

VI International Forum on Teacher Education

# Ergonomic Conditions of Improving Educational Process Quality

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## Abstract

The paper relevance is determined by the fact that the Russian state educational policy is aimed at ensuring quality of education at all levels. The issue of a need for high-quality educational process requires the system of education to change traditional approaches to education in general. Therefore, the study is aimed at checking the efficiency of ergonomic conditions, meant for improvement of the quality of younger schoolchildren education, their identification and testing. Meeting the study objective required conducting an experiment, applying an expert evaluation method and a mathematical statistics method – Spearman's rank correlation coefficient. The study results show that ergonomic conditions of the training of younger schoolchildren facilitate improvement of the school educational process, make the process of comprehensive development of the person and his/her individual traits efficient, provides for proper training of the younger generation in a safe and developing environment and maintain the health of younger schoolchildren and prevent study-related diseases (short-sightedness, scoliosis, etc.). Practical relevance of the study results lies in the fact that the study materials have served a basis for developing methodological recommendations for students of pedagogical majors on ensuring the training of younger schoolchildren with ergonomic conditions, which can be used in practices of primary school teachers, educational psychologists, social care teachers, as well as in the system of advanced training of teaching staff. Implementation of ergonomic conditions in educational institutions also offers new opportunities in training both of younger schoolchildren and of trainees of different age groups and with different educational needs.

*Keywords:* ergonomic conditions, quality, educational process, trainees, younger schoolchildren.

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Published by Kazan federal university and peer-reviewed under responsibility of IFTE-2020 (VI International Forum on Teacher Education)

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## **Introduction**

Modernization in the Russian educational system in accordance with the global tendencies imposes new rules of prioritizing in education. A strategic priority of the Russian state policy in the sphere of education is creation of a mechanism that will ensure constant and high-quality update of the education content. Such modernization of education has led to changes not only of the requirements to the conditions of educational process organization in schools but also of educational forms, methods and technologies. As a result, the issue of determining and implementing conditions for improvement of the modern educational process quality is becoming relevant.

At the same time, special attention is paid to creation of specific ergonomic conditions of training and education that will ensure safety, individual growth and maintenance of health of trainees and staff members of educational institutions, since the efficiency of functioning of the whole system of education and its certain components depends on these very ergonomic conditions. However, a contradiction emerge between the need for raising the quality of education and improving all its processes and a lack of conditions and technologies of training that meet the requirements of Russian and global standards.

## **Purpose and objectives of the study**

The study is aimed at checking the efficiency of ergonomic conditions, meant for improvement of the quality of younger schoolchildren education, their identification and testing.

## **Literature review**

Analysis of the modern pedagogical research shows an active scientific interest in the issue of education quality, which is one of the most pressing social issues. Issues of assessment of education quality and effectiveness are covered in studies of such scientists as Babansky (1982), Bordovsky et al. (2001), Davydova (2004) and others. However, the researchers have not touched upon the issue of improving the educational process quality through creation of ergonomic conditions.

Significant scientific results, providing insight into the ergonomic approach and ergonomic conditions in the educational environment of primary school, can be found in studies on pedagogical ergonomics (Belov, 2002; Kriulina, 2003; Okulova, 2011; Voronina, 2001; Zinchenko & Munipov, 1979), on pedagogical psychology (Vygotsky, 2008; Zinchenko & Munipov, 1979), in the concept of health-saving educational technology (Bazarny, 2004; Borisova, 2005; Smirnov, 2006) and in the ergo-design concept of an

objective-spatial environment of organizations and institutions (Danilyak et al., 1990; Kriulina, 2003; Kulaykina & Chaynova, 2009; Korzh, 1993; Litvak, 1999; Yasvin, 2001). Papers of these scientists dwell on the issues of ergonomization of education, its means and conditions, but there is no uniform classification of ergonomic conditions of training.

Analysis of publications on the issues of improving the educational process quality through creation of ergonomic conditions allows to note that this issue has not been adequately studied in pedagogy. For this reason, traditional models of improving the educational process quality in schools does not ensure socially-set effectiveness of general education.

Currently, the issue of improving the educational process quality through creation of ergonomic conditions, ensuring safe and comfortable development of trainees, in particular younger schoolchildren, is not studied in a consistent manner but is considered fragmentarily. In our opinion, such situation has happened due to an insufficient use of an interdisciplinary approach in training schoolchildren. It is reasonable to suppose that pedagogy has not developed theoretical fundamentals of improving the education process quality in schools through creation of ergonomic conditions yet.

According to ISO 8402, quality is defined as “the totality of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs” (1994).

Analysis of the concept of quality allowed to identify that it has two aspects: 1) meeting standards or specifications; 2) meeting consumer needs.

The sphere of education is also closely connected with quality. Education must meet the standards and social needs.

At the same time, the education quality is considered both as a result and as a process with a complex dynamics of development, conditioned to changes in activities of educational institutions and the person him-/herself, transformation of their socioeconomic, technological and political environment.

The term “educational process” has been studied in the papers by Isaev, Slastenin and Shiyanov, who define it as a “specially organized and goal-oriented interaction of teachers and pupils, aimed at solving tasks of development and education” (2002, p. 167).

According to Podlasy, the educational process is “developing interaction between the educators and educatees, aimed at achieving a specified objective and leading to a preliminarily outlined change in the state, transformation of properties and qualities of the educatees” (1999, p. 111).

Therefore, the “educational process” broadly means a totality of conditions, tools and methods that are applied in training and education and aimed at solution of a global task – to form a well-rounded person. The “educational process” is narrowly defined as a totality of content, tools, methods and forms of organization of training of certain categories of trainees (subjects) to obtain a specific result.

Examining the scientific literature indicates a complex nature of the notion “ergonomic conditions” (EC) in relation to pedagogical activity, fewness and narrowness of interpretations of this notion. At the same time, ergonomic conditions are considered as optimal material and organizational conditions of teacher and trainee’s activity (Danilyak et al., 1990; Okulova, 2011); as factors of health-friendly labor, comfort, all-round development of abilities and creative activity of the person (Rapatsevich, 2001; Runge & Manusevich, 2005); as conditions of optimal psychophysiological development of the student in the educational sphere (Nesterenko, 1973).

Based on the conducted content analysis of different interpretations of definitions of “ergonomic conditions”, we have specified the notion of ergonomic conditions of training younger schoolchildren, which are considered as a set of interrelated factors, ensuring success of the learning activity, individual growth, preservation of health and safety of trainees (Ryabova, 2013).

Let us move on to consideration of conditions of improving the quality of younger schoolchildren education which, in our view, are the main groups that form a set of ergonomic conditions.

Psychological and pedagogical conditions. This group of conditions is specified by scientific propositions of pedagogical and ergonomic studies on the issues of psychological and pedagogical support of children in the educational process of primary school (Davydova & Ryabova, 2012; Vygotsky, 2008; Zinchenko & Munipov, 1979). It consists of the following conditions:

We consider the condition “selection of the content of education with regard to ergonomic requirements” from the perspective of the conditions of implementation of the primary general education programme, forming part of the federal state educational standard (FSSES) (Guarantor, 2009). The educational standard includes not only the volume of the necessary general education training but also the maximum permissible volume of academic workload by study years. Within the framework of the state standard, ergonomic conditions set the main norms and rules, aimed at preservation of schoolchildren’s health in the process of their learning activities.

We define ergonomic requirements as the ones that are imposed to the educational environment in order to optimize activities of participants of the process with regard to their socio-psychological, psycho-

physiological, psychological, anthropological, physiological and other objective characteristics and abilities. In this case, ergonomic conditions serve a basis in the selection of the content of education, establishment of nomenclature of the training equipment, a choice of ergonomic requirements to teaching means, furniture, tools, office appliances, in forming an object environment of training.

The condition of “using a person-centered approach in the process of training younger schoolchildren” deserves particular attention. In order to implement the person-centered approach in education, it is necessary to analyze individual peculiarities of trainees (knowledge of peculiarities of temperament, nervous system properties, psychological peculiarities, etc.) and the influence of EC on these peculiarities. It allows to predetermine children’s reaction and gives an opportunity to choose necessary methods for training, education and necessary EC. That is why it is important that every teacher can draw up a brief “portrait” of each of his/her pupils. A developing effect of the training is determined by teacher’s focus on both age-related and individual peculiarities of younger schoolchildren. At the lesson, the teacher not only works on creating a favourable and comfortable environment but also appeals to schoolchildren’s personal experience, i.e. the experience of their own life, all the time. As a result, the teacher and the trainee build a reciprocal process, facilitating effective training of schoolchildren and stimulating them for positive motivation to learning.

The condition of “involving parents and colleagues into the process of organization of ergonomic conditions in primary school” implies raising the level of parents’ attention to training and education of children and raising the level of knowledge and awareness of schoolteachers about EC and application of such conditions in their practices. It is also necessary to involve parents into the school educational process, stimulate motivation on the importance of understanding and application of EC both at school and at home, using such types of activities as workshops, lectures and seminars, conferences, topic-specific discussions, creation of so-called universities of pedagogical knowledge for parents, etc. Such experience-sharing events will be also useful for teachers of primary schools.

The second group of ergonomic conditions includes health-saving conditions. These conditions are determined in the process of implementing the ideas of health saving at the lessons in primary school (Bazarny, 2004; Babansky, 1982; Borisova, 2005; Nazarova, 1971; Smirnov, 2006). This group of conditions is aimed at preserving health of younger schoolchildren and forming the fundamentals of healthy lifestyle. This group includes observance of the following principles:

The condition of “consideration of ergonomic principles in training” implies meeting the following principles:

- The principle of safety and comfort which implies creation of comfortable, convenient and safe conditions, ensuring health-saving work of teachers and schoolchildren and harmonious development of their personality.
- The principle of productivity and reliability which assumes that training must be productive and imply an educational, developmental and pedagogic effect.
- The principle of complexity which ensures a comprehensive examination of age-related peculiarities of younger schoolchildren in specific conditions of the activity.
- The principle of psychophysiological adaptation that includes constructive and informative adaptation of the educational environment and its certain components to hearing, visual and psychophysiological peculiarities of the trainees.
- The principle of estheticism which considers the beauty and attractiveness of forms of equipment, achieved with the use of technical aesthetics means.

Another important condition is “organization of the mode of training sessions” – a timetable of studies and workloads that is physiologically and psychologically grounded.

The next condition is “using health-saving technologies in training younger schoolchildren”. At the modern stage, engagement of the system of education in addressing the issues of building up and preserving trainees’ health is especially important. At this stage, it is important to create conditions that facilitate optimal adaptation of schoolchildren, elimination of unfavourable factors for children’s health and its maintenance; consideration of the main health-saving technologies, including organizational and pedagogical technologies, determining the educational process structure, partially specified in the sanitary and epidemiological rules (Guarantor, 2010), facilitating the prevention of over-strain, hypodynamia and other desadaptative states; psychological and pedagogical technologies, connected with teacher’s direct work at the lesson, an impact he/she makes on the trainees during all 45 minutes; it also includes psychological and pedagogical support of all elements of the educational process; teaching and educational technologies which include programmes on teaching adequate care of one’s own health and formation of the culture of health among trainees, motivation for living a healthy lifestyle, prevention of unhealthy habits, organizational and educational work with schoolchildren after the lessons, parent education; socially adaptive and person-developmental technologies include technologies that ensure formation and strengthening of trainees’ mental health and improving the resources of person’s psychological adaptation. These include different socio-psychological workshops, programmes of social and family pedagogy which are worth involving both schoolchildren and their parents, as well as teachers; medical and health technologies form independent medical and pedagogical fields of knowledge – curative pedagogy and exercise therapy – which ensure the recovery of schoolchildren’s physical health.

The third group includes didactic design conditions. We marked out these conditions during analysis of scientific propositions of the pedagogical design (Radionov, 1996; Uvarov, 2004), the ergo-design concept of an objective-spatial environment of organizations and institutions (Danilyak et al., 1990; Kriulina, 2003; Kulaykina, 2009) and in the process of cooperation with designers, educational psychologists and dedicated experts.

The conditions are aimed at optimization of the training of younger schoolchildren as a result of ergonomic design of an educational environment in the classroom in order to ensure maximum efficiency and optimality of educational and labour processes of its subjects (trainees and the teacher). This group includes: a condition of “optimal and convenient organization of teacher and trainees’ workspace (by type and degree of group interaction, by type of interpersonal relations, depending on activity content) and work-rest routine” that includes consideration of age-related and individual peculiarities of younger schoolchildren, optimal arrangement of the workspace, trainee’s working stance, classroom furniture, a blackboard (Runge & Manusevich, 2005).

A condition of “classroom interior design with regard to the main requirements of ergo-design” should be considered, to our mind, from the perspectives of ergo-design, since by “ergo-design” we mean creation of an environment that meets human physiological and mental abilities, that ensures the most efficient activity, that does not create a threat to human health, that allows someone to be and act in this environment with minimum expenses of their biological resources, and that gives an opportunity to recover and develop them.

Younger schoolchildren study in primary school classrooms from their admission to school until their transfer to secondary school. Therefore, in order to make the training of younger schoolchildren comfortable, a classroom should be designed with regard to the main rules of ergo-design, where a child not only studies but also relaxes and plays. For this purpose, a teacher should pay attention to the following things: division of the classroom into learning, playing, information and leisure areas; the right choice of colour design of the classroom in terms of ergonomics, facilitating calm, a comfortable stay in the room and children’s activation in different periods of studies.

In our opinion, it is preferable to use tints of yellow and warm green in classrooms for younger schoolchildren because these colours have a beneficial effect on human – their wavelength is within the range from 500 to 600  $\mu\text{m}$ .

It is necessary to pay attention to the fact that creating didactic ergo-design conditions in the educational process requires the assistance of experts in design, psychology, etc.

## **Methodology**

Study objective: to provide scientific basis for and test ergonomic conditions of improvement of the quality of younger schoolchildren education.

Study methods: systems analysis of philosophic, pedagogical, psychological, scientific and methodological literature, examination and generalization of the experience in pedagogical ergonomics; content analysis of the main concepts of the study – ergonomic conditions, quality of education, educational process; scientific reduction method; experiment; expert evaluation method; mathematical statistics method – Spearman's rank correlation coefficient.

The study was carried out on the basis of the municipal budgetary general education institutions of Astrakhan “Secondary Comprehensive School No. 52” and “Secondary Comprehensive School No. 8”.

## **Results**

The experiment involved 118 primary schoolchildren and was carried out in three stages. The first stage (statement) included testing and questioning of younger schoolchildren in order to determine the level of mastering of the educational programme and its compliance with the requirements, specified in the federal state educational standards, as well as determination of a degree of expression of each criterion, given in Table 1.

At the second stage (formation) of the experiment, the ergonomic conditions, aimed at improvement of the quality of younger schoolchildren education, were implemented and tested.

In order to determine the level of quality of younger schoolchildren education, we marked out three levels – low, medium and high. Assessment was conducted by experts (primary school teachers – 8 people, parents – 12 people). The experts were asked to express their opinion using a five-point discrete scale:

5 – a very high degree of expression of the indicator which is expressed in different types of activities;

4 – a high degree of expression of the indicator, but it is not expressed in all types of activities yet;

3 – the assessed and opposite indicators are not clear-cut and in general they balance each other;

2 – the indicator, opposite to the one under assessment, is considerably more pronounced and expressed;

1 – the indicator that is opposite to the one under assessment is clear-cut and expressed in different types of activities.

Since the assessment of each expert was highly individualized, we measured a degree of their coherence with the use of Spearman's rank correlation coefficient (Table 1).

Table 1. Expert survey results

No	Criteria	Teachers	Rank	Parents	Rank	d
1	2	3	4	5	6	7
1.	compliance of the score with the reference, statistical norm or set level	6	2.5	8	1	1.5
2.	trainees' mastering of the programme material	8	14.5	12	14.5	0
3.	dynamics of the educational progress	7	8.5	10	8	0.5
4.	attitude to school subjects					
5.	key competencies (cognitive, social, information and others)	8	14.5	11	12	2.5
6.	satisfaction with education	7	8.5	9	3	5.5
7.	degree of involvement into the educational process (active work at the lesson, participation in extracurricular work, absence from school, etc.)	8	14.5	12	14.5	0
8.	educational education (self-education)	6	2.5	9	3	-0.5
9.	availability of logistical facilities, information support, HR, methodological, financial and other types of support in the organization	6	2.5	10	8	-5.5
10.	accessibility and differentiation of training	7	8.5	10	8	0.5
11.	qualitative composition of trainees	7	8.5	10	8	0.5
12.	optimal conditions and teaching atmosphere	8	14.5	12	14.5	0
13.	quality of gained knowledge, skills and competencies	7	8.5	12	14.5	-6
14.	educational progress in certain subjects	6	2.5	10	8	-5.5
15.	successful results of academic achievements	7	8.5	10	8	0.5
16.	information of further social fate of trainees	7	8.5	10	8	0.5

Spearman's rank correlation coefficient is calculated according to the formula:

$$S = 1 - \frac{6 \sum d^2}{n^3 - n}$$

where S is the rank correlation coefficient (may vary in the range from +1 to -1);

d is the difference of the ranks of the compared objects;

$d^2$  is the squared difference of the ranks of the compared objects;

$n$  is the number of the compared objects ( $n=16$ );

Let us apply the obtained resulted in the given formula:

$$S = 0.75$$

Critical values for  $n = 16$

n	p	
	0.05	0.01
16	0.5	0.64

It is quite a high level of consistency of the experts' opinions. If  $S = -1$ , the experts' opinions are totally opposite, if  $S = +1$ , they fully concur. Therefore, if  $S = 0.75$ , correlation between the experts is statistically significant.

Statistical analysis at the third level (control) of the experiment on determination of the level of quality of younger schoolchildren education showed the efficiency of the implemented ergonomic conditions (Table 2).

Table 2. Experiment results

Levels	Younger schoolchildren	
	In the beginning of the experiment %	In the end of the experiment %
High	33	53
Medium	47	39
Low	38	26

## Discussions

The conducted study is both theoretical and practical and covers only one of the issues of the multiple-aspect system of primary education. While working on the study, we outlined new issues that need to be addressed. They include, among other things, a need for further studies on the issue of non-traditional and relatively new ergonomic theories.

## Conclusion

Therefore, the experimental study organization met the goals to be sought – to check the efficiency of the proposed EC for improvement of the quality of younger schoolchildren education, it met the main requirements for conducting a pedagogical experiment, ensured improvement of the quality of gained knowledge, skills and competencies of younger schoolchildren.

The implementation of ergonomic conditions facilitated the improvement of the educational process quality, comprehensive development of the person and his/her individual traits, ensured a high-quality training of the younger generation in a favourably developing environment.

In this regard, ergonomic conditions help solve a triple task – improvement of the efficiency of trainees' educational activities, preservation of health and high-quality and comprehensive development of the person.

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