Cluster-driven organizational and pedagogical methods of integrating SVE practices and continuous professional development of the current personnel of the real economic sector are pointed out. Methods, management tools, and conditions for successful integration are mentioned. Conditions for the realization of pedagogical interaction between subjects participating in industrial cluster communities are presented. The existing practical experience of the Tomsk region with clusters in SVE transformation is summarized. Socioeconomic and pedagogical prospects of interaction between clusters and networks in SVE for solving urgent and future tasks at the regional level are predicted. The materials of the article are based on the results of educational design and research methods of theoretical analysis, survey, and expert method.

Keywords: *socioeconomic development of the region, secondary vocational education, cluster approach, cluster policy, cluster-network interaction, education-industry cluster.*

The modern phase of educational development in Russia is associated with a number of serious challenges in the modern world. These include uncertainty, diversity, a new economy, and new labor markets [1]. All these challenges reflect the problem of transition to another technological era. This new era is characterized by the digitalization of all aspects of life, artificial intelligence, and a complete cultural transformation of society. These social development trends can be identified as universal modern characteristics of all economies in the world.

The main changes associated with the transformation of the economy and social structure in Russia are set out in the Presidential Decree "On the National Development Goals of the Russian Federation for the period up to 2030" dated 21.07.2020 № 474. This decree sets out the following national development goals of the Russian Federation (hereinafter referred to as national goals) for the period up to 2030:

- Maintaining the population, health, and well-being of people.
- Opportunities for self-realization and talent development.

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- A comfortable and safe living environment.
- Efficient work and successful entrepreneurship.
- Digital transformation [2].

Vocational education is an important tool to solve the above problems of the national development of Russia. Today, the main task of the vocational education system is to ensure the quality of education of graduates according to the requirements of the market. These requirements are determined by professional standards, the needs of the regional economy, and the requirements of industrial partners. The success of training competitive specialists of a new type depends on many factors. One of these factors is the interaction of industry partners and vocational training institutions (VTI), taking into account the specifics of the region.

If we consider this task from the perspective of scientific pedagogy, it becomes clear that it is necessary to determine the conceptual foundations and appropriate theoretical approaches for the effectiveness of such interaction.

The analysis of the literature and expert opinions that we have conducted in connection with the above problem has shown that the cluster approach can be an effective solution to this problem [3–10].

In 1990, M. Porter defined Cluster as a group of geographically adjacent, interconnected companies and related organizations in a certain area, characterized by a common activity [4]. The essence of this concept did not change significantly when it was analyzed in the works of other researchers (A.P. Gavrilova, V.T. Volov, N.B. Nagrudnaya, L.S. Markov, N.S. Rychikhina, A.P. Sokolov). The analysis of these interpretations allows us to distinguish a number of the most common characteristics of a cluster as a system, namely: geographical concentration; specialization; competition and cooperation; cluster-oriented projects; costs in relation to the expected effect from the implementation of these projects; competitive advantages in the area where the cluster is located [5, 6].

As a form of cooperation, the cluster reflects the principles and mechanisms of the law of the triple helix: “business, science, government” (G. Etzkowitz). Moreover, each of these elements involved in the cluster provides certain advantages (strategic, financial, technological, reputational, personnel) [11].

As experts note, cluster systems are characterized by high stability, efficiency, and effectiveness in relation to the common and specific goals of the participants of the cluster cooperation. However, clusters can easily change as needed to adapt to changing conditions, being a manageable structure. Another important characteristic of clusters is that they rely primarily on internal resources. The analysis of global trends in socioeconomic development shows that the formation of clusters has become an important part of public policy in the field of regional development in many countries of the world since the beginning of the 21st century.

The term Cluster has become popular in the field of vocational education. It has begun to complement pedagogical science and serves as a prerequisite for the creation of new models for realizing the socioeconomic potential of various vocational education practices.

Meanwhile, in Russian scientific and pedagogical literature, there are many definitions of the concept of Educational Clusters (S.V. Krivykh, N.S. Rychikhina, E.R. Skoryakova, N.D. Frolova, G.R. Khamidullina).

Thus, E.R. Skornyakova considers that an Educational Cluster (hereinafter EC) is a flexible network structure that includes groups of interconnected objects (educational institutions, public and political organizations, scientific schools, universities, and research organizations) united by innovative educational activities to solve certain problems and achieve a certain result (product) [9]. We agree with this definition when we understand the essence of the term Educational Cluster.

We consider that the educational institutions located in the region (general education, secondary vocational education, and higher education, depending on the specifics of EC) are the system-building elements of the educational cluster. In addition, other organizations and institutions relevant to all cluster participants are part of the cluster cooperation.

The relevance of the cluster approach in the development of educational systems is determined primarily by the advantages of this format in achieving synergistic effects in various educational outcomes. It should be emphasized that a common goal is a central point in educational clusters. The common goal guides the participants in the interaction to choose the content, communication, and technology aspects of the cluster interaction to achieve the outcomes.

According to many experts, the clustering of educational areas is an essential factor in solving the problems of modernization of education, the transformation of its content, and organizational-technological formats.

It is important to note that the cluster approach in education promotes synergistic processes (combination of goals, resources, and efforts). These processes act as an effective mechanism for creating conditions (environments, spaces, events) to develop human capital, human well-being, and maximum self-realization. Russian academic A.G. Asmolov rightly calls the development of human potential the highest priority in pedagogical practice, using the metaphor of Anthropological Change (ACh) in education [12–16].

It is vital to outline the goals, characteristics, and mechanisms of implementing the cluster approach at the regional level. In the following, we will explain the reasons and results (regional practical experience) of planning such changes in the example of the Tomsk region.

According to many experts, the clustering of educational areas is an important factor in the priorities for socioeconomic development of the Tomsk region are as follows:

- New technologies
- Human capital
- Investment and business development
- Effective territorial policy
- Effective management [17]

The economy of the Tomsk region is characterized by the following features: well-established production facilities associated with large investment projects of national significance; a special economic zone for the development of high-tech enterprises; a large number of small and medium-sized enterprises; a strong scientific and educational complex for scientific research and its commercialization for implementation in production.

The modern tasks of transforming the SVE system in the Tomsk region in the framework of the region›s socioeconomic development priorities are associated with creating new organizational and educational mechanisms for training qualified personnel to meet the requirements of the digital economy and high-tech industries. Let us outline the list of these tasks.

1. The redesign of the VTI infrastructure based on the economic clustering and strategic priorities of regional development.

2. Creating effective management mechanisms for implementing the federal Young Professionals project at the regional level.

3. Ensuring conditions for implementing the federal project Digital Educational Environment at the regional level.

4. Creating a regional model for the development of the human resources capacity of the VTI system, aimed at the constant and timely updating of the competencies of management and pedagogical staff in accordance with modern challenges.

5. The introduction of integration-oriented mechanisms for socialization, self-realization, and professional development of students in the region.

In the Tomsk region, strategic planning of secondary vocational education development (from 2017 to 2019) took place with the participation of heads of vocational education institutions of the region and representatives of executive authorities and industrial partners. The cluster approach was chosen as the conceptual basis for change management in this segment of the regional education system, focusing on the possibility of its integration with network and competency-based approaches. These approaches are relevant to solving the problems of regional education system functioning aimed at innovative development [17, 18].

Educational clusters and educational-industrial clusters were defined as basic working concepts for shaping changes in the SVE system of the Tomsk region based on cluster policy.

An *educational cluster* is an association of several VTI institutions providing education in the region for a specific area (cluster). An education cluster may also include general education organizations, continuing education institutions, and non-formal education practices (e.g., non-formal professional communities).

An *educational-industrial cluster* (hereinafter EIC) in the Tomsk region is a systemic association of various subjects (educational organizations, executive and legislative authorities, local self-government bodies, enterprises), which makes it possible to take advantage of interaction within the cluster to modernize educational organizations and increase the competitive potential of the local economy.

The driving factor for the creation of an EIC is the training of VTI graduates for a specific job with clearly defined technological characteristics.

The goals of the educational-industrial cluster are:

– Increase the level of competitiveness of the Tomsk region through the modernization of secondary vocational education.

– Improve the quality of vocational education by focusing on practice – based on the integration of SVE and production.

The objectives of the educational-industrial cluster are:

– To pool the resources of vocational education institutions, various enterprises, public associations, and executive and legislative bodies to develop the SVE system of the Tomsk region.

– Identifying and developing public-private partnership mechanisms for educational institutions and businesses.

– Monitor and forecast labor market needs in the Tomsk region in terms of quantity and quality of labor force.

– Increasing the attractiveness of SVE institutions for graduates of educational institutions of the Tomsk region.

– Development and strengthening of the material and technical base of secondary vocational education in the region.

Productive coherence of the cluster is ensured by networking both within the EIC and at the level of cooperation of different orientations. This is an organizational and activity mechanism that enables the simultaneous participation of several organizations in achieving any goals through the consolidation of resources [7, 10, 18, 19, etc.].

In the context of developing regional SVE practices by using the principles of cluster and network approaches in their integration, we believe the following opportunities are significant in the context of leveraging the resources of cluster network participants:

● Clear alignment between the needs of industry partners and EIC educational programs (alignment of professional work with training of specialists for this work, training of readiness to perform work functions according to the technological specificity of a particular production).

● Continuous immersion of students in a real professional environment representing different areas of their future professional activity.

● Increasing the number of technological platforms for practical training of SVE students.

● Ensure continuous professional development of staff in vocational education/additional vocational education.

● Promote individual professional development pathways for SVE students.

● Provide ongoing professional development for SVE teachers based on practice-oriented principles.

● Update and expand the forms and methods of professional and pedagogical support.

These factors determine qualitatively new features of the value and the substantive, organizational and active aspects of SVE in the region, which can be called its transformation.

When elaborating the region's new SVE project in accordance with the cluster policy, experts considered it useful to create nine secondary vocational education institutions.

By September 2021, the following educational-industrial clusters were organized in the Tomsk region: Agribusiness Cluster (leading VTI – Tomsk Agricultural College), Health Cluster (leading VTI – Tomsk Basic Medical College), Information Technology Cluster (leading VTI – Tomsk Information Technology College), Education and Culture Cluster (leading VTI – Tomsk State Pedagogical College), Services Cluster (leading VTI – College of Industry and Food, Trade and Services), Transportation Cluster (leading VTI – Tomsk College of Civil Transportation), Wood Industry Cluster (leading VTI – Asino College of Industry and Services), Industry Cluster (leading VTI – Tomsk College of Business and Industry), Construction Cluster (leading VTI – Tomsk College of Community and Construction). Such clustering of the SVE system of the Tomsk region is suggested by a detailed analysis of the region's economic geography (20 municipalities – 4 town districts and 16 municipal districts; 7 economic clusters).

The education-industry cluster, uniting the interests of various subjects in the innovation chain – academia-collaboration-industry, makes it possible to use the advantages of interaction within the cluster to develop educational organizations and increase the competitiveness of the Tomsk region economy. Each EIC includes representatives of industrial enterprises and employers' associations, governmental and administrative authorities, and public organizations. Coordination and expert councils are formed from the representatives of each cluster.

The EIC Coordination Council is a permanent governing body uniting the EIC participants – representatives of the executive and legislative branches, heads of the VTI, and representatives of Tomsk region enterprises. The EIC Coordination Council is established to define the strategic policy of cluster development on the territory of the Tomsk region.

The EIC Expert Council is a public expert advisory body in the structure of cluster association management. Firstly, the presence of the Expert Council in the management of the regional EIC network provides an opportunity to objectively assess the effectiveness of EIC activities as a whole and the quality of processes and results of individual cluster subjects. Secondly, with the help of the Expert Council, the necessary adjustments in the activities of the EIC subjects can be made in time.

It is useful to outline another essential aspect of projecting changes in the regional SVE system based on the cluster approach. It is about improving the competencies of the region's VTI managers and teaching staff in connection with the effective solution of the functional tasks of the VTI in the cluster policy of the region, the tasks of vocational-educational interaction [20, 21].

As part of such regional practice, the continuing education program "*SVE as a Resource for Regional Human Capital Development: Cluster Policy*" (72 hours) was developed and implemented in the 2021/2022 academic year.

The program demonstrates the relationship between the activities of the region's SVE organizations and the development of their human potential and capital, as well as an understanding of the socioeconomic impact of cluster policies in SVE and how to achieve it. The program unfolds conceptual-theoretical foundations and organizational-methodological mechanisms of human capital development in the context of the region's socioeconomic development priorities based on the principles of the cluster approach.

This training program aims to develop the following professional competencies in SVE specialists: "Ability to perform effective (pedagogical) management activities in organizational formats of educational and industry clusters of regional SVE systems, including network scenarios."

The program includes the following modules:

1). Human potential development as a task of secondary vocational education. Human potential and human capital in the region.

2). Human capital as a priority of the socioeconomic development of a region.

3). Cluster policy in the SVE of the region: principles and ways of implementation. Socioeconomic impact of cluster policy in the SVE.

4). Using the cluster approach to design the vocational education system changes at the regional level.

5). Designing a new SVE system based on cluster policy: a case study.

6). Cluster network scenarios for the development of SVE practices in the region.

7). Organizational/educational activities in education and education-industry clusters: competency training.

As a final certification process in this educational program, students are expected to present an individual case representing the forms, ways, and means of professional involvement in EIC practices that are professionally aligned for their educational organizations.

This educational program, as mentioned above, is intended for the management and teaching staff of the SVE system in the region.

This program is organized at Tomsk State Pedagogical University for the specialists of all VTI (pilot practice) in the Tomsk region. One of our further research tasks is to analyze the impact of this educational program on the effectiveness of VTI leaders and teachers in the region. This observation will be guided by the principles of cluster policy in the regional SVE system to make the necessary adjustments in this emerging professional practice and its further application.

The implementation of this educational program and a series of seminars for professionals of vocational training institutions in the region on different aspects of the transformation of SVE based on the cluster approach is also seen as a way to transform this educational field in the context discussed.

Conclusion

Thus, a number of conclusions can be drawn, such as:

● The cluster approach to the development of the SVE system in the region is an effective way to realize the socioeconomic potential of vocational education. It ensures the match between the needs of the real economic sector and the content-technological content of the VTI education programs.

● Applying the cluster approach in the context of SVE transformation provides a value-based focus on human capital development.

● The education-industry cluster is a productive way to realize the interaction between industrial enterprises and vocational training institutions in the context of regional labor markets and human capital development in the region.

● An important prerequisite for achieving the goals of cluster interaction between SVEs and the region's industrial complex is the professional development of VTI management and teaching staff in terms of their ability to work effectively in cluster practices.

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Kalinyuk Y.V., Department of Vocational Education of Tomsk region (Frunze, 14, Tomsk, Russia, 634029).
E-mail: kalinuk@dpo.tomsk.gov.ru

Smyslyaeva L.G., Doctor of Pedagogical Sciences, Associate Professor. Tomsk State Pedagogical University (Kievskaya str., 60, Tomsk, Russia, 634061).
E-mail: laris.s@mail.ru

Matveev D.M., Candidate of Historical Sciences, Associate Professor. Tomsk College of Economics and Industry (Irkutsky Trakt str., 175, Tomsk, Russia, 634040).
E-mail: director@tept.edu.ru

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PRESCHOOL EDUCATION IN RUSSIA AND MONGOLIA (ANALYTICAL ASPECT OF THE MODERN STATE)*

***Galiya K. Vakhitova*[1], *Eduard P. Leontyev*[1, 2], *Ajrakhgui Batsuuri*[3]**

[1] *Tomsk State Pedagogical University, Tomsk, Russian Federation*
[2] *International Center of Education "Interdom" named after E.D. Stasova, Ivanovo, Russian Federation*
[3] *School-laboratory "Merged"Uvurkhangai aimag, Mongolia*

Abstract. The state of modern preschool education in Russia and Mongolia is discussed in this paper. It is pointed out that preschool education is an integral and full-fledged part of the state general education system in both countries. This paper notes that preschool education aims not only to prepare five- to six-year-old children for school education but also, more importantly, to develop a healthy personality and self-esteem in preschool children. It is concluded that the system of preschool education in Mongolia is still at a developing stage, while Russia has enough experience to expand and enrich the education system as a whole.

Keywords: *preschool childhood, preschool education, school preparation, preschool institutions of Mongolia, Russian education system, education through playing and gaming.*

The problem of preschool education is pertinent not only in Russia. In a number of countries (England, Cuba, the United States, and others), since the middle of the 20th century, preschool education has received considerable attention not only from scientists and teachers but also from the general public. It is not only problems related to the organization of preschool education that are discussed. The question of who and how children should be prepared for school or later life is being raised in a broader context. The very idea of the term "preschool education" is controversial.

In Russia, the definition of preschool education is set out in the Concept of the Federal Target Program for Educational Development 2006–2010. Preschool education is located at the state level and is defined as "an educational system for children of upper preschool age, ensuring equal starting opportunities for learning in elementary school" [1]. It is important to note that preschool education was originally based on humanistic principles. It focused on children's spiritual and moral development, improving individual abilities rather than excessive intellectualization and sharpening of cognitive skills. These priorities imply the need for effective integration of preschool children into the community of older children, including (and this is very important) successful communication with adults (teachers, parents) and peers. In addition, it is important to note the main tasks of preschool education in the context of school preparation: the formation and regulation of meaningful behavioral responses; the formation of complex skills and habits of language and thinking activity (abstraction, analysis, generalization, comparison); the development of effective communication skills in all types of activities; the formation and

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optimization of children's cognitive and creative needs; the physical development and maintenance of children's health. Most researchers agree that the essential task of preschool education is to ensure the successful socialization and positive cognitive and communication development of children.

Leading scientists in this field (O.V. Almazova, A.G. Asmolov, T.I. Babaeva, M.M. Bezrukikh, N.F. Vinogradova, A.G. Gogoberidze, O.A. Karabanova) believe that preschool education should become a stage that allows a smooth transition from preschool age (5–6 years) to elementary school age (6–7 years). Preschool children differ from younger pupils in a number of specific psychological characteristics. They are characterized by particular referents in motivational-intellectual, and regulatory domains. So, based on the research of Tomsk scientists, especially the work of G. H. Vahitova, we can say that preschool education in the framework of the preparation for school is a unique pedagogical process in which teachers and children interact as subjects of activity. Such pedagogical process leads to assertive changes in preschool children's needs and processes of thinking and acting [2]. As practice shows, these activities provide an opportunity to prepare children for elementary school psychologically and thus solve the problem of successful adaptation in the first year of school.

Given the important role that the preschool age plays in the formation of personality, it is necessary to use only those educational technologies that are effective and adapted to the age of children. In this sense, play techniques and play itself remain fundamental to any activity with children [3].

Today, an essential issue in the organization of preschool education is the diversity of programs, technologies, methods, and forms of education that meet the requirements of the Federal Education Standards. Regardless of the type of preschool educational institution, the educational process includes cooperation between adults and children, as well as children's independence in play and pedagogical-cognitive activities. At the same time, the central role should be assigned to the joint (partnership) activity of children and adults. Education and organization of the learning environment should correspond to the age specifics of children's development. Most parents (legal representatives) and teachers consider preschool education as an opportunity for the holistic intellectual development of the child. This is the so-called "school type" of education: development of arithmetic, writing, and reading skills; learning a foreign language; following the instructions of an adult (a teacher or parent); self-mastery of disciplines, independent performance of a task, i.e., it is an earlier mastery of the first-grade school program. This, in turn, negatively affects preschool children's immediate, personal and physical development. It is believed that preschool children "do not have the opportunity to develop according to their needs and abilities when exposed to an educational load that is not appropriate for their age" [4]. This is confirmed by years of research by G. H. Vakhitova: "Today, there is a general trend among teachers and parents to increase and expand the criteria for preparing children for school education. There is an overabundance of information in preschool programs" [5, pp. 9–10]. Despite the existing problems, modern preschool education in Russia, meeting the requirements of the Federal Education Standard, is focused on variability and the use of alternative programs, forms, and methods. This situation of preschool education is overall beneficial for all parties involved (teachers, parents, and most importantly, children). They have the opportunity to choose the right and urgent ways of development.

Having outlined the current state of preschool education in Russia, let us now turn to Mongolia's problems and prospects for development. We should note that in Mongolia, as in Russia, the issues of preschool education are becoming increasingly urgent in connection with the process of modernization of the whole educational system. The development of preschool

education in Mongolia is taking place in several stages: in 1991, compulsory education was abolished in Mongolia, which led to a deterioration in the quality of primary education. In 2001, the 12 years program was introduced, and at the end of 2010, state education standards were introduced throughout Mongolia. Since 2011, the so-called intensification of education reform (i.e., the introduction of a completely new major education program) began to take effect in all educational organizations nationwide, and this process is still in its current phase. In connection with the transition to 12-year education, six-year-old children enter elementary school, where education lasts five years, because "early enrollment of children is the basis for the successful acquisition of academic disciplines and general development." [6, p. 511]. Given this situation, the Ministry of Education and Science of Mongolia has prepared various projects and programs to rethink the conditions for enrolling preschool children in elementary school.

Despite the radical changes in preschool education in Mongolia, especially in the management of preschool educational institutions, these changes "have not touched the problems of the content, methods, and organization of the educational process" [7, p. 104]. This lies in the fact that funding for the modernization of Mongolia's education system was provided by a group of interested governmental organizations from the United States, Europe, Asia, and international associations such as the IMF and the World Bank, up to UNICEF. However, these various innovative programs and projects were not coordinated with each other, either in content or in the form of implementation, which led to a number of contradictions. As a result, in preschool education in Mongolia, "different variants of education programs adapted to Mongolian conditions were created" [8, p. 165]. Thus, the education system in Mongolia consists of a compulsory and a non-compulsory subsystem, and preschool education is the main basis for compulsory education. Kindergarten is the main institution for preschool education. It is responsible for the care and development of preschool children aged 2 to 6 years, conducts teaching and educational activities, and provides childcare.

The Ministry of Education of Mongolia pays special attention to the state of preschool education, which naturally attracts the interest of scientists who study issues related to preparing children for school. In the last ten years, according to the Scientific Electronic Library eLIBRARY. RU, fourteen publications have appeared on issues and problems of preschool education, including publications in Mongolia (Table 1).

2. In addition to the state system of preschool education (kindergarten), alternative forms are also developing. These include Kindergarten Yurts, care, and education centers, Visiting Teachers, and distance learning. These include preschool programs in Mongolia that correlate with the forms of Mobile Teachers (traveling teachers); Visiting Teachers; Mobile Ger-kindergartens, and Shift Classes [10, p. 14].

According to the Law on Child Care Services of the Government of Mongolia (2015), the organizational forms of preschool education (especially preschool education) are represented by services labeled "1–7". We want to clarify that "1–7" is the form of preschool education based on the age of children, the purpose of the service, the professional status of teachers, and the affiliation with the relevant ministry. Based on the data presented by researchers Jamsrandorjiin Batdelger and Cedengijn Erdenechimeg, it can be argued that these modern alternative forms of preschool education provide a qualitatively new approach to the development and preparation of Mongolian children for school. These forms include the Kindergarten Yurt and Visiting Teachers [11, pp. 19–20], largely because "the learning process in kindergartens is monotonous and largely reduced to Teacher-Centered and Subject-Centered learning. Such conditions limit children's choices and restrict support and encouragement based on their own needs and requirements" [12, p. 31].

Table 1

Research on preschool education and school preparation in Mongolia

Year	Authors	Title	Impressum
2010	Bezborodova L.A. Enkhzhargal G.	Trends in the development of primary education in Mongolia	Teacher XXI century. 2010. № 3-1. pp. 96–99
2013	Popova L. D.	The peculiarities of supplementary education in preschool institutions of Mongolia	Scientific Notes of Zabaikalsky State University. 2013. № 5 (52). pp. 12–18
2014	Bariushanov N.	Professional competence of teachers in creating an innovative educational environment in the elementary grades in schools in Mongolia	Teacher XXI century. 2014. № 4-1. pp. 187–191
2015	Popova L.D.	Regulatory aspect of the organization of additional education of children in preschool educational institutions of Russia and Mongolia	Preschool education in today's changing world: theory and practice: III International. Scientific-practical conference: a collection of articles, Chita, November 27, 2014. Edited by A.I. Ulzytueva. Chita: Zabaykalskyi gos. un, 2015. pp. 130–134
	Delgersaikhan Ts.	Preschool and primary education in Mongolia: current status and prospects	Actual problems of primary general education: theory and practice. International, scientific and practical conf. Ed. by I.A. Shkabur. A. Shkabur. Chita: Zabaykalsky State University, 2015. pp. 28–34
2015	Delgersaikhan Ts.	On some questions regarding the sequence of training programs on social sciences of preschool and primary general education	Actual problems of primary general education: theory and practice. International, scientific and practical conf. Ed. by I.A. Shbura. A. Shkabur. Chita: Zabaykalsky State University, 2015. pp. 128–133
	Javzandulam Batsaikhan	Play-based curriculum in early childhood education in Mongolia	Eurasian Paradigm of Russia: Values, Ideas, Practice: Mat. of the international scientific conference devoted to the 20th anniversary of Buryat State University. Scientific ed. V. Bashkeeva, M.V. Badmaeva. Ulan-Ude: Buryat. State University, 2015. pp. 172–175
2016	Batdelger J., Erdenchimeg C.	Further tasks and services for pre-primary education in Mongolia in modern market conditions	Preschool Education in the Modern Changing World: Theory and Practice: IV International Scientific-Practical Conference: collected articles. Transbaikal State University; ed. by A. I. Ulzytueva. Chita: ZabGU, 2016. pp. 17–23
	Bayarjargal B.	To the question of assessing preschool education in Mongolia	Preschool Education in the Modern Changing World: Theory and Practice: IV International Scientific-Practical Conference: collected articles. Transbaikal State University; ed. by A.I. Ulzytueva. Chita: ZabGU, 2016. pp. 24–28
	Gereltuyaa T., Menhtuul Z.	The analysis of curricula of the higher educational institutions of Mongolia training tutors of preschool educational institutions	Preschool Education in the Modern Changing World: Theory and Practice: IV International Scientific-Practical Conference: collected articles. Transbaikal State University; ed. by A.I. Ulzytueva. Chita: ZabGU, 2016. pp. 65–69
2017	Bariushanov Nomin	comparative analysis of primary school main educational programs in Russia and Mongolia	Secondary vocational education. 2017. № 8. pp. 18–20
	Tatiana Budaeva, Sergey Namsaraev	On the peculiarities of the preschool and general education of Mongolia	Baltic humanities journal. 2017. T. 6. № 4 (21). pp. 266–268

End of Table 1

Year	Authors	Title	Impressum
2020	Tserennadmid Shagdarsuren Tserennadmid Shagdarsuren, Ariunbold Adiya Ariunbold Adiya	Analysis of the result of the integrated steam approach in preschool education in Mongolia	Preschool education in the modern changing world: theory and practice: Mat. VI Intern. nauch.-prakt. conf. In 2 p., Chita, November 27–26, 2020. Chita: Zabaikalye State University, 2020. pp. 227–231
2021	Galiya Vakhitova, Eduard Leontyev, Azhrakhguy Batsuuri	The current state of preschool education in Russia and Mongolia	Scientific and Pedagogical Review. 2021. № 3 (37). pp. 162–171

By analyzing the main aspects of scientific publications, it is possible to identify trends that determine the development vector of Mongolian preschool education:

1. Preschool institutions are designed to provide education based on the main national principle of "Traditional Mongolian Education." When children acquire knowledge and form their character through certain activities" [9], this principle is logical and consistent with the goal of the Mongolian national education program, which aims to introduce children to the national way of life at an early age (animal husbandry, nomadic household management, folk tanning, sewing).

3. In the last decade, the child-centered approach (CCA) has been introduced in almost all Mongolian preschool institutions. The main goal of this approach is to promote the development of children's future skills in a globalized world where traditional education is transforming into alternative education. Traditional learning refers to knowledge or content-based and structured practices that have prevailed since the socialist era. On the other hand, the new child-centered approach promotes children's initiative, self-esteem, independence, and creative thinking [13, p. 63]. This approach was formalized by the Mongolian state national program "The Right Mongolian Child" (2012–2016).

4. Since 2017, after the adoption of the decree "Education Policy (2014–2024)", the main objectives of the new concept of the Mongolian education system, "Development of every child," were defined. The new concept served as a basic normative document for developing and implementing a new basic program called the Core Program of Preschool Education in Mongolia. This program aims to develop every child, regardless of the place of residence (city – village – settlement), create a favorable educational environment for the development of children's individual abilities, and promote their independence [14, p. 160]. Let us emphasize the importance of the method of child-friendly assessment included in this program. It is an assessment criterion for the dynamics of children's physical development, mastery of language, and thinking; from our point of view, important criteria consistent with the age characteristics of preschool children, creative abilities (the ability to dance, sing, play musical instruments, draw).

Overall, a content analysis of preschool education in Mongolia revealed several characteristics or semantic constructs:

1. A qualitative reform of education in Mongolia (especially preschool education): the emergence of a new ideology of education and learning;

2. The incompleteness of the legal framework for preschool education in Mongolia. This affects the coordination of actors to improve the quality and accessibility of services to all segments of the population;

3. The peculiarities of the organization of additional education in preschool institutions, including the development of alternative forms of preschool education;

4. The attempt to implement various concepts, technologies, and programs at the state level to ensure the transition from traditional forms to playful forms in the field of preschool education (State National Program of Mongolia "Right Mongolian Child" (2012–2016), the Normative Law of the Mongolian Government "Education Policy (2014–2024)", the Law on Provision of Services in the Field of Preschool Education (2014–2024), Mongolian Government Law "On Education of Mongolian Children" (2012–2016), Mongolian Government Law on Child Care Services (2015), Mongolian Education System Concept "Development of Each Child" (2014), Core Program for Preschool Education (2014–2015), Home School Preparation Program (2017–2019), STEAM Play Program under Mongol Ail Project (2019));

5. Developing an evaluation system for preschool education in line with international trends (program to implement the new evaluation method "Child friendly");

6. Building preschool education as a complete and integral part of the state system of general education in Mongolia.

To the features we have highlighted, we must add those that can be described as purely negative:

1. The influence of globalization on the Mongolian education system, including preschool education. This manifests itself in "the desire of the West to impose its views and beliefs on all non-Western cultural and historical types as the only true and authentic ones" [15, p. 65]. As a result, Mongolia "cannot find an appropriate strategy for the development of the education system by announcing something new every year" (concepts, programs, projects) [16, p. 214]. In addition, the researchers note that it is easier for ministries and education departments to copy the education policies of highly developed countries than to develop their own Mongolian strategies in education that take into account Mongolian characteristics, especially the traditional nomadic way of life "with a stable tradition to educate the rising generation with an ecological future orientation" [17, p. 32].

2. The introduction of non-traditional religions for Mongolians (Islam, Munism, Protestantism) and their various branches and currents negatively affect the development of children, especially their worldview and mentality (Nyamaa Tsogzolmaa, Navaanzoch H. Tzedev). Researchers at the Pedagogical Institute of the Mongolian State University of Education (Mongol Ulsyn Bolosrolyn Ikh Surguul) and the Mongolian National University (Mongol Ulsyn Ikh Surguul) refer to this influence as Real Religious Violence.

Given the significant differences in the forms of organization of preschool education in Russia and Mongolia, it is important also to note significant differences in the organization of the educational process of preschool education based on the concept of the Federal Educational Standards of Preschool Education (Russia) and the Core Curriculum of Preschool Education (Mongolia) (Table 2).

According to World Bank research, between 2017 and 2019, 35–40% of Mongolian preschool-aged children attended public preschool institutions, while 9–10% participated in alternative forms of preschool education: seasonal preschools, tent camps, mobile preschools, hourly preschool centers. This clearly indicates that 50% of Mongolian preschool children do not have access to adequate preschool education that enables them to transition to elementary school successfully. Therefore, a home-based school preparation program (2017–2019) was implemented in four aimaks in Mongolia. The program was funded and directly implemented by Save the Children Japan (SCJ) and targeted Mongolia's socioeconomically poor communities and pastoralist children who do not have access to preschool education.

A comparative analysis of the current state of preschool education in Russia and Mongolia shows that both systems prioritize children's needs and age-related abilities and give them the right to choose educational institutions, programs, forms of activities, and teaching and learning methods.

Table 2

Features of preschool education in Russia and Mongolia

Features of the educational process	Russian (under the Federal Educational Standard of Preschool Education)	Mongolian (under the "Development of Each Child" + Core Curriculum of Preschool Education)
Children's age	5–6 years	5 years
Forms of implementation of preschool education	Preschool groups in kindergartens, school-preparatory groups based on general educational institutions, additional educational centers, family education	Kindergarten-Yurt, Visiting Teachers, hourly preschool institutions
Priorities	Development of universal values	Development of student' future competencies (in the context of the traditional Mongolian value system)
Goal	Ensure continuity and succession of education by creating a single educational space for preschool and primary school children	Formation of the personality (compulsory training of skills typical of the nomadic way of life)
Dominant component	Learning, development, and education in a diversified environment	Teaching focused on children's development (with minimal support from adults: no joint problem solving, no suggestion of an alternative)
Orientation of the educational process	Personal (taking into account the individual characteristics of children)	Personal (primarily to an average child)
Attitudes of the participants	Teachers and children – are the subjects of the process, direct interaction of teachers and children in a joint activity	A teacher is the subject of the process; a child is the object of the teacher's pedagogical influences and the executor of the teacher's plans
Activities of adults and children	Participants in joint activities. Teachers see children as equal partners and respect their aspirations and individuality	Teachers assume the position of mentor, and children assume the position of learner. Teachers see children as objects of influence and try to draw boundaries between themselves and children
Main activity	Child-specific activities	Some elements of activities for children that focus on learning
Mandatory participation of children	Desirable, but not mandatory. The choice to cooperate with the teacher or engage in other activities	Mandatory for all children
The motivation of the child	The natural interest of the child.	The authority of the teacher
The behavioral style of the teacher	Democratic (children are contributors and interlocutors)	Instructive (children are subordinate and dependent on the teacher).
Child behavior	Creative and cognitive activity	Creative (but also: disciplined, responsible, diligent)
Model of process organization.	Joint activities of teachers and children	Classroom system of teaching
The basis of the educational content	Activity	Instruction
Principle of organization of educational content	Semantic	Subject oriented
Principles for content delivery	Integration. Content is socially and personally meaningful to preschool children and is implemented in various types of children's activities	Differentiation. Content is divided into academic subjects as an analogy to school subjects: the surrounding world, mathematical concepts, language development, drawing, modeling, appliqué, physical education, singing, housekeeping, etc.

End of Table 2

Features of the educational process	Russian (under the Federal Educational Standard of Preschool Education)	Mongolian (under the "Development of Each Child" + Core Curriculum of Preschool Education)
Means for the implementation of the educational content	Pedagogical technologies as a sequence of teachers' actions aimed at the creativity of all those involved in the process	Regulatory framework for precise implementation
Methods for the implementation of the educational content	Playful, exploratory, practical	Reproduction methods
The nature of education	The development of motivation and goal setting	Natural learning Iteration, imitation, copying according to a pattern, algorithmic procedure
Forms of teaching	Independent forms of joint and independent activities for children (games, conversations, observations, book reading, problem solving, exploration)	A lesson with elements of play, conversation, and observation. The traditional form of teaching
Degree of regulation	Low. Flexible regulation. Choice possibilities. They encourage teachers' creativity in making plans, taking into account children's needs and interests	Very high: strictly regulated time, content, and forms
Organization of the space.	Joint activities of teachers and children. Free movement in the activity space (asking, advising, agreeing, handing out)	Teachers are always above and in front of the children – i.e., they occupy what is called the Teacher's Seat. They come in as needed to help the children, supervise them, and evaluate their work. The children move around the room very little for discipline and performance reasons
Results	In accordance with the requirements of the Federal Educational Standards of preschool education, preparing children for further development	Under the requirements of the concept of Development of Each Child (professional and personal)
Monitoring and evaluation	Assessment of the dynamics of children's skill development. Routine evaluation sheets, tests, monitoring	Evaluation of each task that children complete in the development of knowledge, skills, and competencies, with the expansion of the list of children's skills. Tests, quizzes, self-study

In highlighting the main problems and prospects, it should be noted that the system of preschool education in Mongolia's preschool and general education institutions is at a developmental stage. At the same time, Russia has enough experience to enrich the education system. Despite this fact, the Russian educational system can consider the positive aspects of the development of preschool children in Mongolia, which are related to the need and importance of implementing the principles of traditional Mongolian education.

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Vakhitova G.Kh., Candidate of Pedagogical Sciences, Associate Professor. Tomsk State Pedagogical University (ul. Kievskaya, 60, Tomsk, Russian Federation, 634061).
E-mail: Galija2000@mail.ru

Leontyev E.P., Candidate of Philological Sciences, Associate Professor, teacher. International Center of Education "Interdom" named after E.D. Stasova (ul. Sportivnaya, 21, Ivanovo, Russian Federation, 153024). Tomsk State Pedagogical University (ul. Kievskaya, 60, Tomsk, Russian Federation, 634061).
E-mail: ernestleontyev@mail.ru

Batsuuri Ajrakhgui, teacher. School-laboratory "Merged" Uvurkhangai aimag. (ul. Renchinpelzhee, 5th microdistrict, Arvaikheer, Mongolia).
E-mail: ajraxguidagina@gmail.com

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EXTERNAL EVALUATION OF SELF-DIRECTED LEARNING SKILLS: ONLINE EDUCATION*

Konstantin B. Egorov, Vera A. Zakharova

Perm State Humanitarian Pedagogical University, Perm, Russian Federation

Abstract. Self-isolation measures implemented during the Covid-19 pandemic resulted in a quick transition to online instruction. As a result, teachers and students must master online learning tools and technologies in educational institutions. In addition, the problems with online education are frequently reported in scholarly sources.

Many participants in the educational process faced difficulties during this period. In our opinion, many difficulties in online education were caused by insufficient training of self-directed learning skills in students and corresponding skills in teachers. At the same time, this group of universal learning skills is a mandatory part of education in Russian schools. The skills of self-organization and self-control are included in the Russian federal state educational standards requirements. A considerable number of scientific publications are devoted to the formation of assessment skills in school children. At the same time, the problem of training self-directed learning skills in online classes has not been sufficiently studied.

This article examines the results of an independent assessment of self-directed learning skills and training in online classes for both primary school students and primary school teachers.

As a result of the study, the following skills were identified as important for teaching primary school online learners: Planning, Self-Monitoring, Self-assessment, and selecting effective approaches for online learning.

Empirical data were collected as part of the study. From this, the following points can be made: Primary school teachers are not prepared for online teaching; time demands on teachers have increased due to the specifics of teacher self-monitoring under the new conditions. Consequently, students need to learn the following skills during online teaching: self-monitoring, use of automated assessment and monitoring tools, self- and peer-assessment in the digital educational environment, and planning.

The empirical data obtained show the importance of training self-monitoring skills for online teaching. Therefore, the proposed recommendations for improving teacher training education programs in pedagogical universities and in the teacher professional development system have practical relevance and can be implemented through appropriate educational programs.

Keywords: *self-direction, self-control, planning skills, independent assessment in teaching, online learning, online teaching, online education, teacher education, primary school, functional literacy.*

1. Introduction

Self-directed skills are one of the prerequisites for the formation of functional literacy. The need to develop self-directed learning skills in students is a topic that has been actively

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discussed in the wake of forced online learning during the Covid-19 pandemic. The authors of the article update the aspect of building self-directed skills in online learning by comparing online instruction and online learning.

The need for self-isolation during the Covid-19 pandemic led to the transition to online learning. As a result, primary schools were also forced to master online learning technologies.

The advantages and disadvantages of online teaching were discussed even before the pandemic [1, 2]. The unexpected introduction of online learning required urgent and significant changes in the teaching and learning process. During the pandemic, primary school teachers and students quickly acquired tools and resources to transfer their education online. Teachers learned how to video conference and assign homework online. Students mastered computers and mobile apps. Interaction with Internet platforms such as Zoom, Teams, Discord, and Google Classroom intensified. Virtual classes and interactive tools such as Padlet, Kahoot, and others were learned. Many publications have been devoted to these aspects of online learning [3–8]. The problems of teachers in sharing resources in online work have been studied [9]. The issue of stress caused by difficulties in online learning for teachers, students, and parents has been discussed [10].

We believe that many of the difficulties associated with mastering online learning are related to organizational (self-directed) skills. At the same time, little is known about how students and teachers develop self-organizational skills in online learning. In the era of online education, many researchers have sought answers to the question of how teachers can effectively organize their work in online learning and how they can help primary school students acquire self-directed skills.

Materials from the NCEE (National Center on Education and the Economy) in the United States suggest that online learning at home helps to promote students' self-directed learning skills [4]. In addition, some international researchers have discussed aspects of self-organization and assessment activities in the context of online education for college students [11, 12].

Currently, the problem of training self-directed skills in university students is gaining more and more attention [13], and the issue of students' assessment skills is widely discussed [14–16]. In addition, the problem of training teachers' organizational skills in relation to teaching in normal conditions (face to face) was discussed in the works of psychologist O.V. Belous [17].

According to the Russian federal state standards for general primary education [18, 19], primary school students are expected to have the ability to accept and understand the learning task and to plan, control, evaluate, and choose effective ways to achieve the goal. The new edition of the state educational standards for primary school, adopted in 2021, includes two groups of universal activities for self-directed learning: 1) self-organization skills (the ability to plan learning activities to solve a learning task and achieve an outcome, and the ability to create a sequence of selected activities); 2) self-control skills (the ability to identify reasons for success or failure in learning activities and the ability to correct their learning activities to overcome errors) [20].

The ability to engage in self-directed learning is an important outcome of primary education and a prerequisite for the development of functional literacy skills [21, 22].

This article compares the results of an empirical study conducted by Perm State Humanitarian Pedagogical University. The authors of the article address the advantages and disadvantages of teaching self-directed skills to younger students and teachers' professional deficits in self-organization skills in online learning during the pandemic. Identifying poor learning skills through independent assessment during face-to-face instruction is motivated by the need to obtain objective data [23, 24]. Therefore, it makes sense to subject academic outcomes to independent assessment in the online education era. Furthermore, we assume that such a study is not only of

practical value but also of scientific interest. Based on the study results, recommendations were developed to improve the teaching of primary school children and develop primary school teachers' professional skills.

2. Materials and methods

This article describes the results of two independent empirical studies: 1) a study of primary school students' self-organizational skills and 2) a self-assessment of primary school teachers' professional strengths and weaknesses during the Covid-19 pandemic.

The study of primary students' organizational skills was conducted from 2018 to 2021. Pupils of grades 2, 3, and 4 in general educational institutions of the Perm region took part in the study "Quality Cluster of Perm State Pedagogical University." The sample was formed randomly from 159 to 894 persons in each age group. The study of self-directed abilities of primary school students was conducted based on criteria-based diagnostics. The diagnostics focused on revealing aspects of functional literacy and was based on the material of practical life situations. The organizational skills listed in the draft of a new version of the Russian federal state educational standards for general elementary education were used as assessment criteria. The analysis of the results was carried out and visualized using the automated system on the website of the Quality Cluster Project of Perm State University of Humanities and Pedagogy.

Initially, these diagnoses were not aimed at studying the impact of online teaching on the formation of self-directed skills. However, the authors were interested in comparing the results of the diagnoses before the transition to online learning during self-isolation and after the return to face-to-face learning in school.

A self-assessment of primary school teachers' professional strengths and weaknesses in online learning was conducted using a partially structured self-assessment questionnaire that included both choice and open-ended questions. The focus group of participants in a series of online workshops formed the sample. Seventy-nine teachers participated in the study (with different years of experience: 1–5 years – 1 person, 6–14 years – 8 persons, 15–24 years – 19 persons, more than 25 years – 51 persons). The analysis of the results was performed and visualized using automated electronic forms. In addition, the results of the study were subjected to mathematical processing and content analysis.

3. Results

In the study of self-directed abilities of primary school children, the following results were evaluated: a) as a whole, based on the average result of the formation of all groups of self-directed abilities; b) based on the criteria by groups of self-directed abilities, in which case the percentage of students who met each criterion was determined.

In general, a comparison of diagnostic results of self-directed skills among primary school students showed a decrease in 2021 after the online learning phase. Student performance results on the tasks were as follows (Table 1, Fig. 1):

– In the 2nd grade during the 2018–2019 academic year – 72%; in 2019–2020 – 65%; in 2020–2021, after the online learning phase – 63%.

– In the 3rd grade during the 2018–2019 academic year – 60%; in 2019–2020 – 54%; in 2020–2021 academic year, after the online learning phase – 47%.

– In the 4th grade during the 2018–2019 academic year – 58%; in 2019–2020 – 66%; in 2020–2021, after the online learning phase – 56%.

The greatest negative dynamics were observed among students in grades 2–3, who focus more on external control by the teacher.

Table 1

Self-directed learning skills in primary school students

Academic year/School grade	2-nd	3-rd	4-th
2018–2019	72%	60%	58%
2019–2020	65%	54%	66%
2020–2021	63%	47%	56%

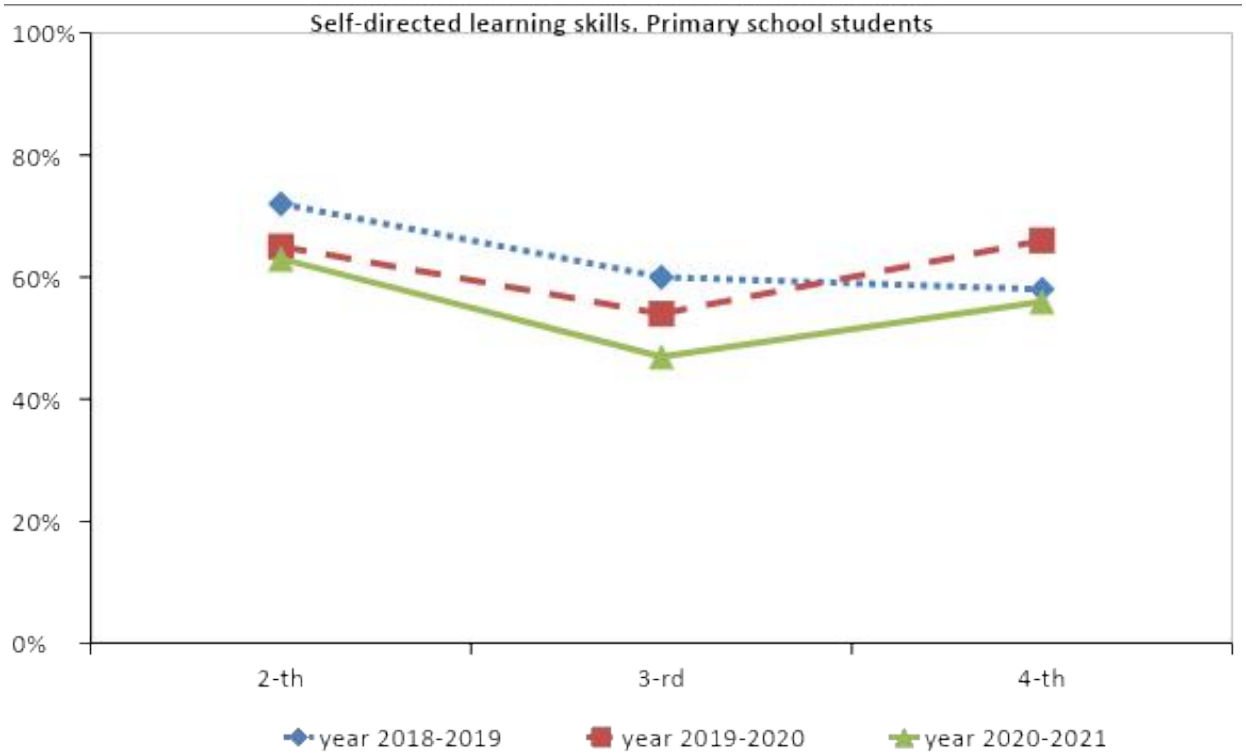

Fig. 1. The dynamics of self-directed learning skills in primary school students

Differentiated data were obtained by analyzing the results among primary school students using the criteria for the groups of self-directed skills.

3.1.1 Criterion 1. The ability of primary school students to accept and maintain a practice/ learning task. Diagnostics included an assessment of a practical task in everyday life in 2nd grade, translating a practical task into a learning situation in 3rd grade, and assessing a practical task in a learning situation in 4th grade.

The diagnostics results showed lower scores after the online learning phase in all grades (Table 2, Fig. 2).

– In the 2nd grade during the 2018–2019 academic year – 84%; in 2019–2020 – 83%; in 2020–2021, after the online learning phase – 58%.

– In the 3rd grade during the 2018–2019 academic year – 83%; in 2019–2020 – 78%; in 2020–2021, after the online learning phase – 14%.

– In the 4th grade during the 2018–2019 academic year – 58%; in 2019–2020 – 88%; in 2020–2021, after the online learning phase – 63%.

The greatest negative trend was found among grade 2 students, who were unable to make the transition from practical tasks to learning tasks at a higher rate.

Table2

The ability of primary school students to accept and maintain a practice/learning task

Academic year/School grade	2-nd	3-rd	4-th
year 2018–2019	84%	83%	58%
year 2019–2020	83%	78%	88%
year 2020–2021	67%	14%	63%

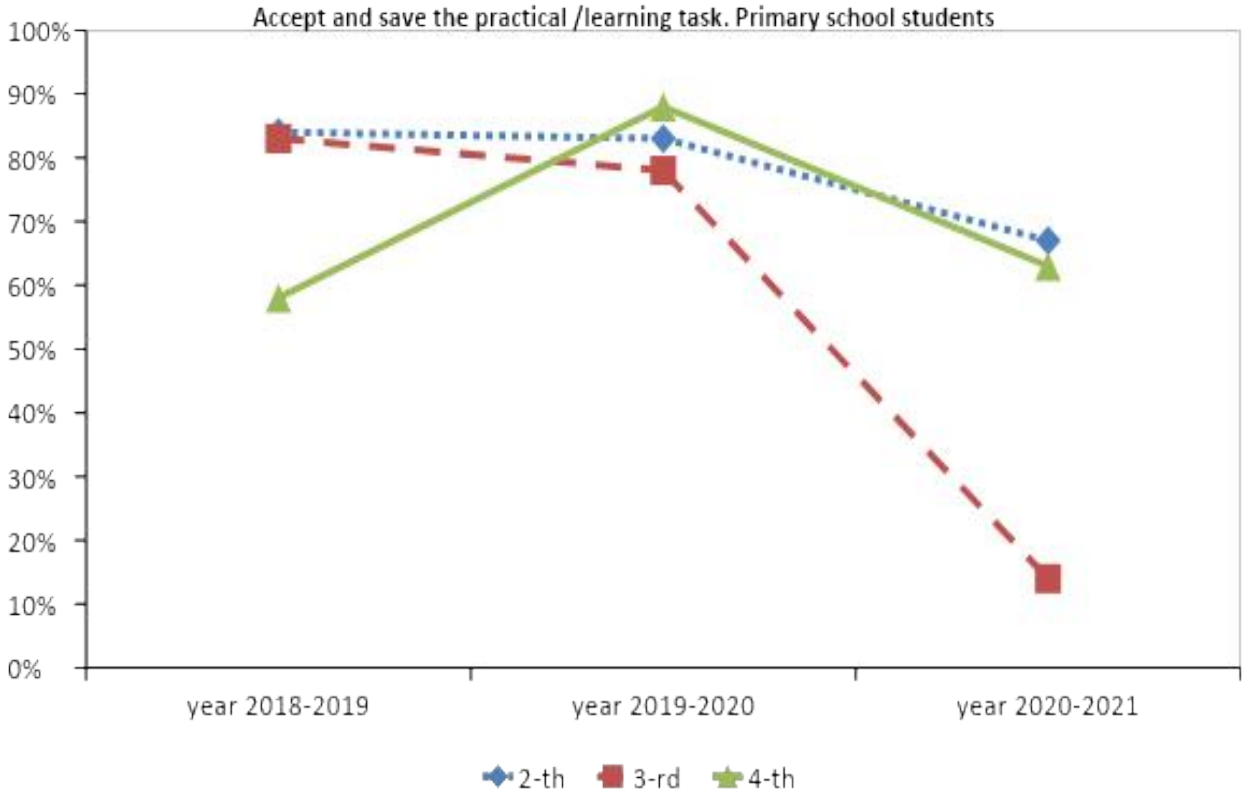

Fig. 2. The ability of primary school students to accept and maintain a practice/learning task

3.1.2 Criterion 2. The ability to plan ways to solve a learning task, outline actions to achieve a result, and create a sequence of chosen actions. Diagnostic results showed positive dynamics in 2nd and 3rd grade after the online learning phase, but in 4th grade, the results became lower (Table 3, Fig. 3).

– In the 2nd grade during the 2018–2019 academic year – 73%; in the 2019–2020 academic year – 69%, in the 2020–2021 academic year, after the online learning phase – 66%.

– In the 3rd grade during the 2018–2019 academic year – 45%; in the 2019–2020 academic year – 45%; in the 2020–2021 academic year, after the online learning phase – 59%.

– In the 4th grade during the 2018–2019 academic year – 66%; in 2019–2020 – 53%; in 2020–2021, after the online learning phase – 46%.

A negative dynamic was found among 4th-grade students, who were more focused on subject test scores, probably due to national monitoring of educational quality (all-Russian tests). On the other hand, the positive dynamics among 2nd and 3rd-grade students are likely related to online learning algorithmization.

Table 3

Planning skills in primary school sudents

Academic year/School grade	2-nd	3-rd	4-th
year 2018–2019	73%	69%	66%
year 2019–2020	45%	45%	53%
year 2020–2021	77%	59%	46%

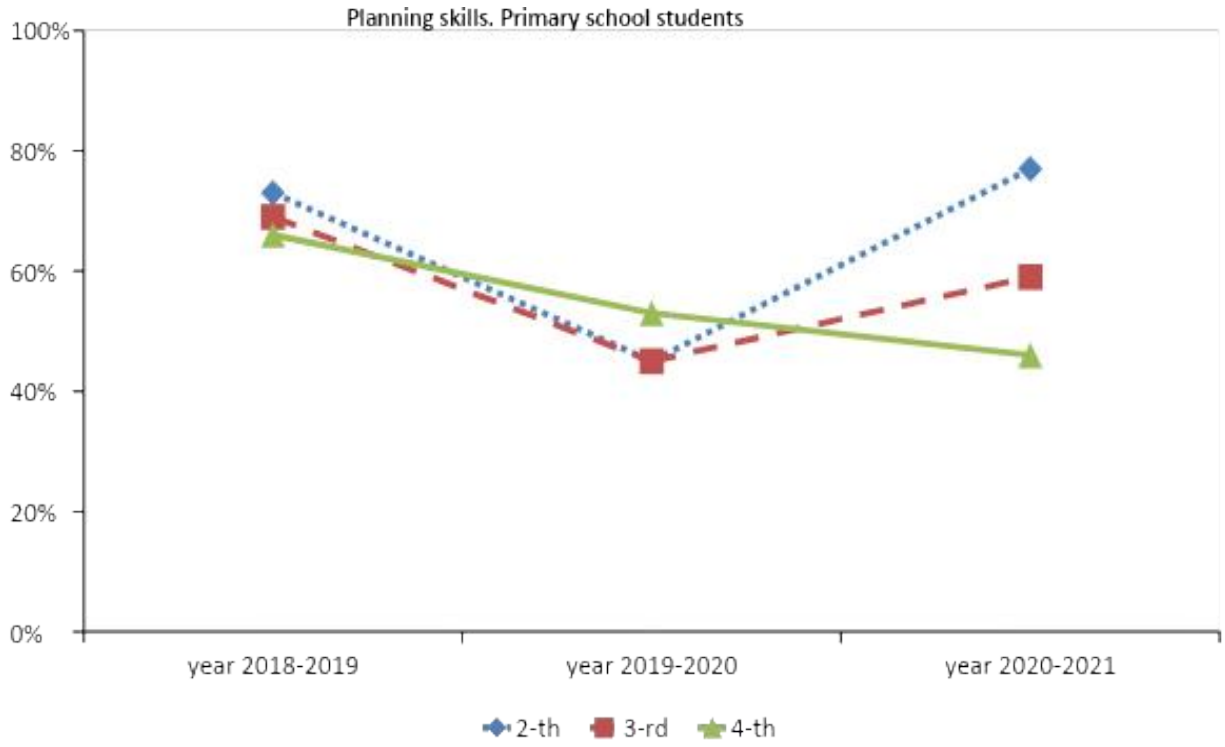

Fig. 3. Planning skills in primary school students

3.1.3. Criterion 3. The ability to evaluate different ways of achieving a result and select the most effective one. Diagnostic results showed positive dynamics in the 3rd grades after the online learning phase, and the results became lower in the 2nd and 4th grades (Table 4, Fig. 4):

– In the 2nd grade during the academic year 2018–2019 – 44%; in the academic year 2019–2020 – 69%; in the academic year 2020–2021, after the online learning phase – 50%.

– In the 3rd grade during the academic year 2018–2019, 97%; in 2019–2020 – 45%; in 2020–2021, after the online learning phase – 69%.

– In the 4th grade during the academic year 2018–2019 – 44%, in 2019–2020 – 57%; in 2020–2021, after the online learning phase – 38%.

A negative dynamic was observed among 4th-grade students, who were more focused on subject test results, probably due to the national monitoring of educational quality (all-Russian tests). The decline in scores for this criterion in the 2nd grade students can be explained by the greater algorithmization of online learning and fewer teacher choices for students. In the 3rd grade, students were likely given more freedom of choice, perhaps with less external teacher control, allowing students to choose effective pathways and solution options.

Table 4

The ability to evaluate different ways of achieving a result and select the most effective one

Academic year/School grade	2-nd	3-rd	4-th
year 2018–2019	44%	97%	44%
year 2019–2020	69%	45%	57%
year 2020–2021	50%	69%	38%

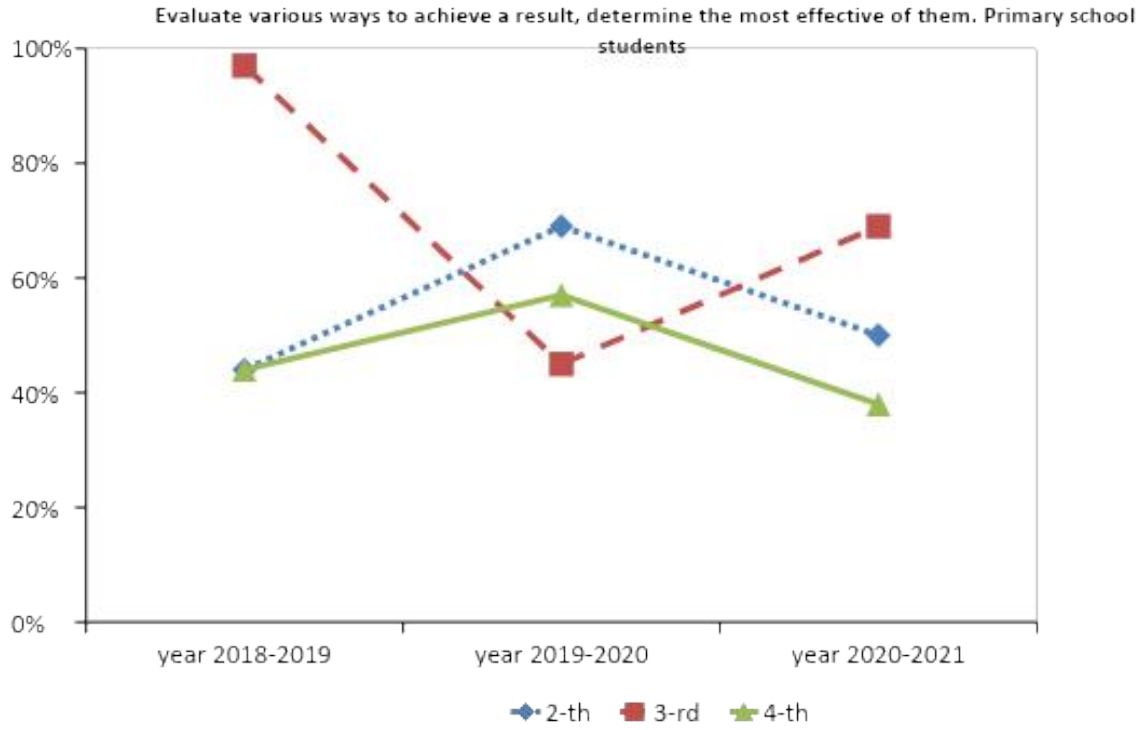

Fig. 4. The ability to evaluate different ways of achieving a result and select the most effective one

3.1.4. Criterion 4. Ability to identify reasons for success/failure and correct learning actions to overcome failures. The diagnostic results showed positive dynamics in the 2nd grades after the online learning phase, and the results became significantly lower in the 3rd and 4th grades (Table 5, Fig. 5):

– In the 2nd grade during the 2018–2019 academic year – 83%; in 2019–2020 – 61%; in 2020–2021, after the online learning phase – 70%.

– In the 3rd grade during the 2018–2019 academic year, no data for this criterion; in 2019–2020 – 73%; in 2020–2021, after the online learning phase – 48%.

– In the 4th grade during the 2018–2019 academic year – 79%; in 2019–2020 – 76%; in 2020–2021, after the online learning phase, 62%.

For 3rd and 4th grade students who had not mastered this skill in the online learning environment, negative dynamics were noted. This could be due to a lack of organization of the appropriate activity on the part of the teacher. Teachers probably did not know how to organize such work under online learning conditions and did not encourage students to correct their actions. In addition, repeated assessment procedures after the students' corrections are associated with a significant amount of time the teachers have to spend.

The improvement of the results in the 2nd grade can be explained by the spontaneous acquisition of skills in an online learning environment.

Table 5

Ability to identify reasons for success/failure, and correct learning actions to overcome failures

Academic year/School grade	2-nd	3-rd	4-th
year 2018–2019	83%	–	79%
year 2019–2020	61%	73%	76%
year 2020–2021	70%	48%	62%

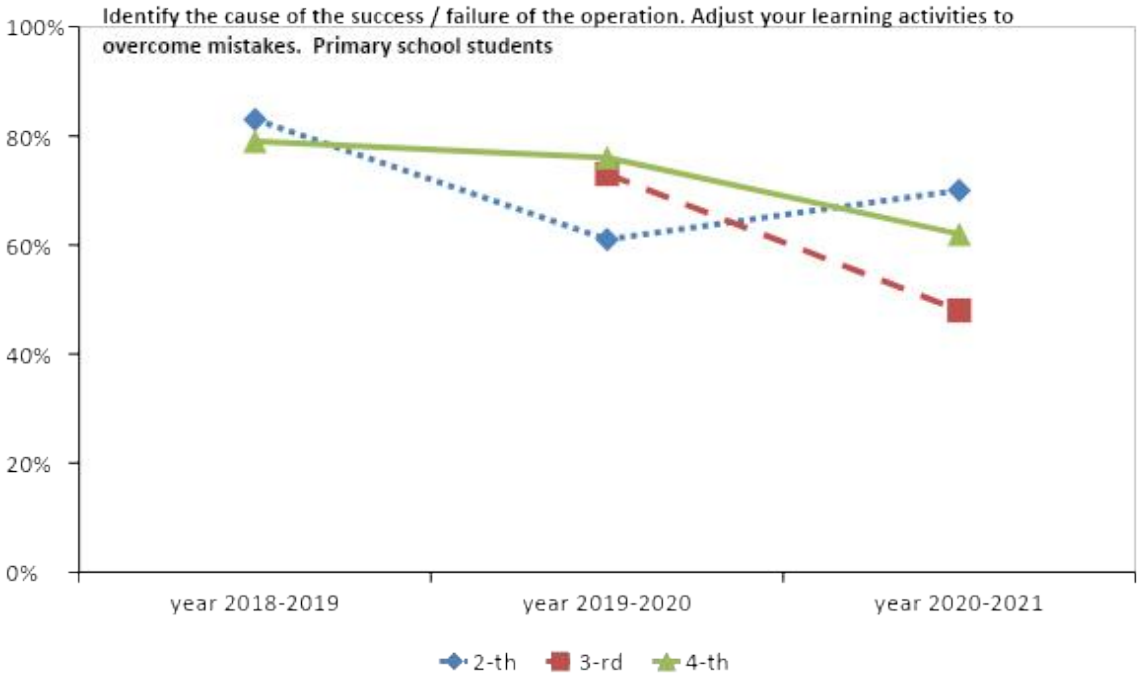

Fig. 5. Ability to identify reasons for success/failure and correct learning actions to overcome failures

3.1.5. Criterion 5. Ability to control the results and process of the activity. Diagnostics aimed to assess the ability to control outcomes in 2nd grade, the ability to control outcomes and processes in 3rd grade, and the ability to control processes in 4th grade. Diagnostic results showed positive dynamics in 3rd and 4th grade after online learning, while results in 2nd grade became worse (Table 6, Fig. 6):

– In the 2nd grade during the 2018–2019 academic year – 75%; in the 2019–2020 academic year – 68%; in the 2020–2021 academic year, after the online learning phase – 50%.

– In the 3rd grade during the 2018–2019 academic year – 53%; in 2019–2020 – 31%; in 2020–2021, after the online learning phase – 46%.

– In the 4th grade during the 2018–2019 academic year – 43%; in 2019–2020 – 56%; in 2020–2021, after the online learning phase – 73%.

A negative dynamic was found in the 2nd grade students who did not master the control skill in online learning conditions. This could be due to an insufficient number of reference standards for comparison, the lack of opportunities for mutual control and comparison to see different results in solving the same task, or the predominance of external control by the teacher.

The better results in grades 3 and 4 can be explained by the earlier mastery of self-monitoring mechanisms in face-to-face learning.

Table 6

Ability to control the results and process of the activity

Academic year/School grade	2-nd	3-rd	4-th
year 2018–2019	75%	53%	43%
year 2019–2020	68%	31%	56%
year 2020–2021	50%	46%	73%

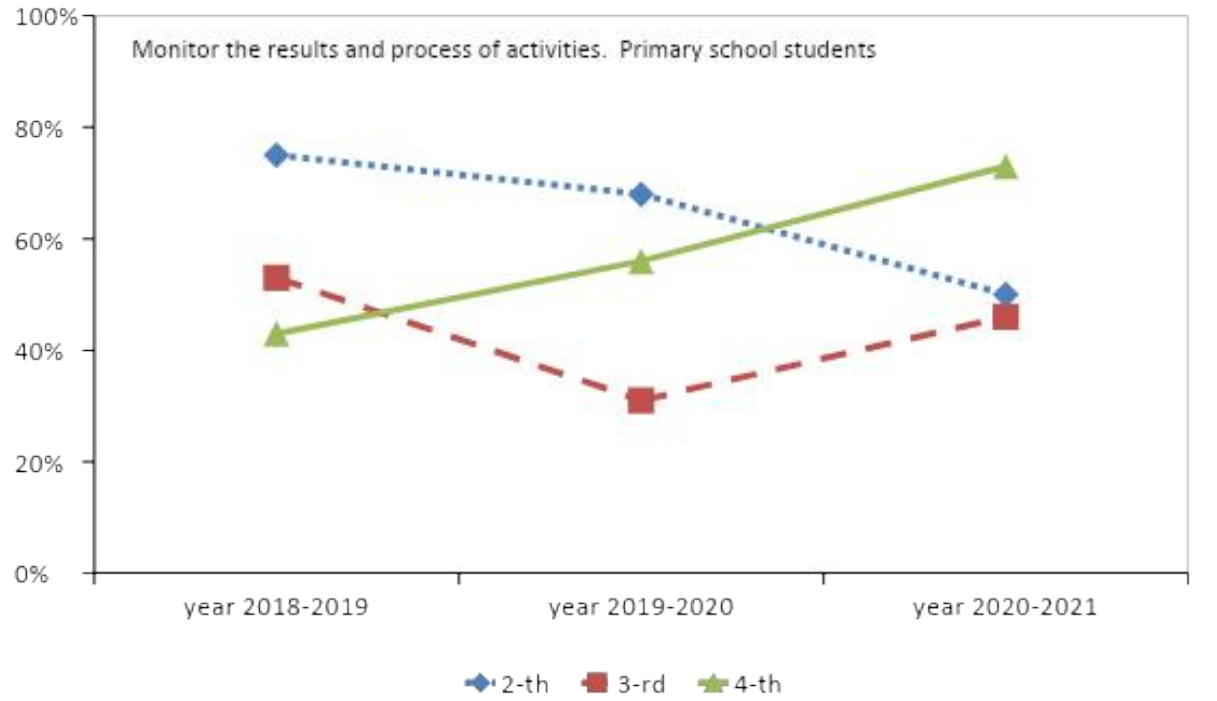

Fig. 6. Ability to control the results and process of the activity

3.2. A study of elementary school teachers' occupational advantages and disadvantages during the Covid-19 pandemic revealed the following.

The study was conducted using a partially structured self-assessment questionnaire. Let us share the results of primary school teachers' responses to the following questions:

– What proved to be the greatest difficulty in shaping primary school students' self-directed skills in an online learning environment?

– How has your view of the process of building self-directed skills changed as a result of the transition to online learning?

– What skills related to shaping self-directed skills are primarily needed by teachers under the new conditions?

3.2.1. Responses to the question "*What proved to be the greatest difficulty in shaping primary school students' self-directed skills in an online learning environment?*" indicated that planning skills presented the greatest difficulty for both the student and the teacher.

Here is an example of a problem of self-organization mentioned by the teachers: "The most difficult thing in the beginning, I think, was planning the daily schedule, because the children did not send their assignments on time, were confused about deadlines, and had problems with the platforms we use. Now it is much more organized."

The teachers mentioned the importance of developing planning skills in younger students, "Many children cannot plan their activities. As a result, they have trouble planning ways to solve tasks, outlining the steps to achieve a result, and creating a sequence of selected steps."

One particularly noteworthy response illustrates the relevance of planning skills among students in online learning: "Developing planning skills is the most difficult, but it is also the strongest!"

Several teachers provided responses that combined the relevance of planning skills and self-direction/self-assessment: "planning and assessing the learning task," "ability to plan and control the learning task," and "planning and control."

Teachers also pointed out the need to train students to find mistakes in their work and correct them: "The ability to correct learning actions to overcome mistakes."

One teacher pointed out the difficulty and importance of the initial phase in working with students – goal setting: "Understand the learning task, plan actions."

3.2.2. Responses to the question "*How has your view of the process of building self-directed skills changed as a result of the transition to online learning?*" indicated that students were confronted with the need for self-organization as they transitioned to online learning.

The analysis of the responses made it possible to classify all the teachers' statements into clusters showing the difficulties and advantages of online learning for the formation of regulative skills in younger students. Table 7 shows the result of the cluster analysis of the teachers' statements:

(a) clustering of difficulties in organizing online learning and teachers' doubts;

(b) clustering of the advantages of online learning for the formation of self-directed skills of primary school students.

Table 7

Challenges in an online learning environment

Difficulties	Some of the examples of teacher responses
Difficulties of students: How students' lives have changed, how students have changed? (7 responses)	"The children found themselves in a situation where they had to independently understand the learning task, plan their actions, control them, evaluate them, and find ways to correct mistakes. It became very clear whether the children understood the task or not." "I think the kids are more organized now. With the transition to online learning, they have to do their homework systematically and expect to plan their day, send out assignments, monitor themselves, and set goals, such as 'What am I going to do today?'" "The amount of independent work has increased. The sense of personal responsibility for the outcome has increased; children need to plan their learning activities, organize themselves, and monitor and evaluate their work. Some children (2nd grade) do not wait for adults, do not wait to be controlled, make their own decisions, submit their work, and ask questions about the material." "The children have become more independent; you can observe an individual approach to their work; they have learned to plan their activities during the day."
The challenges for teachers: what changes should be introduced? (10 responses)	"It is necessary to plan activities more precisely in order to keep up with the times." "The process of forming universal learning activities has slowed down in children in the first grade, so it is better not to use online learning in the early stages of forming self-directed skills." "It is difficult to develop universal learning activities in online learning because the main work is focused on mastering the subject material." "It is very important to work consistently on building self-directed skills from the first days of school." "The learning process has become more complex. It has become more individualized." "It is difficult to plan activities for the individual formation of universal learning activities (requires a lot of teacher time)." "The ability to solve problems that arise in the process of online learning."

End of Table 7

Difficulties	Some of the examples of teacher responses
Teachers' concerns: Losing teachers' monitoring and evaluation tools (14 responses)	"The formation of self-directed skills has become more complicated in some cases because it is impossible to be sure that children will complete all tasks independently." "Not all parents understand how to help their children properly, and they take on the role of the student. Therefore, it is difficult for the teacher to assess this process objectively." "Excessive 'help' from parents. If the adults do not give children the opportunity to take responsibility for the learning outcomes (at least partially)." "In my opinion, it is most difficult to teach children self-discipline and responsibility. When you can control children when only teaching online, with no school routine, then it is the most difficult to motivate the primary school children to do the tasks well." "In an online learning environment, it is more difficult to ensure self-control and objectivity of control over some steps of the work and the results obtained." "Correction problems: it is difficult to make necessary additions and corrections to the plan when the standard, the actual action, and the result differ." "Inability to track whether children can correct their actions in case of failure."
What are the challenges in forming and diagnosing self-directed skills? (7 responses)	"It is quite difficult to follow the process of forming self-directed skills." "Basically, performance tasks aim at mastering the subject of the lesson. There are time constraints and conditions for performing tasks of metadisciplinary nature."

Teachers evaluated the benefits of forming self-directed skills: hidden deficits became apparent, career development prospects became visible, and new skills were mastered (Table 8)

Table 8

The benefits of online learning for the formation of self-directed skills in primary school students

Benefits	Examples of teachers' responses
Previously hidden deficits came to light (9 responses)	"Problem areas have been uncovered that need to be worked on." "Self-directed skills help to foster children's independence under online learning conditions." "I have become even more confident in the importance of self-directed skills; the students whose self-directed skills were trained to an appropriate degree remained successful." "I have always considered the formation of self-directed skills an essential learning process. This situation clearly demonstrates the importance of self-directed skills." "For successful learning in an online learning environment, students must have the ability to organize their learning activities independently. For this purpose, they need to train self-directed skills, i.e., students should be able to set a task correctly, assess their knowledge and skills appropriately, find the easiest way to solve the task." "It is possible to track which of the students clearly plan their activities when performing tasks."
New perspectives (2 responses)	"The new role of teachers: they are entrusted with functions such as coordinating the cognitive process, adapting the course, advising on the development of an individual curriculum, and managing learning projects." "Attention to teachers' self-directed skills should be systematic, integrating tasks for their training into the online learning mode."
New competencies mastered (1 response)	"Online learning raised the question of independent, successful acquisition of new knowledge and competencies (the ability to learn). We had to look for other means, learning methods, and methodological techniques."

3.2.3. Replies to the question, "*What skills related to shaping self-directed skills are primarily needed by teachers under the new conditions?*" revealed the actual competencies of teachers. The need to acquire new skills was identified by 47% of teachers (Table 9).

Table 9

Relevant self-directed skills in an online learning environment

Examples of teacher responses	
Student skills	Teacher skills
Ability to set or accept a goal or learning objective	
"The ability to form learning skills in students, that is, to accept the learning task, plan actions, and carry out the task according to the plan." "The retention of the learning task throughout the lesson." "Understanding the learning goal."	"Setting the right goals and then helping and guiding the students." "Setting a specific goal."
Ability to plan	
"The ability to learn, that is, to plan actions, to perform tasks according to a plan." "To teach how to plan and correct the plan." "To plan ways to solve a learning task. To outline procedures that lead to a result; build a sequence of selected procedures."	"Planning and selecting instructional materials." "Consistent Planning" "The ability to properly organize the stages of acquiring material in an online learning environment." "Learning how to plan a lesson in a new way."
Monitoring and evaluation skills	
"Training of students' self-activity, self-monitoring of activities and results" "Self-direction" "Ability to control and evaluate the results and the process of the activity."	"New forms of pedagogical control" "Remote forms of control and evaluation of student outcomes" "It is important to help students and their parents organize their own learning activities." "A tool to track intermediate actions, not just the end result" "The ability to organize monitoring and evaluation activities and reflection"
Ability to determine the causes of failures and correct activities	
"Ability to determine the reasons for success/failure of activities." "Be able to correct learning activities to overcome failures"; "To teach how to plan and correct."	"To adapt actions to the current situation"; "Teachers must now organize the learning process not only as a process of mastering the system of knowledge, skills, and competencies that form the instrumental basis of students' learning activities but also as a process of personal development, acquisition of spiritual, moral, social, family and other values"; "Ability to organize work quickly under new conditions." "Ability to analyze one's own teaching activity and students' learning activity."
The ability to evaluate different ways to achieve an outcome to determine the most effective of them	The ability to evaluate different ways to achieve an outcome to determine the most effective of them
"Looking for different ways to achieve results."	"Anticipating children's difficulties in independent learning." "The ability to anticipate the outcome, including the level of knowledge absorption and its temporal characteristics." "Prediction of possible situations." "The ability to select methodological methods for designing self-directed universal learning activities." "The ability to plan and use different types and forms of work with children to develop self-directed skills, and to identify and systematize the most effective of them."

4. Discussion

Thus, the following facts and trends can be derived from the results of the study:

– Primary school teachers were not prepared for the online learning environment;

– Teachers' time commitment increased. This is due not only to the need to master new teaching technologies but also to the peculiarities of teachers' self-regulation in the new conditions

– the need for special work on the formation of students' self-directed skills was highlighted

– The following groups of students' self-directed skills essential for online learning were identified: Planning skills, self-control and self-assessment, selection of effective courses of action;

– The training problems related to the teacher's assessment activity were identified: formation of students' assessment skills, use of automated external assessment and monitoring tools, formation of students' self-assessment and peer assessment skills in the digital learning environment.

Some trends can be outlined, and the following hypotheses are offered for discussion:

In the era of online learning, there may be differences in assessing students' self-directed skills in solving learning tasks (primary literacy) and practical tasks (functional literacy). Therefore, it is necessary to investigate the role of self-directed skills in forming functional literacy.

The issue of teachers' self-directed skills as a component of teachers' professional competence was also recognized in the era of online learning.

5. Conclusion

Thus, the independent assessment of self-directed skills in online teaching and learning presented in this publication allows us to identify the need for changes to educational programs in pedagogical fields to improve the quality of education for current and future teachers.

Such changes can be initiated by federal and state executive agencies, university departments, and educational organizations – employers.

Independent evaluation can promote changes in teacher education that may include the following relevant aspects:

– Methods of teaching subjects

– The mastery of information technologies

– The mastery of methods for teaching self-directed skills to primary school students

– The mastery of digital tools for planning, monitoring, evaluating, and selecting effective courses of action for students.

We can assume that acquiring appropriate skills will optimize teachers' time, organize constructive interaction between the school and students' families, and create the conditions for forming the self-directed skills required by educational standards in primary school students.

Teacher training can be provided through professional development programs. Changes in the educational program of higher education of the pedagogical profile can be made through specialized modules of educational programs, internship programs, electives, and programs to form digital skills.

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Egorov K.B., Candidate of Historical Sciences, Associate Professor, Rector of the Perm State Humanitarian Pedagogical University (ul. Sibirskaya, 24, Perm, Russian Federation, 614990).
E-mail: egorov@pspu.ru

Zakharova V.A., Candidate of Pedagogical Sciences, Associate Professor of the Department of Theory and Technology of Teaching and Upbringing of Younger Schoolchildren, Perm State Humanitarian Pedagogical University, Head of the Center for Independent Assessment of the Quality of Education (ul. Sibirskaya, 24, Perm, Russian Federation, 614990).
E-mail: zaharova_va@pspu.ru

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EVENT NETWORKS OF NON-FORMAL EDUCATION AS A RESULT OF SELF-ORGANIZATION OF ALL AGE COMMUNITIES*

***Marina S. Yakushkina*[1], *Marina R. Ilakavicius*[2]**

[1] *Branch of the Institute of Education Management of the Russian Academy of Education in St. Petersburg, St. Petersburg, Russian Federation*
[2] *St. Petersburg Academy of Postgraduate Pedagogical Education, St. Petersburg, Russian Federation*

Abstract. *Introduction.* The life of a modern person today is characterized by a constant renewal of the educational path, which allows one to quickly solve problems in both professional and personal development. The countries of Eurasia are no exception. The prioritized form of continuous education in the 21st century is non-formal education. It is democratic and makes exceptional use of the resources of civil society. Leading the development of non-formal education are self-organized communities of all ages, whose members create educational, cultural, and recreational activities in the network mode. In order to promote the educational activities of these communities, normative support is required, based on the provisions of the sciences of the interdisciplinary humanities field.

The aim of the article. Describe the features of all age communities' self-organization that form event networks.

Research methods. Research methods include analyzing domestic and foreign studies, identifying scientific works whose results can be interpreted as possible solutions to the problems identified in this development, modeling methods, analysis and generalization of pedagogical experiences, pedagogical surveys, interviews, participant observation, and publicly speaking initiated and organized expertise.

Results and Discussion. Rationale. To realize the developmental potential of non-formal practices in a formal educational setting, conditions must be created that attract a community of all ages (especially children and adults). Effective forms of self-organization of non-formal educational communities of all ages include the following: school communities for informal communication (CAS activities, music, sports, extracurricular academic subjects), families (family education and leisure), reading clubs, religious communities, travel groups, and city tour communities. This includes the active use of pedagogical practices of non-formal education: play and project activities, independent creative group activities, crowdsourcing, and participation in social networks. All age communities create networks of events of different types and forms, which make it possible to attract new members to the communities.

Conclusion. In order to realize the development potential of non-formal education for all age communities, those responsible for formal educational institutions must create the conditions for the development of event networks: provide a venue and methodological support.

Keywords: *continuing education, adult education, non-formal education, network of educational events, all-age communities.*

Introduction

After analyzing the role and functional purpose of non-formal (or non-formalized) education in the state multinational education systems of the Eurasian countries [1], it should be noted, first

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of all, that today in the Eurasian educational space, different aspects characterizing non-formal education are taken into account [2, 3] and, in general, specialists emphasize its ability to open up a culture of conflict-free dialog between representatives of different countries and improving the quality of life [4]. First of all, non-formal education is considered a service sector to satisfy the needs of the population [5]. This function allows us to consider non-formal education as the most flexible sector, sensitive to changes in the socio-cultural situation of society [6, 7]. It is proposed to focus on the potential of non-formal education's ability to respond to the requirements of society in the implementation of value orientations, ideals, methods, and forms of social activity [8, 9] as well as to influence the transformation of modern civil society and the dynamics of the personality of fellow citizens [10, p.71; 11]. Each society strives to realize the function of non-formal education, which at a given time appears significant for a particular state structure and educational policy [12, 13]. The development of the state provides social services, ensures compliance with civil law, the conditions for various types of social and public activities, creates conditions for the participation of different social strata in solving political, socio-cultural, and educational problems; supports appropriate actions in a multinational, multicultural educational space [14; 15, p. 7].

It should be noted that there is no legal and regulatory framework for non-formal education sufficient for the intensive development and active training of subjects. In order to change the content of educational activities of non-formal educational structures and training of their subjects, it is necessary not only to change the dynamics of legislation and other conditions created for the development of the field of non-formal education in the Eurasian states but also to look for ways and forms to train organizations capable of building event-based educational networks, which are considered as a dynamically developing continuum of pedagogically based educational events (understood as encounters, events that are meaningful for students). They were created in a pedagogical environment in which the network subjects created the conditions for their coexistence, the polylogue. One of the most effective ways to identify and prepare such subjects is to create the conditions for their self-organization.

We emphasize that the formation of human relations in a group, community, team, organizational processes [16, p. 157], and relations self-organization [17] are essential. Organizational processes are associated with [15, p. 64], so we find it necessary to emphasize that it is more appropriate to use the term self-organization, assuming that these processes are inseparable. The process of self-organization explains the formation of a new community, a team, by creating conditions for the interaction of group members and their management – external conditions (acceptance of the conditions that determine the activities of the community, awareness of the role of the leader, curator of the community, depending on the conditions, roles, attitudes) and internal (motivation, ability to work effectively to achieve results, planning time and its actions). The process of self-organization assumes that in the formation of a new community, a person can learn to perform a certain activity not under coercion but from internal motivation, recognizing its usefulness in everyday life for both themselves and their community [18]. Ultimately, such processes contribute to the self-affirmation of the individual [19, p. 101], while the community itself becomes stable for some time. It should be noted that the main object of the considered processes are all age communities, which we consider as a naturally organized community of people of different ages united by a common essence (living together), a goal, an idea, a complementary activity, a developing personal social experience.

Methodological approaches and research methods

The andragogical approach considers the student's self-understanding as an educational subject in educational networks, with awareness of their educational needs and planning a

deliberate, vigorous activity to meet them. Pedocentric – takes into account the interests and abilities of the child. Systemic – allows a community of different ages, having all the components of educational and educating activities, such as goals, content, forms, methods of education, to overcome the risks associated with the fragmentation of education through the formation of interconnected relationships between the components and the integrity of the processes. Synergetic – based on the self-organization processes of an open community of different ages. The self-organization processes make it possible to fix the system components that appear for the first time, change the existing connections of the system components, and identify new connections with other systems. Event-based – provides the opportunity to consider the space of non-formalized education in which a network of interconnected educational events for all age communities develops dynamically through the forces of children and adults (subjects of the educational environment) as an integrated condition for the personal growth of the community members. Ambivalence – in the eventfulness of the educational and educative space, ambivalence is the rationale for presenting non-formalized education as eventful encounters, not so much in terms of their expected positive outcomes but also taking into account possible risks in the field of personality dynamics of participants in a community of different ages.

In order to solve the set and methodologically justified scientific task, a list of the following research methods was selected: identification, based on the analysis of domestic and foreign studies of scientific works whose results can be interpreted as possible solutions to the problems identified in this work, methods of modeling, analysis and generalization of pedagogical experiences, pedagogical surveys, interviews, participant observation, publicly initiated and organized expertise.

Results

Suppose it is an educational institution where event-based practices of non-formal education (the basis of event networks) are actively developing. In that case, it is very important to create conditions for the self-organization of a community of different ages (involving mainly children and adults) to become a priority process in an educational organization [19, p. 210]. Self-organization in this kind of community is based on teachers' voluntary participation in community activities, self-imposed responsibility, interest in community development, self-determination, and self-realization. In a situation of self-organization, the school can demonstrate coherence without directly influencing the school's principals. However, unfortunately, few schools are capable of self-organization.

As effective forms of self-organization of all age communities that actively use the practices of non-formal education, we generally mention school communities (CAS activities, music, sports, extracurricular academic subjects), families (family education and recreation); reading clubs; religious communities; travelers and hitchhikers; travel communities. The forms correspond to different criteria that characterize self-organization, such as hierarchy and pluralism, passivity, and activity. They can be further systematized according to the levels of self-organization: the general social level assumes that a person perceives himself as a part of a social group (stratum), ethnic group (e.g., a citizen of a country, representative of a national minority, religion or denomination); as a specialist, professional, representative of a particular social institution (e.g., member of the professional-pedagogical community, school community, family or clan); at the managerial level – as a part of a professional group (school principal); at the group level – as a part of a cultural society or interest group (a political party, representative of a community of amateur zoologists); finally, perhaps the perception on a personal level as an individual.

It should be emphasized that the object of this study is event networks in which non-formal educational practices are actively used for all age communities. Therefore, any outside interference in the development of such networks may lead to unplanned or unexpected results:

according to the so-called butterfly effect, this is typical when dealing with an object that evolves according to nonlinear, synergistic laws.

Methods of self-organization of all age communities in the field of non-formal education include play activities; project activities aimed at identifying and forming common values and interests of the group determined by a particular political, socio-cultural or educational situation; independent group activities in the direction chosen by the polysubject; crowdsourcing [20], participation in social network communities [21]. Nowadays, social networks, the predominant form of self-organization in youth communities, require special attention.

As one of the most effective methods for self-organization of educational communities of all ages actively using non-formalized practices, M.P. Konzevoy [22] suggests considering crowdsourcing. In this method of community activity, networks are organized to solve a specific socially significant task. Some researchers also consider crowdsourcing as a certain practice aimed at procuring the necessary (required) educational services for all age communities, new ideas (projects), or some new educational content through collaborative arrangements in order to solve the problems of the educational system [23, 24]. It is important to note that the emergence and recognition of non-formalized education are associated with the same phenomena as the introduction of crowdsourcing [22]. The group creation of educational resources and the change of educational content are the basis of the modern internet space. Crowdsourcing can be seen as a mechanism for the transition from traditional social communities (information or event-driven) to network communities. Crowdsourcing is actively used today in building interactions between educational organizations and other socio-cultural institutions. Real results today are characterized by the interaction of museums with each other, a museum and an educational institution (preschool, school, university), and more often – a public institution.

In some cases, for the success of joint activities of various institutions focused on creating the project, so-called guided self-organization is used. To apply it, various formal (formalized) education institutions select programs that were previously considered mandatory. The mandatory components of the project include (depending on the type of institution and the initiator of the project) whole subjects, comprehensive course programs, and city tours. Teachers of such institutions introduce students to a certain platform, form a network community based on this platform, post a list of information sources on the selected programs in the internet resource, and create a list of tasks and questions. The preparatory activities for the implementation of the project promote the students' self-organization processes in the field of non-formal education. Formal motivation for one's education can be transformed into non-formal if the student has internal motivation. Nowadays, such a transition from formal to non-formal motivation is rarely observed. These processes can promote the allocation of the field of independent activity of participants in non-formal (non-formalized) education.

The modern labor market sets the requirements for preparing a competitive, independent personality, self-confident in its decisions, responsible for its actions and results, and ready for changes in life and professional activity. These requirements demand a unit capable of managing educational and professional activities, setting priorities and goals, and developing the necessary skills from the educational system.

Independent activity that precedes the processes of self-organization can be considered a result of educational activities that are accompanied by a meaningful transition of the student's learning process from memorization to the practices of independent information acquisition and the formation of experience in its application to the development of initiative, a subjective position in education, and finally to competitiveness. In addition, the development of independence in educational activities contributes to the formation of self-control mechanisms for the personal development and self-realization of the student.

The complexity of such a task means it is difficult to solve it with the resources of an educational institution – even if the student chooses it. To solve the problem, social partners can be used. These include educational and educative organizations (centers for preschool development of children, general educational organizations, centers for extracurricular activities, centers for continuing education of adults, universities), traditionally non-educational social institutions that carry out educational or educative programs, and educational practices that create conditions for the formation of a personal subjective position. Nowadays, there are many such organizations. It is possible to plan cooperation with library and museum centers, theater troupes, public institutions, youth groups, family and tribal communities in a big city and a small town.

The key condition for the development of the sphere of independent activities of students in all age communities, the self-organization of students in the structures of non-formalized education, and the result of jointly organized activities of socio-cultural institutions according to the principles of social partnership, is the presence of a network underlying the developing educational space, created at the initiative of the institution and the community, promoting non-formalized education [5]. The resources of the educational space can be realized by transforming the environment into a place with different forms and technologies of non-formal education recommended for all age communities. In the context of this study, the educational space is presented as a pedagogically transformed educational environment. Active participants in these processes (or subjects of the space) are event communities that self-organize and enrich each other to realize certain projects.

Self-organization of educational activities is a multistage process that includes the processes of motivation and position formation in a potential educational subject. Self-organization of educational activities can be presented as a series of processes striving to reach a mutual understanding between generations in an all age community, the promotion of the principle of freedom-responsibility-dependence in the community, coordination of priorities and abilities of subjects, and the planning and organization of educational or educative meetings (or events) for of members of an all age community.

The following stages of formation and development of the independent activity of subjects of the educational space include: the creation of a system of preliminary adaptation of students to the conditions of education and readiness for independent activity; elimination of psychological and emotional stress in the conditions of educational activities; mastering the system of tasks for the reproduction of information; formation of value orientations; development of productive activity; formation of the author's approach to creative activity; participation in children's and adult communities, project groups and the presentation of pupils' opportunities.

We have proved that there are several levels of independent activities of subjects in the educational space of non-formal education. The first level is associated with creating and implementing test tasks to assess each potential student's readiness for independent activity. Such assessment provides objectivity in determining certain knowledge. A certain list of game tasks is carried out at the second level. Based on the results of the method of participant observation, the curator can conclude the development of the reality of the educational space by the potential subject. For example, the textbook УGames of the Peoples of the World," created by teachers based on traditions from around the world presented in the Museum of Anthropology and Ethnography, provides educational tasks for children aged 6–12 years as well as parents and teachers in the museum space. The game tasks were developed based on games played in the American and African continents, as well as multinational countries such as Azerbaijan, India, China, Korea, Russia, and Japan, and are a resource for joint independent creativity of adults (parents, teachers) and children (preschoolers, elementary school students).

The tasks included in the textbook have proven effective in overcoming passivity in collaboration between children and adults. The public experts (both organizers and initiators) noted that students working with the textbook could form a number of skills and competencies: concentrating, focusing, and understanding the technique of applying a particular scientific topic. The development of imagination, creativity, and the formation of ideas about space and time are indicated; the ability to work in teams is developing. Artistic creativity and drawing are important for realizing the child's potential in the proposed situations in self-organized communities of all ages. In childhood (until adolescence), drawing can be considered a playful activity. When drawing, the child fantasizes and changes the immediate environment in which they acquire and develop the necessary communication skills with peers and adults. A child needs to imagine what they are drawing. At the same time, vital values are formed in the child: the health of each person, positive work, respect and love for the small and large motherland, cognitive interest, and the desire to create something and express an opinion. Active use of play situations for children, and professional situations for adults, incorporates the principles of creativity, visibility, and usefulness to learning. These experiences can then be easily transferred to informal practice. The third level is associated with independent research. The activities of trainees (pupils, students) include educational and popular science seminars, conferences, carrying out specific educational and research tasks, homework, and final projects traditionally organized in educational institutions. In recent decades, educational and research activities for preschool and school children have been organized in collaboration with parents, teachers, and professionals from non-educational institutions. The use of problem situations shifts the emphasis from reproductive to creative activity methods and contributes to the self-organization of research and other creative groups. Creative projects offer maximum freedom to all who participate in the activities of the project team (research projects have certain limits). The curator of the group outlines the general tasks of the project and builds pathways and solutions. The project participants must understand the planned outcome and its personal meaning in this case. It is assumed that the project participants will work intensively with bibliographic sources, archival documents, and other materials that allow finding ambiguous solutions. To work on a creative project, the community of different age groups uses the space of the discussion club.

Of course, the organization of such work cannot be sporadic. Programs and projects for the development of student autonomy within educational institutions create the conditions for the emergence of a field of dialog in creative communities of all ages, involving students and their parents and teachers. In this way, group subjects can be prepared to develop new areas of non-formal education.

Self-organization can be seen as a prerequisite for developing non-formal education systems and the expansion of their opportunities. Event-based educational networks can serve as an example. Self-organization makes it possible to achieve unplanned effects and positive results by understanding the intended meaningful attitudes, algorithms, or mechanisms for carrying out projects with minimum time and resources. The self-organization processes lead to complications in educational structures, but self-organization can also lead to deterioration. The phenomenon of self-organization is important for synergetics [6]. However, the description of self-organization is often contradictory. An educational system that uses self-organization in education is understood as a complex of elements connected by stable links and characterized by a formed structure and system properties. Often self-organization is understood as an arbitrary refinement of an already existing system. Self-organization of participants in educational processes can occur at different levels (at the level of teachers, students, and the level of educational systems, and educational communities, at the level of the educational system as a whole, and in an integral educational space).

The management of such complex, dynamic, open, self-organizing systems in a multi-age community is based on the logic of a synergetic approach. According to M. Ozhevan, the leader must consider the managed system's characteristics, which directly depend on the degree of its self-organization and on the leader's ability to conduct a dialog with the participants in educational processes. Many risks can be avoided if the subject-subject principle is applied in management. Otherwise, the leader is more likely to manipulate participants in daily educational practice than lead them with negative consequences. A synergistic approach to managing regional non-formal education leads to the self-organization of the population and the decentralization of educational management. V. Khitsenko [25, p. 87] states that decentralized structures effectively solve modern educational problems. Such processes create influential leaders and teachers who can perform leadership tasks, including the formation of educational demands.

Conclusion

In conclusion, the creation and activities of all age communities in non-formal education (the creation of event-based educational networks) require significant changes in the activities of leaders in the formalized education system. Quality, meaningful, and satisfying non-formal education can only exist if students and adults have the opportunity and an appropriately prepared space to use their creative powers and imagination.

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Yakushkina M. S., Doctor of Pedagogical Sciences, Head of the Laboratory, Branch of the Federal State Budget Scientific Institution "Institute of Education Management of the Russian Academy of Education" (ul. Chernyakhovskogo, 2, Saint Petersburg, Russian Federation, 191119).
E-mail: vosp_spbgu@mail.ru

Ilakavichus M. R., Doctor of Pedagogical Sciences, Professor, Saint Petersburg Academy of Postgraduate Pedagogical Education (ul. Lomonosova, 11–13, Saint Petersburg, Russian Federation, 191002).
E-mail: marinaorlova_99@inbox.ru

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MODERN ASPECTS OF STUDYING RUSSIAN TERMINOLOGY BY INTERNATIONAL STUDENTS AT THE PREPARATORY DEPARTMENT IN A TECHNICAL UNIVERSITY*

***Lyudmila I. Yaritsa*[1], *Battsetseg Narmandakh*[2]**

[1] *Tomsk State University of Architecture and Building, Tomsk, Russian Federation*
[2] *Representative office of Rossotrudnichestvo in Mongolia, Russian House in Ulanbatar, Ulanbator, Mongolia*

Abstract. In this study, one of the aspects of teaching Russian as an international language, namely the teaching of mathematical terms in the preparatory department of a technical university in Russia, is considered. The relevance of this subject has arisen due to the growing number of international students in Russian universities and the need for them to master the Russian language as soon as possible to continue their studies at Russian universities.

This work aims to describe the learning process of Russian scientific vocabulary and terminology of technical disciplines, especially the language of mathematics, by international students from the countries of the former Soviet Union studying at the Preparatory Department of Tomsk State University of Architecture and Civil Engineering. The complexity of mastering scientific vocabulary in Russian arises from the characteristic differences between Russian and Turkic languages.

A linguistic experiment was conducted in which students heard and wrote down scientific terms, words, and phrases in Russian. Students were given a dictation test rich in scientific vocabulary. The results have been gathered, and numerous errors in spelling scientific terms have been pointed out. Studies in Russian universities take place mainly in Russian, with active use of scientific vocabulary, which is extremely difficult for people who are just beginning to learn Russian. After correcting the mistakes and explaining the correct spelling of the words, the dictation is repeated. The results obtained are compared.

The features of deviations from the norm are identified, described, and structured, and options for working on the implementation of a program for the development of normative writing skills in international students are suggested. For example, it is quite challenging to determine the boundaries of a word, to identify differences between prefixes and prepositions, the normative spelling of vowels in the endings of nouns, adjectives, and verbs, and the spelling of fricative consonants.

Keywords: *higher education in Russia, teaching international students, Russian as a foreign language, scientific language style, scientific terminology, language of mathematics.*

In recent years, the percentage of international students at Russian universities has increased. There are many reasons for this. Firstly, the changing role of teachers, their competencies [1, p.41; 2–4], the academic mobility of students [5], and the requirements for accessibility and improving the quality and efficiency of education [1, 3]. Secondly, the cost of education in

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Russian universities is much lower than in European and American universities, which makes education in the Russian Federation more accessible [5].

International students who have completed a one-year (one-and-a-half-year) course of study at the University Preparatory Department can study at any university in the Russian Federation [5, p. 70].

However, the increase in the proportion of international students at Russian universities is accompanied by a deterioration in the mathematics performance of most international students, especially if they pay full tuition [6, 7].

During one year (sometimes one-and-a-half-years) of studies at the preparatory department, international students of a technical degree program must learn the basic material of courses such as scientific language, mathematics, physics, computer science, and technical graphics in Russian.

The study of mathematical language is introduced into the educational process after two months of Russian language teaching in parallel with the scientific language style course.

The experience of teaching in the preparatory department has shown that in recent years there has been an increase in the number of international students who have difficulty in memorizing a large amount of information, are unable to grasp the essence of the text, and work independently with literature in Russian [8, 9]. Poor education required the activation of cognitive activity of both students and teachers, for whom an important aspect of pedagogical activity was the activation of the competence-based approach, the formation of knowledge and technologies, and the strengthening of communicative orientation [10].

Therefore, teachers of Russian as a foreign language teaching international students in the Russian Language Preparation Department are constantly looking for new forms and methods of organizing students' educational process and independent work [10].

We consider the study of the language of mathematics as an extremely important element of the curriculum of a technical university, and within the framework of education, we set the main tasks for teaching international students:

– To familiarize students with mathematical terms, definitions, concepts, symbols, signs, and notations, the knowledge which they need for the study of higher mathematics

– To teach how to recognize the main idea in a mathematical text and write a summary

– To teach how to write a mathematical text using mathematical symbols [11].

In the initial stage of teaching international students in the preparatory department of a technical university, the main problem is insufficient knowledge of active vocabulary. This prevents them from developing the linguistic and communicative skills necessary for learning [6, 11–14].

The Russian language is necessary for international students to learn about their future profession, set a goal, and choose a way to achieve it.

To successfully master a technical discipline (due to the different curricula) in the conditions of gradual mastery of the Russian language, the student needs methodological support [10, 11].

In this case, the study of mathematics with the inclusion of its universal symbolic language can help in learning Russian and contribute to the formation of an internal language system in the minds of students as well as the study of the language of their major, which is necessary for successful learning in the future. Therefore, it is necessary that the student understands the lecture material, learns to highlight the most important points in the text of the lecture, can write a summary by themselves, and educate themselves [11].

The study of mathematical terms in Russian first takes place in the scientific language style classes in Russian as a Foreign Language course and is gradually deepened and systematized in the mathematics classes and then in chemistry, physics, and technical graphics.

Students learn familiar formulas and graphs of functions in written form, solve equations similar to those they solved in school while learning in their native language, hear terms in Russian, and thus learn technical disciplines.

One of the most important tasks of teachers of mathematical disciplines for international learners is to teach students to use mathematical terminology in Russian, develop the ability to formulate definitions and theorems, and write them correctly in Russian [9, 14, 15].

Mathematical symbols: = – equality (equal); ≠ – inequality (not equal); < – strict inequality (less than); > – strict inequality (greater than); ∈ – set membership (belongs to); ∉ – not in; ∃ – existential quantification (there exists); ∀– for any; ∪ – set-theoretic union (union); set-theoretic intersection (intersection), and so on., are understood by speakers of any language, and their meaning does not change depending on the language.

The language of mathematics can serve as a tool. Using familiar symbols instead of words makes it possible to construct already known mathematical statements and control whether or not students perceive this information and how completely and accurately it is perceived.

With the help of mathematical symbols, it is possible to create associative structures from other subject areas, thus expanding students' vocabulary and organizing the acquired knowledge into a system [16, 17].

Scientific terminology is first learned in class through the scientific language style course and then in mathematics, physics, and chemistry classes, contributing to more solid assimilation.

The terms are integrated into the lexical-grammatical constructions of the Russian language, using various language models from mathematical and technical texts.

Difficulties in comprehension arise when polysemantic words are used, whose meanings in the language of mathematics differ from those in everyday language. This work helps students better understand all the subtleties of the language and prepare for the perception of stereotyped expressions and non-adapted language, which they will encounter in lectures after the first year of study.

Cooperation with a Russian language teacher allows filling the content of the text material presented in class according to the needs of other disciplines [11, 8, 9].

In each of the lectures, students hear new theoretical information and actively solve tasks, which improves comprehension and memorization of the information, as students are involved in oral and written forms of work, and the fact that students think in their native language slows down the thinking process. Language and even the first lectures are written in their native language, which slows down the work.

To determine the difficulties in mastering Russian scientific vocabulary, we conducted a linguistic experiment on two groups of first-year students (26 people) from neighboring countries (Turkmenistan, Uzbekistan, Tajikistan, Tyva). At the first stage of the experiment, students were asked to write a mathematical dictation consisting of words, phrases, and sentences. Then we asked each student to explain why they wrote everything the way they did. Following this phase, an assessment was conducted. In the last phase, the students wrote the dictation again. The number of errors decreased significantly.

Errors in writing words in a non-native language are quite common among students from neighboring countries studying Russian at the Preparatory Department of Tomsk State University of Architecture and Building. Let us point out the main features of these errors (the students' spelling has been retained). The most common deviations from the norm are:

● Errors in agreement of subject and predicate (сифри обозначает числам, прямые линии чертит карандашом)

● Errors in matching a noun with an adjective, pronoun, and numerals (системотическое запис, числого вроженья, дватсот тесичь кник, пиятст девит лет)

● Misunderstanding of hard and soft consonants (простая дроп, запис, примерь, брать, часть, воть, сем, скопкы, розност, мырадоства, дватст, тесичь, дисичеьний, натуралные, покозатил, стеьпен, селое, тридцядь)

● Misunderstanding of palatalized (soft) consonants before vowels е, ё, ю, я (множетелья, рязные, сумь, трицядь, пятсот, девядцот, семдесят, семьдесять)

● Incorrect understanding of unvoiced/voiced consonants (сполнизетися, девядь)

● Incorrect use of vowels that are similar in spelling or pronunciation (розност, корондашом)

● Difficulty in perceiving vowels at the end of words (вичетания, записивый, слогаемо, степение, тысячат, девитносто, тесичь, вычитаеме)

● Difficulty in pronunciation, perception, and spelling of a vowel between two consonants (внесение, дление, вражение, взведение, пиятст, дватст)

● Incorrect use of singular and plural nouns (орифметический действия, сложенья, слаженииия, для шота предмета, десятичное дробь, две тысяча)

● Difficulty in pronouncing and spelling two or more adjacent vowels, omitting one of them (призвидения, действо)

● Difficulties in determining the gender of nouns and adjectives (нотуралное запис, системотическое запис, кводрадный скопкый, длимая, присти опши зимнатилю, сменишиния, положителная число, отресателная число, одинаковая знаки, примий линии)

● The difficulty of determining the location of the soft sign in words (суммь, дильтил, дисичеьний дрок, натуралнье, стеьпен, чемь, частьная)

● The absence of the soft sign (положитилнийе, чеслител, паказатил, болши, девятсот, пят, уминшаемоя, болшее чем, меншее чем, розност, дроп, степен)

● Difficulty in determining word boundaries, incorrect use of prepositions and prefixes, combining two words into one or forming two words from one (спойумыщ, дву знанны число, вы несинья вномножесинья, заскопке, не равенство, вы читаниемое, вилентна метро, противо положнее, привнисти к общезнаминатилью)

● Replacing an unfamiliar and therefore unintelligible word with a familiar, understandable one (понятное в математике – понятие, часть моя – частное, степи – степень, десятьтысичное дроп)

● Difficulty in pronunciation and perception of a sustained consonant (расскрытие, натуралнные)

● Pronunciation of two- to three-syllable words is distinguished with great difficulty. Consonants are often spelled arbitrarily (записуют, тиримилие черти корондашом, нужно скратик зиминнатилю, ротсиональный покозатель);

● Difficulty in perceiving the sound [ы], inconsistencies in spelling arises from its absence in the students› native language (записивит, внесение, скопкый, мырадоства, вороженья, даситычная дроп).

The table shows the words and phrases dictated by the teacher and the written results of the students; in most cases, it is misspelled; the explanations and possible causes for the errors made are given.

Table 1

Words and phrases dictated by the teacher Words and phrases	written by the student	Notes
понятие математики	понятное в математике	Difficulty in perceiving a word in a non-native language. The word “понятное,” which the student knows, is used to explain an unknown lexeme “понятие”
для счёта предметов	для шота предмета, для шёта притметов,	Misinterpretation of hard and soft (palatalized) fricative consonants (ш/щ) and paired voiced and unvoiced consonants (д/т)
используется	сполнизетися	Misinterpretation of voiced and unvoiced consonants (д/т) and hard and soft (л/ль), additional consonants appear
записывают с помощью цифр	записивит с помнит сифр, спойумыщ	Students do not hear a difference between (ы/и, ц/с, о/ы). The soft sign separation function is hardly perceived by the ear (с помощью)
двузначное число	дву знанны число	“Дву” – a word with similar pronunciation as “два”, the sound [ч’] is omitted as it remains unheard
запись натурального числа	нотуралное запис	Misunderstanding of hard and soft consonants (л/ль, с/сь), the word order is incorrect; one word is missing; no agreement between adjective and noun
записывают	записивый	Misunderstanding of hard and soft (с/сь), the ending is not perceived by the ear and is replaced by what seems clear to them
систематическая запись	системотическое запис	Misunderstanding of hard and soft (с/сь), misunderstanding of unstressed vowels, difficulty in mastering unstressed vowels o/a in the root and at the end of words, incorrect use of adjective and noun agreement
вычитаемое	вичетания	Difficulties in listening comprehension of words, the substitution of vowels at the end of words in nouns in singular and plural, misunderstanding of hard and soft (вы/ви)
	вы читаниемое	Boundaries are defined incorrectly (“вы” is written separately, as a personal pronoun), difficulties in listening comprehension, formation of invented morphemes (читаниемое)
уменьшаемое	уминщаемное	Misunderstanding of hard and soft (н/нь, ш/щ, н/нь, ш/щ); additional letters are added to the word (-емное)
разность	розност	Misunderstanding of stressed vowels (a/o), writing a letter similar to the spelling of (a/o). Misunderstanding of hard and soft consonants (т/ть)
пять тысяч	пятьтысяч	Difficulties in defining the boundaries of digit spelling. Difficulties in pronunciation (тьт) are not observed
две точки	дветочки	Numerals are written in a word with a noun.
разные знаки	разнйзнаки	This phrase (adjective + noun) is written in one word, although it is almost impossible to pronounce five consonants together (знйзн)
частное	часть моя	Substitution of an unfamiliar word for one already heard and therefore familiar
раскрытие скобок	расскрытие скобок	Misunderstanding the sound duration of consonants

Continuation of Table 1

Words and phrases dictated by the teacher Words and phrases	written by the student	Notes
вынесение	внесение	Difficulty in pronunciation and perception of vowels, the student does not hear a vowel between two consonants; the meaning of the word is reversed
вынесение множителя за скобки	внесение множетелья	Difficulty hearing vowels, the student does not distinguish between a vowel in a position between two consonants; the lexical meaning of the word changes to an antonym (вынесение/внесение); difficulty writing a soft consonant: instead of (ля)] the student chooses to write the palatalized (л) with a soft sign
	вы несинья вномножесинья заскопке	Difficulty in determining the boundaries of words (вы – is separated, заскопке – in a word, вномножья- in a word); writing a separating soft sign (-нья instead of -ния)
	внесение обжего множателя	Difficulty hearing a vowel between consonants (множателя). Misunderstanding of the hissing consonants (ж/щ) – обжего
квадратные скобки	кводрадный скопкый	Misunderstanding of voiced and unvoiced consonants (д/т, п/б), hard and soft (ки/кы); there is a desire to complete the word with a consonant (й)
возведение в степень	возбудемием степи	Misunderstanding of consonants (б/в) that are close in spelling, the desire to complete the word with a consonant. Substitution of an unknown word (степень) for one already heard and known (степи); errors in spelling word endings: Misunderstanding of vowels in endings
показатель степени	показателы стемныи	Misunderstanding of vowels that are close to each other in spelling (и/ы), as well as misunderstanding of hard and soft consonants (л’/л), in the second word, there is an ambiguous perception by the ear and consequently writing of additional letters (н/мн)
неравенство	не равенство	Incorrect definition of word boundaries (spelling error)
	мырадоства	Misunderstanding of hard and soft consonants (м/н) and those similar in spelling (в/д), misunderstanding of hard and soft consonants (не-/мы-)
в целое число	вселое число	Incorrect definition of word boundaries, incorrect word division, misunderstanding between a preposition (в) and a prefix (в-), misunderstanding of hissing consonants (ц/с)
деление	дление	The vowel sound (е) is reduced. Between two soft consonants, the vowel (е) is not defined (neither pronounced nor written)
делимое	длимое длимая делимейе	No (е) between two palatalized consonants. Incorrect use of sounds after the stressed vowel at the end of a word; difficulty in gender determination

Continuation of Table 1

Words and phrases dictated by the teacher Words and phrases	written by the student	Notes
делитель	длитель, дилетьы, дилити	Omission of the sound [э] in the pre-stressed position; between two palatalized consonants, the sound [и] is not always determined; writing a palatalized consonant with a separating soft sign (дилетьы); misunderstanding of sounds at the end of a word (ти/тель)
сложение	сложенья слаженииния	Difficulty in determining the gender of a noun. Misunderstanding of sounds at the end of words (-ья/-ниния), repetition of similar sounds (-нини-)
слагаемое	слогаемо	Loss of a vowel, misunderstanding of vowels at the end of a word. Of the two vowels at the end of a word (-ое), the last one is not heard by the student and, therefore, not written down
множитель	множитик	Difficulty hearing the final vowels and consonants in the suffix (-тель/-тик)
произведение	призвидения	Reduction of vowels at the intersection of morphemes [а, и], the sound [а] is not written with the letter (о)
числовое выражение	числовое вражение; числовое вложение	Reduction. Between two hard consonants (в, р/л), the vowel (ы) is not present; incorrect pronunciation of sonorous consonants [р, л]
	числового вороженья	The sound [ы] is not heard because it is not present in the languages of the neighboring countries. This sound is either replaced by another vowel or not written at all. Difficulty hearing the end of the word (-енья)
	числого вроженья	Difficulty in pronouncing and writing the adjective (числого instead of числового); between two hard consonants (в, р), the vowel sound [ы] is not heard, contraction occurs
	числагова вражение	Difficulty in pronunciation and spelling of the adjective (числого instead of числового); between two hard consonants (в, р), the vowel sound [ы] is not heard, contraction occurs
возведение в степень	взведение в степень	Contraction; between two hard consonants (в, з), the vowel sound [ы] is not present
	васбидения степин,	Misunderstanding of consonants (в, б) that are close in spelling; there is no preposition; there is no soft sign at the end of the word, there is no distinction between hard and soft consonants (н/нь)
делится нацело	1)делится насело, 2) делетьсонатсое, 3) делетцанадсова, 4) делетьсянадсоло	Misunderstanding of hissing consonants (с/ц); 2,3,4) Difficulty in defining the boundaries of a word (instead of two words, students write one word); difficulty in hearing and understanding words
арифметические	архимитические	Difficulty in perceiving sounds by ear, misunderstanding consonants (ф/х); incorrect order of letters (архи-/ариф-)
арифметические действия	орифметический действия	Misunderstanding of vowels in post-stressed syllables (-ий/-ие): difficulty in perceiving the duration of sounds (-ие/-ий); the desire to end the adjective with a consonant; misunderstanding of gender and number aspects of adjectives (masculine and neuter)

End of Table 1

Words and phrases dictated by the teacher Words and phrases	written by the student	Notes
действие	действо	Misunderstanding of vowels at the end of words (о/ие), contraction occurs.
билет на метро	вилентна метро	Misunderstanding of consonants (б/в, т/нт); difficulty in determining word boundaries (the preposition НА is written together with the previous word and has become a prefix)
аспирант	аспираметь	Misunderstanding of sonorous consonants (н/м); between two consonants, there is a vowel (е), a tendency to open a closed syllable; misunderstanding of hard and soft consonants (т/ть)
записывают	записуют	Misunderstanding of consonants in the middle of a word (there is no suffix -ыва-)
с помощью цифр	с помуши сифров	Misunderstanding of hissing consonants (ц/с), hard and soft (ш/щ), misunderstanding of vowels (о/у), misunderstanding of consonants at the end of words (Ø /-ов).
скобки	скопкы	Misunderstanding of hard and soft consonants (кы/-ки) at the end of a word. Phonetic writing (they write what they hear)
пример	примерь	Misunderstanding of hard and soft consonants (р/рь), at the end of a word the student writes a soft sign; the noun is changed to a verb in the imperative
брат	брать	Misunderstanding of hard and soft consonants (т/ть) at the end of the word, the noun is changed into a verb in indefinite form
вот	воть	Misunderstanding of hard and soft consonants (т/ть) at the end of a word
юрист	юристь	Misunderstanding of hard and soft consonants (т/ть) at the end of a word
час	часть	Misunderstanding of hard and soft consonants (с/сь), a soft sign is written at the end of the word
семь	сем	Misunderstanding of hard and soft consonants (м/мь), no soft sign at the end of the numeral
цифры	цифри	Misunderstanding of hard and soft consonants (ры/ри), there is no sound [ы] in the native language
чей	чень	Misunderstanding of voiced consonant [й’], replacement with a more understandable sonorant [н’], both sounds are sonorant and soft
цифры обозначают числа.	цифри обозначает числам.	There are misunderstandings of hard and soft consonants (с/си, р/ри), misunderstanding of (ц/с); there is no sound [ы] in the native language. The subject “цифры” (plural) does not agree with the predicate “обозначает” (singular). Error at the end of the word: instead of “числа” there is “числам”, the consonant “М” is added
меньше, чем	менши чем	Misunderstanding of hard and soft consonants (н/нь), ignoring punctuation, no comma (before conjunction – чем)
дробь	дрок	Misunderstanding hard and soft consonants (п/пь), replacing a voiced consonant with a voiceless velar stop ([п’] /[к])

Continuation of Table 1

Words and phrases dictated by the teacher Words and phrases	written by the student	Notes
простая дробь	прастой дрок	Incorrect use of the gender of the noun due to the peculiarities of Turkic languages; misunderstanding of consonants at the end of a noun (дробь)
обыкновенная дробь	абекванийе	Incorrect use of the gender of a noun. There is no category of gender in the native language
равен	правин	To pronounce a voiced [р], a voiceless [п] is pronounced before it: it is easier to pronounce it that way
показатель степени	паказатил степение	Misunderstanding of hard and soft consonants (л/ль); difficulty writing vowels at the end of words
разные знаки	разназнаки	Difficulty in determining the boundaries of a word when two words are merged into one; the ending of the first word is not present
тысяча сто два	тичисит сто два	1) One-word numerals are written correctly (сто два); 2) a three-syllable word (тысяча) is perceived with difficulty; 3) hissing (ч,с) are not distinguished in pronunciation
тысяча двадцать	тесичь дватсот	1) misunderstanding of the gender of the noun (тысяча – тысячØ); 2) incorrect use of the letter order (-сот instead of -дцать)
семьсот пятьдесят девять	пиятст семсот девит	1) incorrect word order; 2) contraction in numeral word (пятьдесят. -тст-); 3) wrong understanding of hard and soft consonants (т/ть, м/мь)
одинаковые знаки	одиннаковое знаки	1) misunderstanding of the pronunciation length of the double consonant (-нн-); 2) the adjective does not agree with the noun.

As one can see, spelling errors occur for a variety of reasons.

To improve the educational process in mathematics for students studying in a non-native language at a technical university, each teacher of Russian as a foreign language finds unique working methods to help students effectively study topics that are difficult for them [12, 13]. In mathematics classes, group work is actively used, which allows students to quickly and effectively engage in the work, try to understand the topic, and retell it to their classmates so that everyone understands [8]. It is especially important to plan the work of subject teachers so that it is possible to teach international students in close connection with teachers of Russian as a foreign language.

For effective learning and ensuring the assimilation of terms and vocabulary, special work is regularly carried out, which includes a large number of different types of tasks on various rules, for example, matching a noun to an adjective in gender, case, number (gender, number, case of nouns and adjectives, pronunciation standards). A dictation is then given again, and the level of knowledge of the terms is determined. Again, a pattern emerges – the more detailed and careful the vocabulary work, the fewer errors we find in the dictation text.

Listening comprehension is usually done in two phases to check and develop spelling skills. After the first reading of the dictation, the teacher checks, analyzes, and corrects the errors to avoid them in the future. Simple repetitions solve the spelling problem. Some students take longer to master difficult words. They need to repeat the vocabulary regularly and return to it from time to time during the semester.

Another option is possible. Give the words and speech constructions needed for the work in advance (with translation or with the task of translating new words independently) before class. As experience shows, this method will significantly facilitate and accelerate the vocabulary acquisition necessary for studying the subject. The linguistic abilities of each individual are different, and each student can choose an option for themselves.

We believe that the most effective option for teaching international students lies in the community of teachers of Russian as a foreign language and teachers of mathematics, physics, chemistry, biology, and geography.

Syntactic constructions from the scientific language style course must be memorized and edited before they can be used in class. Then students can approach the new topic prepared.

All this makes it possible to master scientific terminology in practical Russian classes, the language of physics, chemistry, and mathematics. However, when several subject disciplines are taught, a course requires a great amount of both time and mental effort from international students to effectively master, for example, mathematics, despite good mathematical skills and previous success in mastering the school curriculum. In addition, the oral speech of subject teachers is characterized by individual features. Therefore, it is necessary to adhere to uniform specifications, select tasks according to the lesson's objectives, make an effort to speak clearly and slowly, and be ready to repeat words several times.

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Yaritsa L.I., Candidate of Philological Sciences, Associate Professor, Tomsk State University of Architecture and Building (pl. Solyanaya, 3, Tomsk, Russian Federation, 634061).
E-mail: liya446@mail.ru

Narmandakh B., Representative office of Rossotrudnichestvo in Mongolia, Russian House in Ulanbatar (st. Tokyo 39 Bayanzurkh district, 12 microdistrict, Ulanbator, Mongolia).
E-mail: btstsg@mail.ru

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ADDRESSING DIFFICULTIES IN TEACHING MATHEMATICS TO STUDENTS WITH MATHEMATICAL LEARNING DISABILITIES*

Alexander Yu. Pigarev

Novosibirsk State University of Economics and Management, Novosibirsk, Russian Federation

Abstract. The essence and reason for the inability to master mathematics are described as a lack of working memory. This paper describes two main approaches to solving the problem of teaching mathematics to students with learning difficulties in mathematics (MLD): (1) training working memory and (2) reducing the load on working memory in the instructional process. It was found that the results of the first approach are ambiguous: Training working memory leads to its improvement, which is confirmed by the test results but may not lead to improvement of the mathematical learning process associated with the student's working memory. This justifies the primacy of the second approach. Both previously known methods for reducing the load on working memory in mathematics instruction are presented. A computer-based mathematics learning system developed by the author aims at automating basic computational skills (arithmetics, trigonometry, geometry). It is explained how to work with the developed computer-assisted learning system, which is based on the method of interval repetitions, and empirical data on the results of the system implementation are given.

Keywords: *mathematical skills, mathematics education, working memory, computer-assisted mathematics learning, interval repetitions, learning anxiety in mathematics.*

School children can be divided into Very Capable, Capable, Average, and Incapable according to the degree of development of their mathematical abilities [1, p. 191]. How does one deal with the inability to study mathematics? In the world of the digital economy, one cannot succeed in many fields without basic mathematical skills. After understanding the reason for the inability to learn mathematics, such teaching methods should be developed so that children with poor academic performance can get out of the vicious circle of failure and gain potential for growth and development.

The essence of mathematical learning disability

The differences in mathematical abilities of different students are reflected in the fact that "the same exercises, the same practical work, the same experience (as far as this Sameness can be judged) leads to different results in students with different abilities. For example, in some pupils (we call them Capable), these exercises lead to the development of the ability to see analytically and synthetically; in others, this is not the case" [1, pp. 252–253].

About students who are unable to learn mathematics, Krutetsky [1] states, "The study of mathematics is challenging for such students, despite their diligence; they cannot expect great success in mathematics, both in terms of speed of progress and level of achievement [1, p. 189].

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"Their mathematical skills are formed laboriously, with a large number of exercises, and are fragile-they fall apart easily when there are no exercises [1, p. 190]."

As for the age at which one can speak about the presence or absence of mathematical abilities, Krutetsky [1] says: "Mathematical abilities and their absence show up in the grades VI–VII in connection with the beginning of the systematic study of algebra and geometry. Furthermore, in grades IX–X, the abilities are completely reviled [1, pp. 101–102]."

Causes of the inability to study mathematics

Krutetsky in [1] did not disclose the reason for the inability to study mathematics. He only gives the following explanation: "...the inability to study mathematics has its root in a great difficulty in the selection of stimuli by the brain, such as generalized mathematical relations, functional dependencies, numerical abstractions and symbols, and the difficulty of working with them [1, p. 390]."

Within the framework of the computer metaphor, the concept of human working memory emerged, whose founder was Alan Baddeley, at the end of the twentieth century [2].

Working memory is a system that combines and transforms a limited amount of information it receives from the perceptual organs, short-term memory, and long-term memory. Working memory supports thinking processes; it is an interface between short-term and long-term memory and provides both the consolidation of long-term memory and the extraction of information from it [2].

According to the basic model proposed by Alan Baddeley [2], working memory consists of three main components, the "central executive, which acts as a supervisory system and controls the flow of information to and from subordinate systems: the phonological loop and the visuospatial sketchpad. The phonological loop stores verbal content, while the visuospatial sketchpad is responsible for visuospatial data. Both slave systems function only as short-term storage centers." (Fig. 1).

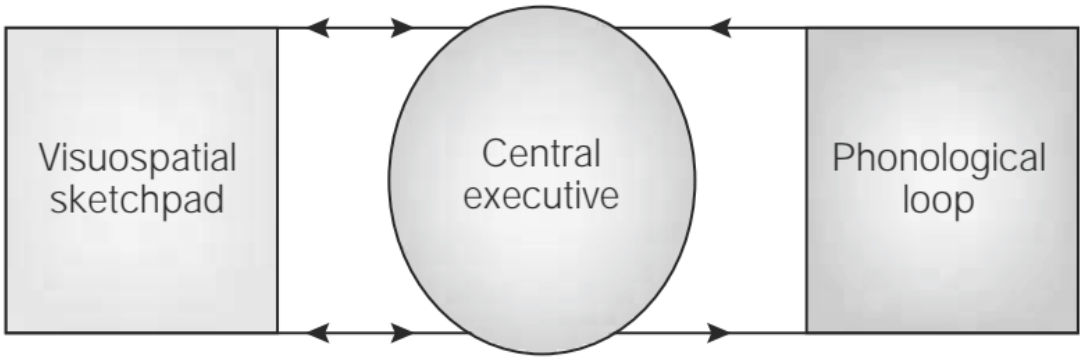

Fig. 1. A three-component model of working memory [2]

Later, a fourth subordinate system, an episodic buffer, was added to the model. It is responsible for the interaction of the visuospatial sketchpad and the phonological loop with long-term memory [2].

The extent of working memory was highly correlated with instructional outcomes, especially in mathematics subjects: "...memory skills clearly predicted mathematical skills and arithmetic skills [3, p.136]." This conclusion has been confirmed by many other studies, for example [4–7].

Thus, the lack of working memory is the cause of the inability to learn mathematics. All three components of the basic working memory model are essential for understanding mathematics. Mathematical ability is most strongly correlated with the visuospatial sketchpad, which is like a mental board on which numbers and variables are represented in calculation and comparison [4,

5]. The central executive and phonological loops determine the ability to solve verbal mathematical problems [6].

Based on the concept of working memory, two approaches to teaching mathematics to students with learning difficulties in mathematics have been developed.

Basic approaches to solving the problem of teaching mathematics to students with learning difficulties in mathematics

The first approach is to improve the student's working memory by exercising it or by seeking medical treatment if the deficit in working memory is some kind of injury, such as a concussion.

As for improving working memory with the help of a computer-assisted learning system, the initial results were auspicious, but later studies have called them into question.

The first work appeared in 2008 [8]. The authors argued that training a person's working memory with a computer-assisted learning system built based on an "n-back" task in a relatively short period (10–20 days) can not only increase the efficiency of a person's working memory but also develop the ability to learn and assimilate new knowledge. The authors "provided evidence for the transfer of working memory training results to the development of fluid intelligence." [8] According to their data, the more and the longer the training sessions were, the more significant was the improvement in fluid intelligence, which was determined by means of special tests.

This conclusion was refuted in [9, 2013]. Working memory training was based on the Cogmed platform (https://www.cogmed.com/). The training cycle consisted of 20–25 sessions. Each session lasted from 30 to 45 minutes and included eight exercises, and each exercise was repeated 15 times. The founder of this company, Professor Torkel Klingberg (M.D., Ph.D. Professor in Cognitive Neuroscience Karolinska Institutet), has published sixty-two articles and two popular science books on the benefits of the platform he created (http://www.klingberglab.se/torkel-klingberg/).

Working memory was assessed with the standardized test battery AWMA (Automated Working Memory Assessment) [9]. One of the authors created this test system in [9] Susan E. Gathercole. However, the Cogmed training exercises differ in content from the AWMA test system tasks, so the authors of [9] argue that working memory training improves working memory performance, as measured by "untrained" tests: "adaptive W.M. training significantly boosted performance on untrained W.M. tasks in children with low W.M. [9]".

Learning ability was measured with two test batteries: the Wechsler Abbreviated Scales of Intelligence (WASI) and the Kaufman Test of Educational Attainment (KTEA). Improving working memory performance based on the results of taking "untrained" tests did not improve learning performance based on the results of taking intelligence tests, leading the authors of [9] to conclude that working memory training is useless as a tool for improving academic performance. This study involved 810 schoolchildren.

On the other hand, the positive effect of training working memory on performance in mathematical disciplines is confirmed in [10, 2018]. In this study, 104 schoolchildren participated.

Schoolchildren in the same age group (8–13 years old) participated in both studies. However, the study conditions were different. In the experiment presented in [9], the training was carried out in a special laboratory; in [10], it took place in the school where the children were learning. In addition, the training programs were also different. In the study [10], there were also exercises to develop computational skills in addition to the classic working memory simulators.

Currently, specific working memory training benefits are still open and controversial. Many papers claim the benefits of such training, and even more papers question the effectiveness of this approach.

The second approach is to reduce the load on working memory during the learning process. When the load on working memory exceeds its limits, the student cannot process new material.

Methods for reducing the load on working memory in math class

1. Automate basic math skills (arithmetic, trigonometry, geometry) so that the computational process puts minimal load on working memory.

2. Use simple sentences when presenting new material, as compound and complex sentences overload weak working memory [11].

3. Keep statements and instructions short, containing no more than one "if" condition and relating directly to the current task. For example, one cannot give the following instruction until the previous instructions have been solved by all students in the class [11].

4. The reference materials for solving tasks should be at the level of the textbook on which the task is solved: on a tablet or smartphone, in printed form. Because if you look from a distant object (blackboard) to a close one (notebook), working memory can fail [11].

5. Mathematical facts (formulas, rules) frequently used to solve problems must be memorized because retrieving well-remembered information from long-term memory does not tax working memory, e.g., reduction formulas. There is a mnemonic rule that stresses working memory. Furthermore, if one memorizes frequently used formulas ($F(\pi \pm x)$, $F(\pi/2 \pm x)$), such a load can be eliminated [12].

6. Minimize the intensity of the new information flow by redistributing it over time. For example, teach a method for solving irrational equations in class, indicate that the solutions obtained must be checked by substitution, and postpone the justification for extra roots and the solution of irrational inequalities until the next lesson. Thus, extend the study of rules and exceptions as the lesson progresses [12].

7. Visualize the material in conceptual diagrams, charts, and mind maps. This reduces the load on working memory and provides a deeper awareness of the new information, leading to better retention [12].

8. Use mnemonics to anchor new information in long-term memory. Although mnemonics are not as commonly used in mathematics as in the humanities, they should not be neglected. For example, the Horse Rule in trigonometry combines the condition of replacing a function with a co-function using commonly accepted head movements to express agreement or disagreement [12]. Use a computer-assisted learning system.

A necessary condition for teaching the basics of elementary mathematics to students with MLD is individualization and a specially developed methodology: "A detailed study (during the year) of a group of MLD students has again convincingly shown that they have only an elementary level of generalization of the mathematical material available to them in the process of independent work. A higher degree of generalization (necessary for a satisfactory mastery of mathematics) came about only gradually due to very hard work and the direct help of the experimenter. In a number of cases, such generalization came about only as a result of work specially organized by the experimenter. In difficult cases, no generalization occurred at all." [1, p. 274–275]

As a result of his many years of research on mathematical ability, Krutetsky [1] concludes that "Students with mathematical learning problems need to be trained for a long time, with specially selected material covering all possible cases and combinations of insignificant features, so that a more or less elementary level of generalization is available to them" [1, pp. 258–259].

Prolonged training on specially selected exercises makes it possible to overcome the objective difficulties in learning mathematics for students with MLD since the automation of basic

computational skills (arithmetic, trigonometry, geometry) reduces the load on working memory in solving relevant problems and frees its resources for understanding the conditions and searching for algorithms.

Computer programs can become a generator of such specially selected exercises and, at the same time, a tutor who suggests the order in which they should be performed and evaluates the result of the work. The author has developed a computer-assisted learning system available at http://www.workingmemory.ru/.

Figures 2–5 show screenshots, and Table 1 provides a brief description. In addition, a link to a video describing the methodology for working with the training exercises can be found on the main page of the following website: http://www.workingmemory.ru/.

Registration is free to get an objective picture of the work with the training exercises.

Fig. 2. Screenshot of the training exercise “Mental counting.” Optimized for mobile phones

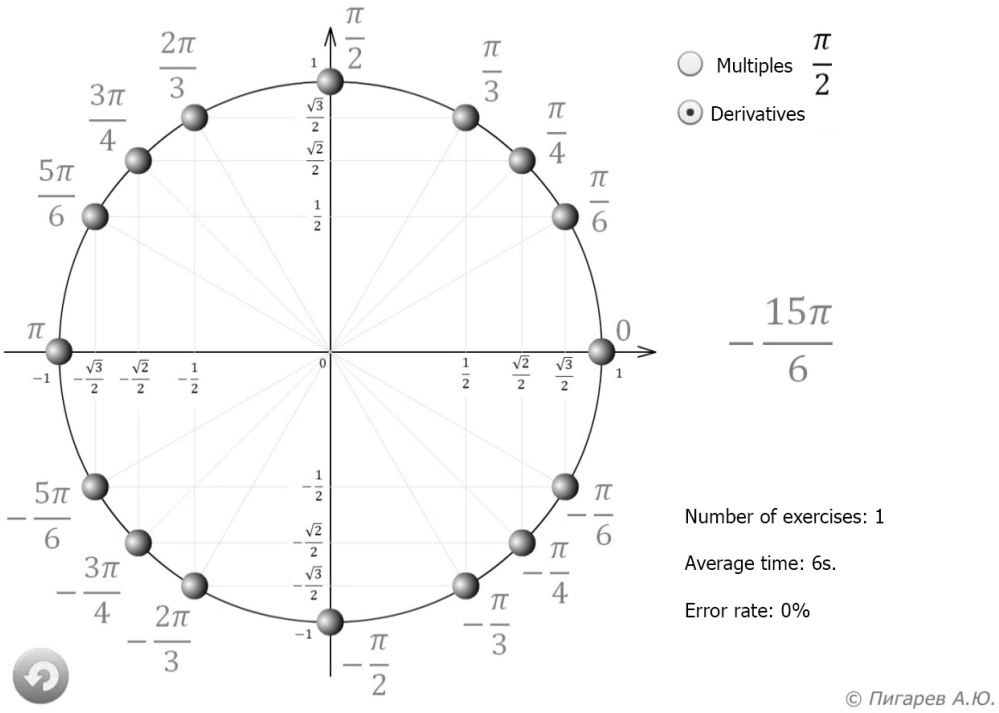

Fig. 3. Screenshot of the training exercise Unit Circle

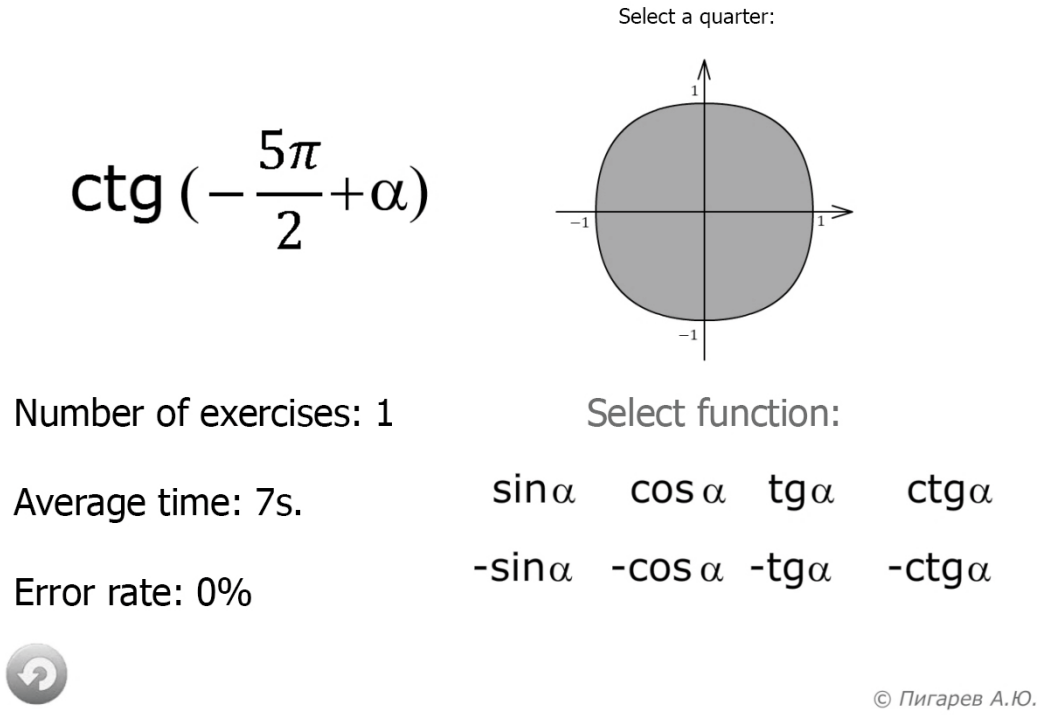

Fig. 4. Screenshot of the training exercise Reduction Formulas

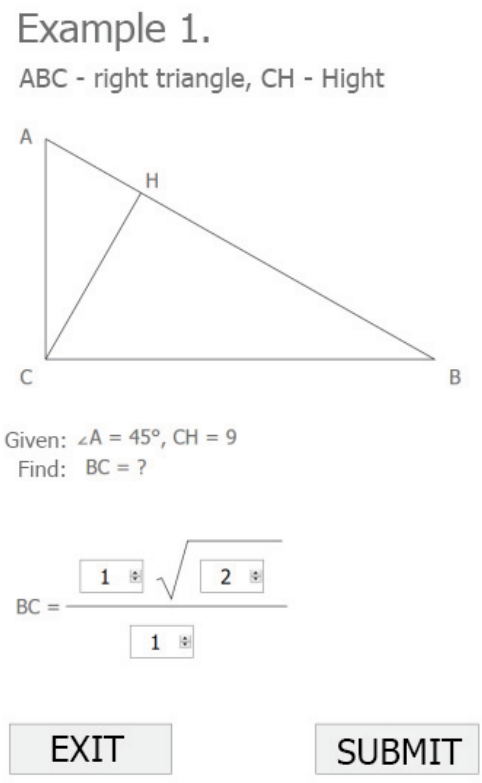

Fig. 5. Screenshot of the training exercise Right Triangle. Optimized for cell phones

Table 1

Brief description of computer-assisted training exercises published at: http://www.workingmemory.ru/

Training exercise name	Description	Numbers of tasks from the Unified State Exam in Mathematics (Russia, 2020)	Grades
Mental Counting	Develops mental counting skills, including the use of various methods and computational procedures	1–19	2–11
Unit Circle	Develops the ability to quickly find a point on a unit circle for a given numerical value in radians or degrees	5, 9, 10, 13	10–11
Reduction Formulas	Develops the ability to use reduction formulas without error when solving trigonometric equations and inequalities	5, 9, 13	10–11
Right Triangle	Develops the ability to automatically and accurately determine the relationship between the sides of a right triangle using the values of the trigonometric functions of the acute angles	6, 14, 16	8–11

Methodology for training exercises

1. Consistent study of the basic rules for performing arithmetic operations (arithmetic, trigonometric, or geometric).

2. Twenty minutes of daily practice for one month. One can see a positive dynamic by tracking the average practice time and error rate. The student subjectively feels that the arithmetic problems are solved easier, faster, and without errors.

3. After a one-month break, the training is repeated to consolidate computational skills in long-term memory.

The experiment participants were selected from the students of the preparatory course for the Unified State Examination in Mathematics (grades 10–11). Each participant was given a unique login and password. The results of each training exercise were stored as a separate dataset in the server database. The dataset contains a unique student login. At the time of writing, 31 students participated in the experiment.

As a result of the training, the average time to complete an exercise decreased significantly (Table 2), and the frequency of errors also decreased (Table 3). The decrease in the time for one exercise indicates a lower load on working memory, and the decrease in error frequency indicates a more efficient use of its resources.

The effect of the training is characterized by the feedback of the students themselves, both during the course: “Thanks to the training exercises, I got an excellent grade in school because I solved the problems in trigonometry optimally,” and after passing the exam in mathematics: “I did not make a single mistake in the second part of the exam...” These training exercises are not only a tool for teaching school children with MLD but also know-how for successful preparation for a state exam in mathematics.

Table 2

Average time in seconds to complete a training exercise considering the standard deviation

Training exercise	At the beginning of the training course	After the training course
Unit Circle	35 ± 20	13 ± 11
Reduction Formulas	33 ± 17	21 ±5
Mental Counting. Exercise in which one of the numbers is one-digit, and the other is two-digit	18 ± 7	7 ± 3
Mental Counting. Exercise on multiplication of two-digit numbers in the head.	57 ± 27	20 ± 11

Table 3

The percentage of errors in the number of correctly performed exercises considering the standard deviation (%)

Training exercise	At the beginning of the training course	After the training course
Unit Circle	54 ± 48	10 ± 8
Reduction Formulas	52± 32	29 ± 14

The thresholds of the indicators for working with the training exercises depend on the working memory and effort of the student. Therefore, the average deviations of the indicators are comparable to the average values in Tables 2 and 3.

The presence of time and computational error counters in the training exercises puts the student's working memory in the maximum effort mode, which indirectly contributes to its improvement through training. This effect was not quantified because the students' working memory was not measured. However, it should be considered as one of the arguments for the benefits of using such training exercises in the teaching process.

In any approach, it is important to consider the psycho-emotional state of the student. For example, poor academic performance and unsatisfactory grades can lead to Math Anxiety. Math anxiety is the fear of learning math and solving math problems. It is a feeling of tension associated with working with numbers and solving math problems in school or everyday life. Math anxiety develops in students at all grade levels because of negative past or present experiences. It is a lack of confidence in working with numbers and mathematical structures [13, pp. 166–167].

Anxiety of any kind leads to the release of the hormone cortisol in the blood. The primary function of cortisol is to direct the mind to the source of the anxiety and determine actions that will relieve the stress; pulse and blood pressure increase; the frontal lobes are no longer engaged in the study of mathematics or mathematical operations because they are preoccupied with a threat to personal safety. As a result, the student can no longer concentrate on learning and struggles with attention deficit disorder. The most crucial point is that anxiety affects the working memory's ability to store numbers in short-term memory and manipulate numerical expressions.

To reduce the level of anxiety, the teacher should provide individualized support to students: (1) develop in them a sense of confidence in dealing with numbers through a computerized training system and individually selected tasks appropriate to their level; (2) maintain a sense of accomplishment through grades that reflect the student's effort rather than their absolute level in mathematics; (3) encourage the development of a positive attitude toward mathematics as one of the greatest achievements of civilization.

Conclusion

The best results in teaching mathematics to students with mathematical learning disabilities can be achieved if we avoid overloading their working memory and encourage their positive attitude toward mathematics as a subject and as one of the greatest achievements of civilization. One method is to develop their computational skills using a computer-assisted training system developed by the author. This increases the efficiency of using working memory and frees up its resources for mastering problem-solving methods and absorbing new knowledge. Thus, the performance of students with mathematical learning disabilities in learning the basic course of school mathematics increases.

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Pigarev A.Yu., Candidate of pedagogical sciences, associate professor. Novosibirsk State University of Economics and Management, Department of Information Technology (ul. Kamenskaya, 56, Novosibirsk, Russian Federation, 630099).
E-mail: physflash@yandex.ru

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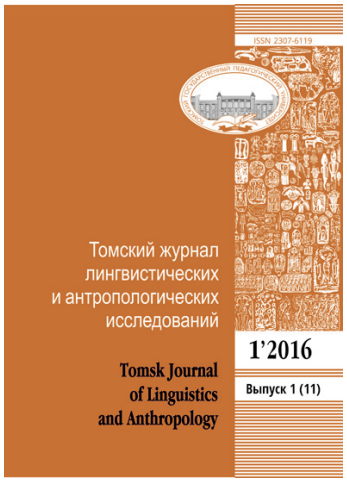
Tomsk Journal of Linguistics and Anthropology – a peer-reviewed scientific journal founded in 2013 and published four times a year. It is among the leading peer-reviewed scientific journals and publishes the main scientific results of dissertations from Candidates of Sciences and Doctors of Sciences, which have passed the Higher Attestation Commission of the Ministry of Education and Science of the Russian Federation. The top priority for the journal is to organize productive academic exchanges between experienced and young researchers in a wide range of topics in linguistics and anthropology, linked primarily by a common geographical area – Siberia, including genetically related and unrelated cultures of the past and present. In addition, the journal is naturally interested in theoretical, methodological, and technological aspects of linguistic and anthropological research.



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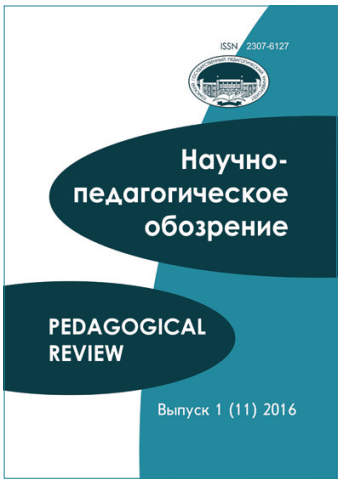

Pedagogical Review – a peer-reviewed scientific journal founded in 2013 and published six times a year. It is included in the list of leading peer-reviewed scientific journals and publishes the main scientific results of dissertations of candidates of sciences and doctors of sciences who have passed the Higher Attestation Commission of the Ministry of Education and Science of the Russian Federation. The aim is to acquaint the general scientific and educational community with current research in pedagogy, psychology, and learning and teaching methods.

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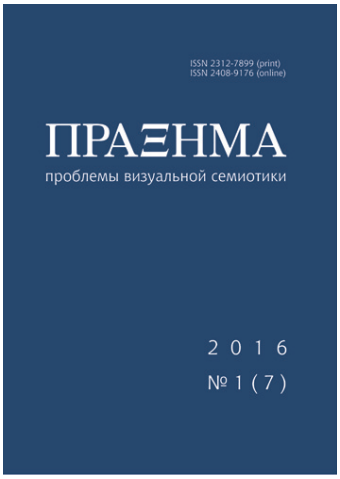

The journal "ПРАΞНМА. Journal of Visual Semiotics" ("PRAXEMA") is a periodical issue intended for the discussion of theoretical problems of modern visual semiotics, dealing with the study of visual aspects of the organization and functioning of culture as a communicative environment. It was founded in 2014 and is published four times a year. The journal is part of the ULRICHSWEB, SJR databases, and is included in the Russian Science Citation Index (RSCI).

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