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## THE REACTION OF MAST CELL IN THE PAROTID GLAND ON CHAIN ALCOHOL INTOXICATION

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The parotid gland is a major salivary gland in many animals. In humans, the two parotid glands are present on either side of the mouth and in front of both ears. They are the largest of the salivary glands. Each parotid is wrapped around the mandibular ramus, and secretes saliva through the parotid duct into the mouth, to facilitate mastication and swallowing and to begin the digestion of starches. The parotid glands are a pair of mainly serous salivary glands located below and in front of each ear canal, draining their secretions into the vestibule of the mouth through the parotid duct [1]. Each gland lies behind the mandibular ramus and in front of the mastoid process of the temporal bone. The gland can be felt on either side, by feeling in front of each ear, along the cheek, and below the angle of the mandible [2]. The gland is roughly wedge-shaped when seen from the surface. The parotid duct, a long excretory duct, emerges from the front of each gland, superficial to the masseter muscle. The duct pierces the buccinators muscle, then opens into the mouth on the inner surface of the cheek, usually opposite the maxillary second molar. The parotid papilla is a small elevation of tissue that marks the opening of the parotid duct on the inner surface of the cheek [3]. The gland has four surfaces – superficial or lateral, superior, anteromedial, and posteromedial. The gland has three borders – anterior, medial, and posterior. The parotid gland has two ends – superior end in the form of small superior surface and an inferior end (apex). Chronic and frequent alcohol (ethanol [EtOH]) intake has been associated with an increased incidence of several types of cancers including breast, mouth, throat, esophageal, stomach, and colorectal (CRC). The underlying mechanism of this deleterious carcinogenic effect of alcohol has not been clearly established but inflammation may be one unifying feature of these cancers. We have recently shown that parotid mast cells play a central role in parotid carcinogenesis. In this study, we tested our hypothesis that mast cell-mediated inflammation is one underlying mechanism by which chronic alcohol promotes parotitis tumorigenesis.

**Keywords:** Adenoid cystic carcinoma, mast cell, mucoepidermoid carcinoma, pleomorphic adenoma, salivary gland tumor

Cells in labial salivary glands obtained from patients with xerostomia with or without focal sialadenitis/Sjogren's syndrome were studied.

There was no significant correlation between the intensity of local lymphocyte infiltration and the morphometrically analysed number of mast cells staining positive with toluidine blue.

Histamine staining with heterologous IIC antiserum showed significantly fewer positive cells than staining with toluidine blue. This suggests heterogeneity of the mast cell population.

Furthermore, there was a correlation between the focus score and the number of mast cells containing histamine.

This suggests that the proliferation of mast cells containing histamine may be locally regulated by the immune inflammation, possibly through mediators from macrophages and fibroblasts.

Mast cells were previously studied by metachromatic toluidine blue staining of the labial salivary glands of patients fulfilling the 1958 criteria of the American Rheumatism Association for RA. The study showed that the number of mast cells was higher in patients than in healthy controls.

### Parotitis

*Main article: Parotitis*

Inflammation of one or both parotid glands is known as parotitis. The most common cause

of parotitis is mumps. Widespread vaccination against mumps has markedly reduced the incidence of mumps parotitis. The pain of mumps is due to the swelling of the gland within its fibrous capsule [1].

Apart from viral infection, other infections, such as bacterial, can cause parotitis (acute suppurative parotitis or chronic parotitis). These infections may cause blockage of the duct by salivary duct calculi or external compression. Parotid gland swellings can also be due to benign lymphoepithelial lesions [*clarification needed*] caused by Mikulicz disease and Sjögren syndrome. Swelling of the parotid gland may also indicate the eating disorder bulimia nervosa, creating the look of a heavy jaw line. With the inflammation of mumps or obstruction of the ducts, increased levels of the salivary alpha amylase secreted by the parotid gland can be detected in the blood stream.

### Salivary stones

Salivary stones mainly occur within the main confluence of the ducts and within the main parotid duct. The patient usually complains of intense pain when salivating and tends to avoid foods which produce this symptom. In addition, the parotid gland may become enlarged upon trying to eat. The pain can be reproduced in clinic by squirting lemon juice into the mouth. Surgery depends upon the site of the stone: if within the anterior aspect of the duct,

a simple incision into the buccal mucosa with sphincterotomy [*clarification needed*] may allow removal; however, if situated more posteriorly [*clarification needed*] within the main duct, complete gland excision may be necessary.

### Injury

The parotid salivary gland can also be pierced and the facial nerve temporarily traumatized when an inferior alveolar local anesthesia nerve block is incorrectly administered, causing transient facial paralysis [2].

### Materials and methods of research

Patients Labial salivary gland biopsy specimens were obtained from 12 patients, who had all given their informed consent to the biopsy. The project was also accepted by the local ethical committee.

Eight patients had Sjogren's syndrome according to the Copenhagen criteria<sup>9</sup>- two had primary Sjogren's syndrome and six secondary Sjogren's syndrome associated with RA according to the 1987 criteria of the American Rheumatism Association.

The remaining four patients had other diseases-two patients had RA, one systemic lupus erythematosus, and one sialolithiasis.

The patients who did not, in the final evaluation, have Sjogren's syndrome, were suspected of having that condition on clinical grounds.

### Demonstration of mast cells with toluidine blue staining

For staining with toluidine blue the frozen glands were cut in a cryostat. The specimens (6,  $\mu\text{m}$  thick) were fixed in cold (4°C) acetone for five minutes. After fixation the specimens were washed in phosphate buffered saline (PBS), pH 7-2, and then stained with toluidine blue for five minutes. After staining, the specimens were washed in running water for 10 minutes, dehydrated in alcohol, cleared, and then mounted.

### Immunohistochemical staining for mast

CELLS The frozen specimens (6  $\mu\text{m}$  thick) were fixed in paraformaldehyde for five minutes and then washed in PBS. Intrinsic peroxidase was inhibited by pretreating the specimens

The tissue sections were incubated in 3,3-diaminobenzidine tetrahydrochloride (50 mg in 150 ml PBS) with 0.003% H<sub>2</sub>O<sub>2</sub> substrate for seven minutes and then washed in PBS. Counterstaining was performed with haematoxylin.

The specimens were finally washed, dehydrated, cleared, and mounted. To test the specificity of the immunoperoxidase staining the first antiserum was replaced by either PBS or normal rabbit serum. TRANSMISSION ELECTRON MICROSCOPY Several small (about 1 mm<sup>3</sup>) pieces were cut for ultrastruc-

tural study from three patients with Sjogren's syndrome.

### Results of research and their discussion

After staining with toluidine blue the metachromatic mast cells were seen as violet, granular mononuclear cells. Histamine staining using 1 IC antiserum in the peroxidase-antiperoxidase method stained mast cells brown. Mast cells were usually located in the periphery of the lymphocyte foci or diffusely scattered in the salivary tissue stroma. Staining controls confirmed the specificity of immunoperoxidase staining.

In this study the presence of mast cells in labial salivary gland biopsy specimens was shown by histochemical toluidine blue staining, immunohistochemical histamine staining, and transmission electron microscopic evaluation of the fine structure.

Toluidine blue staining shows the proteoglycan matrix of the mast cell granules, the heterologous 1 IC antiserum labels mast cell mediator histamine, and transmission electron microscopy demonstrates the typical ultrastructure.<sup>5 16</sup> Although mast cells show heterogeneity in their histochemical, functional, and morphological criteria,<sup>7</sup> our study, based on three different, independent methods, established beyond any doubt that mast cells are present in diseased salivary glands in Sjogren's syndrome.

Mast cells have been implicated in various diseases, particularly allergic rhinitis, asthma, and anaphylaxis. Mast cells modify homeostatic regulation and effect functions, such as mucus production, microcirculation and blood vessel growth, and bone remodelling.

They have also been implicated as markers of inflammatory disorders.<sup>6 18</sup> In particular, mucosal type mast cells-easily overlooked in routine histological analysis owing to poor visualisation after formalin fixation-depend on T cell derived interleukin-3 for their proliferation.<sup>17-19</sup> The factors regulating the proliferation of connective tissue mast cells are less clear but they seem to be derived from macrophages and fibroblasts.

Therefore, one would expect that active focal sialadenitis would be accompanied by extensive proliferation of mast cells in situ. The extent of labial salivary gland participation can be assessed by focus score counting according to Greenspan.

### Conclusion

SGTs showed greater MC counts compared to normal SGs but benign neoplasms

were similar to malignant ones. MCC counts in minor normal and neoplastic SGs were more than those in major glands, maybe due to anatomical variations.

Further studies are suggested to determine the type of MCs in these neoplasms and its relationship to behavior of the tumor.

Lymphoma of Salivary Gland is a slow-growing malignancy with a generally good prognosis with early diagnosis and treatment

The prognosis is mainly dependent upon the tumor stage and lymphoma subtype. Also, primary lymphomas have better prognoses than secondary or recurrent lymphoma

In general, the prognosis depends upon a set of several factors, which include:

- Stage of tumor: With lower-stage tumors, when the tumor is confined to site of origin, the prognosis is usually excellent with appropriate therapy. In higher-stage tumors, such as tumors with metastasis, the prognosis is poor

- Overall health of the individual: Individuals with overall excellent health have better prognosis compared with those with poor health

- Age of the individual: Older individuals generally have poorer prognosis than younger individuals

- The size of the tumor: Individuals with small-sized tumors fare better than those with large-sized tumors

- Individuals with bulky disease have a poorer prognosis

- Involvement of vital organs may complicate the condition

- The surgical respectability of the tumor (meaning, if the tumor can be removed completely) – it is a rare option

- Whether the tumor is occurring for the first time, or is a recurrent tumor. Recurring tumors have worse prognosis compared to tumors that do not recur

- Response to treatment: Tumors that respond to treatment have better prognosis compared to tumors that do not respond to treatment

- Progression of the condition makes the outcome worse (progressive Salivary Gland Lymphoma)

- Cancer and tumours

- About 80% of tumors of the parotid gland are benign [11]. The most common of these include pleomorphic adenoma (70% of tumors, [11] affecting predominantly females (60% [11])) and Warthin tumor (i.e. adenolymphoma) more in males than in females. Their importance is in relation to their anatomical position and tendency to grow over time. The tumorous growth can also change the consist-

ency of the gland and cause facial pain on the involved side [12].

- Around 20% of parotid tumors are malignant, with the most common tumors being mucoepidermoid carcinoma and adenoid cystic carcinoma. Other malignant tumors of the parotid gland include acinic cell carcinoma, carcinoma expleomorphic adenoma, adenocarcinoma (arising from ductal epithelium of parotid gland), squamous cell carcinoma (arising from parenchyma of parotid gland), and undifferentiated carcinoma. Metastasis from other sites like phyllodes tumour of breast presenting as parotid swelling have also been described [13]. Critically, the relationship of the tumor to the branches of the facial nerve (CN VII) must be defined because resection may damage the nerves, resulting in paralysis of the muscles of facial expression.

#### Note

The combination chemotherapy drugs used, may have some severe side effects (such as cardio-toxicity).

This chiefly impacts the elderly adults, or those who are already affected by other medical conditions. Tolerance to the chemotherapy sessions is a positive influencing factor.

Progression to bone marrow failure is usually associated with short survive.

#### Diagnosed

Inflammatory swelling of the glands may present a serious diagnostic challenge. Parotitis presents in many forms and the symptoms vary from modest to prostrating.

Reading the numerous journal on parotitis articles reveals frequent contradictions in the classification, etiology, and treatment of the disorders.

A pure viral or bacterial infection, an autoimmune inflammation, or a combination of these can be the etiology.

In this article, evolution of the knowledge of parotitis, as well as the diagnosis and treatment, is discussed. Parotid gland cancer is most often diagnosed when a person goes to a doctor because of symptoms he or she is having.

If you have signs or symptoms that might be caused by a salivary gland tumor, your doctor will do exams and tests to find out if it's cancer or some other condition.

If cancer is found, other tests may be done to find out if it has spread.

#### Surgery

Surgical treatment of parotid gland tumors is sometimes difficult because of the anatomical relations of the facial nerve parotid lodge,

as well as the increased potential for postoperative relapse. Thus, detection of early stages of a parotid tumor is extremely important in terms of postoperative prognosis [11]. Operative technique is laborious, because of relapses and incomplete previous treatment made in other border specialties [11].

After surgical removal of the parotid gland (Parotidectomy), the auriculotemporal nerve is liable to damage and upon recovery it fuses with sweat glands. This can cause sweating on the cheek on the side of the face of the affected gland. This condition is known as Frey's syndrome [14].

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*Materials of Conferences***TRADITIONAL AND LAPAROSCOPIC METHODS OF TREATMENT IN SURGERY OF ECHINOCOCCUS (PRACTICAL CASES)**

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**Urgency.** Diagnostics and treatment of echinococcus has a long story. Regardless of this fact, nowadays, in XXI century this problem remains urgent. Important aspects of it are: modern diagnostics of echinococcus, pre-surgical preparation, selection of rational treatment, and post-surgical attendance over patients. Development of surgical technology in scientific progress provides for improvement not only in diagnostics, but also surgical treatment of organ echinococcus.

**Objective of work.** Demonstrate results of surgical treatment of 22 patients with diagnosis of liver echinococcus (21 cases) and echinococcus of lungs (1 case) in surgical department of railroad hospital of the city of Aktobe during the recent 10 years (2005–2015). During the pre-surgical period all patients were taken to a complete clinical-laboratory and roengenologic examination (CT, MRT, etc). Examination was complimented with apparatus: UZI”Apogei” – 800 (USA) “Aloka” (Japan). During the laboratory examination of patients it eosinophilia (above 4%) was registered among one third of them.

All patients endured surgical treatment after the corresponding preparation, but only 10 patients were operated via laparoscopic method in stomach and chest cavity. The foundation of traditional surgeries in case of liver echinococcus is formed by laparotomy, and in case of combined pathology in lungs torocoabdominal access is facilitated. In one case lung echinococcus was diagnosed on a patients during the secondary examination in one year after removing liver echinococcus via traditional method, the surgery was carried out with toroscope. Duration of post-surgical period depended on selection of treatment method. Traditional surgery is traumatic and usually results in different complications, thus leading to additional days of immobility for a patient. For all types of surgical treatment the selected method of anaesthesia was endotracheal narcosis. For laparotomic method the surgery started with puncture of echinococcus cyst, aspiration contents, sanitization of its cavity with formalin, and then removal of all cyst elements. Drainage was placed in the cavity, and section of a large omentum was adjusted to this place, for small and uncomplicated cysts half-closed or closed (ideal echinococcoectomy) methods of treatment were implemented. An open method of surgery (marsu-

pilization) was also used. For modern non-invasive, low-traumatic method of treating echinococcus laparoscope, produced by “Olympus” was used. As we have already mentioned, for all laparoscopic echinococcoectomies, as well as majority of traditional interventions, pathology was located in liver.

**Conclusion**

We should outline that traditional and laparoscopic methods should be and are implemented in surgery of liver and lungs echnococcus according to the provided indications. But, as a rule, laparoscopic methods of treatment, in comparison to traditional, are low-traumatic and apodous, lead to less complications, and don’t result in long period of patient’s immobility. All patients (22) who endured traditional and laparoscopic surgeries, were dismissed for dispensary observation. The remote results are positive.

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**MEDICAL SCHOOL E-LEARNING: THE FACTOR OF EDUCATIONAL PROCESS INDIVIDUALIZATION**

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E-learning opportunities studies in university students’ educational process individualization is provided by the author. The most often used educational process e-learning elements were chosen as the research object. Testing of first-year medical faculty students was carried out at the end of an academic year. The students were distributed into 3 groups according to their academic progress. Research results shows that all e-learning elements of medical school educational process are highly demanded by students. And, low academic rate students are interested in e-learning much more, than students with good results of studies, because e-learning provides effective self-control, psychological comfort and educational process individualization with respect to the students’ cognitive activity. Research results can be used by the university medical faculties to increase an e-learning efficiency of medical students.

University e-learning various elements are intensively developed recent years, taking their own place between the traditional teaching methods in educational process of high school. The e-learning effectiveness, its role in university students’ cognitive activity development, e-learning opportunity in students’ skills formation are the objects of modern scientific research [2, 3, 5, 6]. However, e-learning

effectiveness in medical school educational individualization process is still questioned [1, 4, 7].

That's why, the aim of our research is defined as e-learning opportunities studies in university students' educational process individualization.

We chose the often used educational process e-learning elements as the research object.

#### Materials and methods of research

Testing of 179 first-year medical faculty students was carried out. First-year students were involved into testing at the end of an academic year.

The students were distributed into 3 groups according to their educational activity results: students with excellent results – 27,4%, good results of studies – 66,5%, and 6,1% – the poor educational activity results.

The experiment was held in constant conditions for all groups of students: the research was held at 11 a.m. in the academic auditory. The research duration was about 12 minutes. The medical faculty students performed the testing independently. The testing was built on the basis of original author test including 12 questions.

#### Results of research and their discussion

First, students were asked to arrange e-learning various elements according to their frequency in high school educational process use. Examinees arranged the elements in the following order:

- computer testing;
- electronic manuals;
- multimedia lectures;
- university website information;
- problem tasks on computer;
- laboratory works on computer.

The next step of our research e-learning various elements effectiveness in educational process was esteemed by first-year medical faculty students. According to the test results 96,1% of all students consider multimedia lectures as highly efficient element of university educational process. 100% of students with poor educational activity results think that multimedia lectures are the great instrument of representing and visualizing the information. While 4,2% of students with good results of studying and 4% of examinees with excellent indicators of educational activity consider multimedia lectures as unuseful element of university educational process.

To our mind, such results proof that visualization of studying material is highly important for students with poor educational activity results.

Illustrated and animated studying material of multimedia lectures in addition to the lecturer explanation helps students to understand the subject better, and to consider processes and phenomena from different points of view.

Further research results made us sure about the real base of our conclusion. 87,7% of first-year students noted high efficiency of practical training with e-learning materials. More than that, 100% of students with poor educational results of the pupils regard the problem tasks on computer to be useful,

while 6% of high academic rate students, and 15,8% of students with good educational results consider solving the problem tasks on computer inexpedient.

Computer laboratory works performing is highly appreciated by 74,9% of medical students. In particular, students with poor results of studies note that laboratory works on the computer gives them the chance to repeat an educational experiment necessary number of times, allowing to achieve the required result. The timing of laboratory work and educational process individualization make 81,8% of low academic rate students assess computer laboratory work efficiency as high. For example, 73,1% of first-year students with good results of studies consider computer laboratory work as effective e-learning element.

86,6% of examinees noted high efficiency of computer testing. However, 27% of poor educational activity results students think that computer testing does not give the objective results. 8,2% of high academic rate students and 14,3% of students with good results of studies endorse the opinion of approximately the fourth part of low academic rate students.

In our opinion, dissatisfaction of poor results of educational activity students with computer testing is explained, first of all, by the computer work rigid time limitations. Restriction in time, in opinion of low academic rate students, is the barrier in demonstrating the actual knowledge level. Secondly, computer testing does not esteem the intermediate chain of reasonings. In this regard we consider it expedient to supplement computer testing with interview for the students with poor educational results.

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*Short Reports***LAPAROSCOPIC ASPECT IN SURGERY OF COMPLICATED APPENDICITIS**

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More than 500 laparoscopic surgeries were undertaken on patients with diagnosis of acute appendicitis in surgical clinic of Aktobe Railroad hospital in 2005–2015. A complicated form of acute appendicitis was revealed among 143 patients. However, not all of the undertaken surgeries were finished successfully. Laparoscopic appendectomy (LA) in complicated forms included:

- 1) diagnostic stage – evaluation of changes in vermicular sprout, nature of complication severity in stomach cavity;
- 2) laparoscopic appendectomy with intra-abdominal sanitization;
- 3) control dynamic laparoscopy (according to indications).

A dense appendicular infiltrate without abscess was registered among 6 patients, in these cases microirrigators were placed for antibiotic discharge. Assisted appendectomy was carried out on 7 patients, complication severity was registered. After

analyzing the received results, we have defined the following contraindications for laparoscopic appendectomy in complicated cases of acute appendicitis:

- 1) perforation of sprout foundation;
- 2) typhlitis;
- 3) diffuse purulent peritonitis;
- 4) dense appendicular infiltrate.

Results of treating patients with complicated forms of appendicitis are presented in this report. Ligature method was implemented on 93 patients. Among other 40 patients a modified method was used in respect to various categories of intraperitoneal complications. In 36 cases laparoscopic appendectomy was carried out with access through 4 points, and for 5 patients stump was placed into the wall of blind gut through intracorporal cuts – two crossed cuts of Z form. Our results prove significant advantages of laparoscopic appendectomy in comparison to traditional methods. Innovative method allowed us to decrease frequency of post-surgical complications from 23% to 4,2%, secondary surgeries – from 10,2% to 2,3%. No lethal results happened. Thus, provided with technical equipment and clear definition of indications laparoscopic appendectomy is the selected method of treating complicated forms of acute appendicitis.

## THEORETICAL RESEARCHES OF WORKING PROCESS ELECTROMAGNETICALLY MECHANOACTIVATIONS OF THE PRODUCT IN THE MAGNETOLIQUEFIED LAYER FERROTEL

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Results of theoretical researches of an electromagnetic way of mechanoactivation are presented in article, the electromagnetic field based on use of energy constant on a sign and regulated in size, acting on ferromagnetic grinding elements, brought in displacement volume of devices in mix with the processed product. On the basis of the force interaction Maxwell hypothesis ferro balls viewed as the interaction of dipoles in an external magnetic field undisturbed. The formulas for the determination of forces and moments acting on the grinding elements in the working volume of the electromagnetic mechanoaktivatorov (EMMA) through a layer of activated material. The formulas for determining work, expended in magnetic fluidized layer ferrotel for grinding the product to the final grain size of the static compression and impact loads.

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**Keywords:** mechanoactivation electromagnetic, magnetic fluidized layer

Analysis of the work of domestic and foreign researchers in the field of mechanical activation, a bibliography which includes several thousand names [1], showed that modern advances in technology and milling technology is associated with the creation of new methods of organization of the process, the development of highly efficient low energy devices and metal [2, 3], constructed based on these methods, as well as the creation of the products obtained dispersion rational management systems. It was revealed that the introduction of hardware – technological systems of methods of physical mechanical activation using electromagnetic fields allows intensifying the classical technological scheme of production of products for various purposes, going to the one-step process of grinding, improve the quality and reduce the power consumption of finished products [4, 5]. A method of forming dispersing loads formed the basis of a new type of equipment – electromagnetic actuators (EMMA), can reduce energy consumption by tens of percent. It is proved that these apparatus can be regarded as power amplifiers [2]. To provide conditions for increasing energy dispersion process in EMMA is necessary to observe the principle of “necessity and sufficiency of energy supply” (or adherence to security and energy conditions), taking into account the kinetic energy and the patterns of the products grinding [6, 7].

**The objective of the work:** The object of research is the electromagnetic method of mechanical activation of materials for various purposes in magnetic fluidized layer ferrotel.

**The material and methods of the investigation:** Investigations were carried out on the basis of the dipole interaction model ferrotel in a magnetic field.

### Results of research and their discussion

The electromagnetic mechanoaktivatore (EMMA) [8–10] the fracture energy is transferred to the material in the Acts of regulated energy-intensive multi-point contact between the grinding ferromagnetic elements. The force interaction ferro balls viewed as the interaction of dipoles in an external magnetic field undisturbed moments:

$$\bar{p}_k = -\frac{\mu-1}{\mu+2} R_0^3 \bar{H}_{ok}, \quad (1)$$

where  $\bar{H}_{ok}$  – vector of the unperturbed magnetic field at the point of the space of the working volume of EMMA, which is the center  $k$ -s th grinding element with a radius  $R_0$ .

The coordinates  $X, Y, Z$  dipole moment is equal to  $\bar{p}$ :

$$\left. \begin{aligned} p_x &= -\frac{\mu-1}{\mu+2} R_0^3 H_x; \\ p_y &= -\frac{\mu-1}{\mu+2} R_0^3 H_y; \\ p_z &= -\frac{\mu-1}{\mu+2} R_0^3 H_z. \end{aligned} \right\} \quad (2)$$

Force  $\bar{F}$  acts on a dipole in a magnetic field determined system of equations:

$$\begin{aligned} \bar{F} &= (F_x, F_y, F_z); \\ F_x &= -m_x \lg \frac{\partial H_x}{\partial x} - m_y \lg \frac{\partial H_x}{\partial y} - m_z \lg \frac{\partial H_x}{\partial z}; \\ F_z &= -m_x \lg \frac{\partial H_z}{\partial x} - m_y \lg \frac{\partial H_z}{\partial y} - m_z \lg \frac{\partial H_z}{\partial z}; \quad (3) \\ F_z &= -m_x \lg \frac{\partial H_z}{\partial x} - m_y \lg \frac{\partial H_z}{\partial y} - m_z \lg \frac{\partial H_z}{\partial z}. \end{aligned}$$

where  $m_x, m_y, m_z$  – magnetic dipole charges;  $lg$  – shoulder dipole.

Taking into account the expressions for the magnetic charges:

$$\left. \begin{aligned} m_x &= -\frac{\mu-1}{\mu+2} \frac{R_0^3}{lg} H_x; \\ m_y &= -\frac{\mu-1}{\mu+2} \frac{R_0^3}{lg} H_y; \\ m_z &= -\frac{\mu-1}{\mu+2} \frac{R_0^3}{lg} H_z. \end{aligned} \right\} \quad (4)$$

Formulas for the determination of the forces  $Fr$  and  $Mv$  moments acting on the grinding elements in the working volume through EMMA layer activatable material:

$$Fr = \frac{1}{2} \frac{\mu-1}{\mu+2} R_0^3 \frac{\partial H^2}{\partial r} \Big|_{r=2R_0+r_x}; \quad (5)$$

$$Mv = \frac{1}{2} \frac{\mu-1}{\mu+2} R_0^3 \frac{\partial H^2}{\partial v} \Big|_{r=2R_0+r_x}. \quad (6)$$

Numerical integration provides the following desired expression:

$$F_r = \frac{3}{356} H_0^2 R_0^2 \frac{(\mu-1)^2}{(\mu+2)^3} \left\{ -[(11+13\mu) + 9(5+3\mu)\cos 2v] + \frac{r_x}{2R_0} [(29+67\mu) + (171-117\mu)\cos 2v] \right\}, \quad (7)$$

$$M_v = \frac{3}{128} H_0^2 R_0^3 \frac{(\mu-1)^2}{(\mu+2)^3} \sin(2v) \left[ -(31+17\mu) + \frac{r_x}{R_0} (5+3\mu) \right]. \quad (8)$$

The work expended on product refinement of the original size to the final  $r_1$  grain size  $r_2$  static compression, determined expressions:

$$A = A_1 + A_2; \quad (9)$$

$$A_1 = \frac{3}{64} H_0^2 R_0^2 \frac{(\mu-2)^2}{(\mu+2)^3} \frac{N}{2} [(5\mu+7)(r_1-r_2) - \frac{(23\mu+25)}{4R_0} (r_1^2-r_2^2)];$$

$$A_2 = H_0^2 R_0^2 \frac{(\mu-1)^2}{(\mu+2)^3} \frac{N}{2} [0,43(\mu+1,37)(r_1-r_2) - \frac{1}{2R_0} (\mu+1)(r_1^2-r_2^2)].$$

Where  $A_1, A_2$  – the work of compression in the first and second periods of the formation of dispersing efforts;  $N$  – the number of grinding elements in the working volume of EMMA.

When the shock impact of the work is spent:

$$A = N_0 H_0^2 R_0^3 \frac{(\mu-1)^2 (0,002\mu - 0,02)}{(\mu+2)^3}, \quad (10)$$

where  $N_0$  – the number of structural groups of ferroelementov.

In the process of mechanical activation energy change and technological properties of finely dispersed material, which are determined by the average level of  $W_V$  and  $W_{\Delta V}$  local energy densities achieved in the activation process. The stored energy is released to form a new surface  $\Delta S$ . Parameter  $\Delta S / V$  ( $\Delta S$  – surface increase due to the grinding of the sample

volume  $V$ ) depends on the energy properties of the material, manifested in the surface energy values of  $W_p$ , efficiency dispersion  $\eta_D$ , average  $W_V$  (in the volume of the sample) and the local  $W_{\Delta V}$  (in the centers of destruction) energy density at fracture:

$$\Delta S/V \approx (W_V \eta_D) / W_p$$

or

$$\Delta S/V \approx (W_{\Delta V} \varepsilon V \eta_D) / W_p. \quad (11)$$

Assuming that the external input energy is concentrated in the process of deformation in structural defects, and in the act of dispersing converted into work disclosures structural grains, evaluation of specific energy consumption in the mechanoactivation largest possible local elastic energy density foci destruction (dispersing zones) and it can be determined by the formula:

$$W_{\Delta V} = W_V / \varepsilon_i = \sigma_0 \varepsilon_0 / 2 \varepsilon_i, \quad (12)$$

where  $\sigma_0$ ,  $\varepsilon_0$  – tensile strength and deformation at the limit of strength;

$\varepsilon_i$  – strain in the dispersion step.

### Conclusion

When calculating recommended to use software package “ANSIS”, allowing to determine the electromagnetic field strength in a given system of contact points “ball – particle – ball” working volume EMMA any design modification [4] and to determine on the basis of the decision of problems of Solid State elasticity specific activation energy needed and sufficient to obtain stable predictable properties of activated materials for various purposes [12, 13].

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*Materials of Conferences***MODERN FEATURES OF DEVELOPMENT  
MEDICAL INFORMATION SYSTEMS**

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In the next two years on the implementation of modern information systems in health care is assumed by the Russian government to send about 24 billion rubles. Topical is the study of tendencies of development of modern medical information systems (MIS). We have attempted to analyze and to point out some features of the development of modern MIS. They have been studied and analyzed 190 MIS. The main sources of information were: Internet, medical and specialized periodicals, monographs and scientific conferences, forums and exhibitions. IIA classification by purpose has been spent. All systems were divided into two classes: diagnosis and treatment, and the rest.

During the study period, since 1998, it has been an increase in the share of medical-diagnostic ISI in relation to other systems. Therapeutic and diagnostic systems account for 32 % in 2016 in relation to the total number of MIS. In 1998, the share of these systems was about 10%, in 2005 – 18%. The main share studied MIS (190 software products, 54 firms of developers) take diagnostic and treatment (32%), organizational and economic (14%) and complex (12%). As for the amount of introduction of information systems for medicine, then we can speak of a greater use of organizational-economic general purpose and specialized MIS solutions for the management and administrative tasks. The reasons for the imbalance in the provision of information needs physicians and administrative staff are considered to be high cost-priore plants are, the reluctance of doctors to learn to work with your computer, use the inconvenience (suitability) IIA medical staff and its functionality. There is a significant gap between the information systems of health care institutions (MPI) for the doctor and for the administration.

Most urgent and challenging development MIS is to develop support systems decision making (CDSS) doctor. CDSS in medicine (health care) – this is problem-oriented system (or hardware and software systems), implementing information technology to support decision-making processes of therapeutic and diagnostic and / or administrative decisions by medical personnel. The need for application of CDSS arises in the case of limited resources, lack of time, experts deficit, uncertainty of information about the world and the object under study. This situation is typical for the majority of decision-making problems in medical diagnosis

and treatment, in particular in the fields of high-tech medical care.

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**THE PHENOMENON OF REDUCTION  
IN STRENGTH OF HARD-COATED  
CUTTING TOOLS AND THE CONDITIONS  
FOR ITS OCCURRENCE**<sup>1</sup>Lieberman Ya.L., <sup>1</sup>Letnev K. Yu., <sup>2</sup>Shterenson V.A.<sup>1</sup>*Ural Federal University, Yekaterinburg,  
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The article presents a summary of well-known facts on reduction in strength of metal cutting tools with diamond like carbon (DLC) coatings.

The last decade saw an increase in the usage of hard coatings of the diamond-like carbon (DLC) type and ones similar to them. As a rule, they are applied by dispersing coating materials (for example, graphite) in a vacuum with a cathode and depositing them over the working surface of a tool [1–2]. They are fastened on the surface by means of adhesion, without infiltration into it.

Today, significant experience has already been gained from the usage of cutting tools with hard coatings, DLC coatings, in particular. As a whole, the experience is positive, but the accumulated data is uncoordinated and, as a rule, presents results for a specific case only. If there are negative results among them, they are usually deemed to be accidental, caused by errors during either the experiment itself or mathematical treatment of its data.

In view of the above, the authors conducted at the Department of Metal Cutting Machines and Tools of the Ural Federal University an analytic research the goal of which was to generalize currently known facts and figures on the efficiency of tools with DLC coatings, to study deeper negative examples of their usage, and to find out reasons behind those negative outcomes.

The research studied data on the wear and wear resistance of end milling and disk milling cutters, lathe tools, drills of 0,5–2,5 mm in diameter and knives of guillotine shears [3–9]. The methodology of the research was based on the analysis of reliability of the mathematical models which describe the dependence of tools wear on duration of their usage in various combinations of cutting modes and for various machined materials. Also, other sources of data were used, like the one from metallographic

examination of the structure of tools before and after they have been used, and also the results of the microscopic examination and profilography of the surface of tool cutting parts.

Thus, the following facts were established:

1. DLC coatings indeed reduce the wear and increase the resistance of cutting tools by 3–4 times within the whole range of cutting modes recommended by «The Reference Book for Production and Mechanical Engineers» [10] for fine-turning and milling operations.

2. In rough-turning or milling operations, on the contrary, the wear rate of DLC-coated tools turns out to be 3–4 times higher than that of uncoated tools.

3. In those operations when holes are machined with drills of 4 mm or more in diameter using the modes recommended by the reference book noted above, the wear of tools also decreases, similar to fine-turning and milling.

4. In those operations when holes are machined with drills of small diameter (up to 2,5–3 mm), the DLC coating contributes to a substantial tool life reduction, causing their breakage.

5. In those operations when metals are machined at high speeds by means of turning, milling or drilling, the strength of DLC-coated tools turns out to be higher than that of uncoated tools.

6. In those operations when thin-sheet metals are cut with guillotine shears, holes are reamed, other types of machining at low speeds of cutting (except those mentioned in paragraph 2 of this list) are used, the strength of cutting tools increases by 2–5 times after having them DLC-coated.

The physics analysis of cutting with DLC-coated tools and its comparison with the conditions of machining noted above allow us to state that those situations when using the coating gives no result or affects negatively are nonrandom at all. There exists quite an evident phenomenon of the reduction in strength of tools which have been DLC-coated, and the reasons behind it are quite specific.

The first one of those is a high brittleness of the coating. In rough-milling or turning operations, the impact of considerable forces of cutting and the deformation of the undercoat (however small it is) cause breakage of the coating and formation of chips and fly grit in the area of cutting. The grit, in its turn, increases the wear rate mentioned in paragraph 2 of the list above.

The second reason is the increase of tool surface roughness and the «tool-detail» friction coefficient. Nowadays, it is commonly accepted that this coefficient decreases after the coating have been applied. This conclusion is made from those experiments when a surface, with or without the coating, is acted on with a small but very hard ball. By the trail size of such a ball, they assess the coefficient – a harder surface is obviously indicated by a smaller trail. Which leads to the conclusion noted above. But, in reality, it is true only for the coefficient of

rolling friction, and not as much so for the one of sliding friction, and the «tool-detail» pair is characterized by the latter. The coefficient of such friction increases after having a hard coating of the DLC type applied to the surface. That is because graphite, while being dispersed with a cathode, settles unevenly on the undercoat and forms significant microirregularities whose depth exceeds by more than 50 times the depth of irregularities of a polished undercoat. This leads to the increase of the friction coefficient by more than 30% [1–2]. But such an increase of the coefficient and, accordingly, the friction force results in a corresponding rise of cutting forces. And if stress in the tool body exceeds the strength limit of this tool, it breaks. That is the reason behind the breakage of drills of small diameters mentioned in paragraph 4 of the list above.

Thus, the cases of the decrease in strength of DLC-coated cutting tools are quite natural and caused both by some peculiarities of their usage and certain specifics of how the coating is applied. However, one can find ways of combating the phenomenon. For this, special measures should be taken to prevent the increase of surface roughness when applying the coating to fine-sized tools, such as drills of small diameters.

Such measures could include oxygen-based ion etching of the coating just after it has been applied (proposed by the authors of the article as early as in 1998 in paper [4]), laser-based pulse vaporization [11], magnetic separation of the dispersed graphite (proposed by the «CreepService Sarl» company from Switzerland [12–13] and used by the «New Plasma Technologies» company since 2011). Also, you cannot use DLC-coated tools for rough or high-speed cutting machining. Although the forces of cutting at an increased speed, as a rule, decrease, the temperature of cutting rises and the structure of the coating changes [1–2]. This explains the inefficiency of the coating noted in paragraph 5 of the list.

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#### ENERGY-SAVING AND ELECTROCHROMIC GLASS OBTAINED BY EXTRACTION-PYROLYTIC TECHNIQUE

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Recently the usage of transparent conductive film (TCO) is growing rapidly. The most popular transparent and conductive oxide is indium tin oxide  $\text{In}_9\text{SnO}_{15-x}$  (ITO). ITO films have a high light transmittance in the visible spectrum, good electrical conductivity, hardness and chemical inertness. They can be widely used in the construction and automotive industry, provided that they obtain a low-cost large-scale method. ITO film reflects infrared rays and they can be used it as a thermal barrier coating on the window panes [1].

The application of TCO films as transparent electrodes for electrochromic glass is actual. Electrochromic glasses are used in the buildings and window and offices dressing, automobile industry for the auto-dimming rear-view mirror of the car. Electrochromic glass reduces the heat loss and costs of air conditioning and lighting. They are an alternative to mechanical shutters and shading screens or curtains. Absorption or reflection of light in the visible and near infrared region is regulated by the electric field applied. Dynamic control of sunlight and infrared radiation can significantly reduce energy consumption in hot summer and cold winter conditions. But now the electrochromic glass has a relatively high cost.

To reduce the cost of the electrochromic glass need to develop the low-cost technology of their production. Availability of raw materials and the cost of manufacturing method are important factors in the manufacture of functional materials. The choice of method is generally associated with optimal operation considering of thin solid film for a particular use and minimizing manufacturing costs.

Oxide films traditionally deposited by vacuum sputtering of targets heated to high temperatures [2]. Now developed larger machines with complex processes of measurement and control systems to stabilize the reactive sputtering process. The method of laser sputtering [3] allows to spray almost any composition of the target. Ionic plating method [4] uses a fully automated vacuum chamber with a cryo-pump equipped with analytical devices. Sol-gel method [5] can be used to produce quality films with a wide possibility of changing properties with changing the solution composition.

Physical and chemical properties of the resulting film (resistivity, optical transmittance, surface roughness) correspond to the method of deposition and process conditions. Properties of oxide films is determined by technological factors which ensuring the homogeneity of the material and stoichiometry. In particular, the extraction-pyrolytic method provides the mixing of components in solution in a given proportion and maintaining the stoichiometry of obtaining materials.

This paper describe the transparent conductive films and electrochromic glass obtained by extraction-pyrolytic method [6]. Extracts of metals are characterized by low content of impurity elements at the level of 5.10 mg / l and the adjusted concentration unchanged during storage.

#### Materials and methods of research

In this paper, for the synthesis of transparent conductive oxide  $\text{InSnO}$  films and electrochromic  $\text{NiO}$  films, the extraction-pyrolytic (EP) method [6] has been used. The method consists of the extraction of metals from solutions of inorganic salts for purification from impurities and transfer of the metal to organic phase. The obtained extracts – salts of organic acids – wet the substrate well of any type and form of self-assembled thin film. Metal concentrations in the extracts were estimated by the atomic absorption technique with the AAS-1M device. The organic extracts were mixed in the required stoichiometric ratios and diluted to a predetermined concentration, the most optimal for the formation of thin films.

The films were deposited by rolling of extract on a glass substrate which has been previously cleared. The organic extracts well moistened the glass substrate and form a self-assembled thin film. After drying the wetting film are placed in a open pyrolysis furnace. After drying the substrate, the wetting film was placed in a furnace for pyrolysis in air at a temperature of 450 °C. Pyrolysis of wetting film results the formation of many nucleation

centers and result the nanostructured complex oxide films. It is found that the solution density 0.93 g/cm<sup>3</sup> provides after pyrolysis a continuous conductive film which thickness about 30 nm.

The images of films were investigated by atomic force microscopy (AFM) using a multimode scanning probe microscope (Veeco, USA). The electrochemical device was assembled and tested with the application of direct and reverse current through the DC generator (DAZHENG-Electronics, Model: PS-305D). The measurements of transmittance films were performed on a Fourier spectrophotometer (VERTEX-80V, Bruker Corp.) in the wavelength range of visible light and mid-infrared (IR) range.

The potentiodynamic curves were displayed on a potentiostat PI-50-1. The sweep rate was 10 mV/s.

#### Results of research and their discussion

To form the electrochromic device the nickel oxide film is formed on the surface of the ITO-electrode from solutions with different concentrations of nickel extracts. The obtained NiO film had a dark color, which is intensified with increasing film thickness. Transmittance of NiO film with thickness of 150 nm (5 layers) was 62%, for NiO film with thickness of 300 nm (10 layers) – 51%, and for NiO film thickness of 450 nm (15 layers) – 41%. Proceeding from these data, you can choose the required degree of staining of the electrochromic glass, taking into account the degree of discoloration of the film upon application of an electric current. As shown by further studies, the discoloration of NiO film slightly increases with decreasing its thickness (from 85 to 81 %).

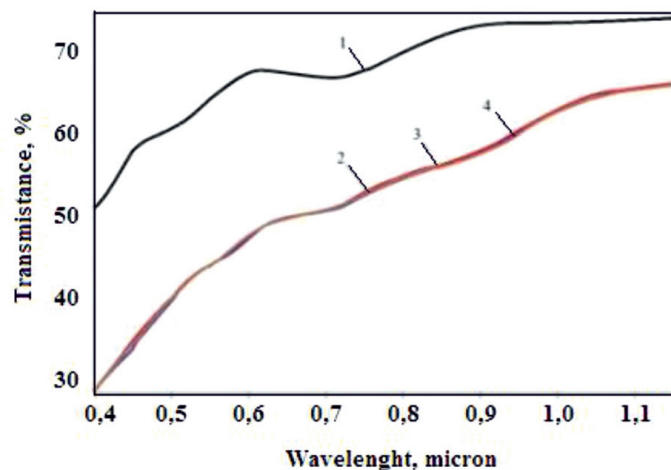


Fig. 1. Transmission spectrum of EC cell produced by EP method (visible range). 1 – bleached state cycle number: 1; 2 – coloured state cycle number: 1; 3 – coloured state cycle number: 100; 4 – coloured state cycle number: 500

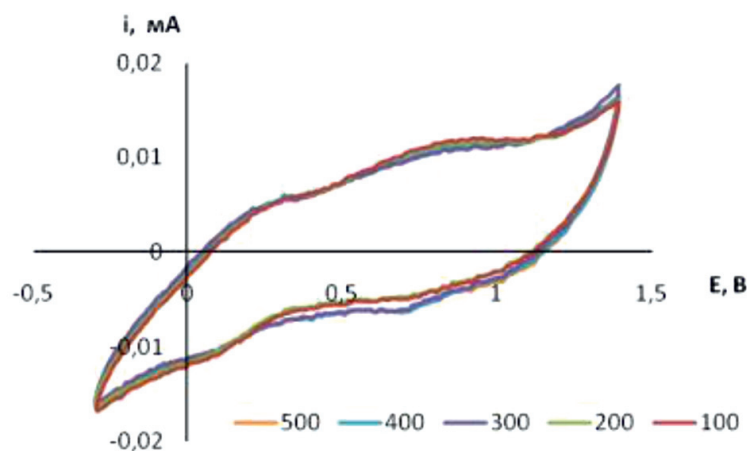


Fig. 2. Potentiodynamic curves of a two-electrode cell at a scan rate of 10 mV/s. Extents of the cycles are shown in the graph. Electrolyte: 1 M propylene carbonate solution of LiClO<sub>4</sub> + PEG



The obtained NiO films had a dark colour, which intensified with increasing film thickness. In order to study the possibility of using NiO film in electrochromic devices, the dependence of light transmittance at wavelength  $\lambda = 633$  nm on the thickness of NiO films was investigated. Transmittance spectra of EC cells in the visible and IR regions at different work cycles are illustrated in Fig. 1.

Spectra of cell transmission in the bleached and colored states to 1 and 500 cycles are coincided. The transmittance of light in the visible range was 70–80% without voltage application. ITO film on the glass absorbs the UV light. The transmittance in the IR region is averaged 10–40% in the colored state and 10–55% in the bleached state. There is not transmission in the far infrared.

The applied voltage (approximately 12 V) with an appropriate polarity introduced a charge into the electrochromic material that causes a change in absorption in the visible region of spectrum. The potentiodynamic curves are shown in Fig. 2.

According to the data of potentiometric cycling of electrochromic cells during the first 500 cycles passes with Coulomb efficiency greater than 98%, with comparable to the cathode and anode current, and thus charge and discharge capacity. That, indicate to the complete reversibility of the processes. The color change can be attributed to nickel oxide transition from one phase to another. Nickel oxides are non-stoichiometric. Nonstoichiometry is accompanied by a change of color from green to black due to the Ni (III)existence.

The developed method can be used for deposition of functional coatings on large surfaces, such as the transparent surface and cabinet doors and windows. Such coatings help to save energy and improve the environment.

### Conclusion

The electrochromic device in which nickel oxide film transfers from the reduced NiOOH state to the oxidized Ni(OH)<sub>2</sub> state with change from the colour brown to transparent has been produced by extraction-pyrolysis technique. Optimally, for obtaining a uniform electrochromic NiO film, the extract solution with concentration of 2% should be used. According to the thermogravimetric data, the oxide film formation occurs at 370–450°C. The resulting NiO film on transparent conductive glass, combined with the counter-electrode in the presence of quasi-solid electrolyte, withstood more than 500 cycles of discolouration–staining without changing the intensity of the colour.

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## CLUSTERING FOR ENERGY EFFICIENCY PROJECTS IN THE INNOVATIVE DEVELOPMENT

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The article studies the cluster form of organization and financing for energy efficiency projects in the Republic of Mordovia «Energy efficient lighting engineering and intellectual lighting control system». Methodology of system approach allows revealing the purpose and objectives of the cluster, the structure and composition of its elemental base, the funding mechanism and the results. From the position of an integrated approach characterized by an innovative orientation of development of economy of region. Shown the most significant and promising projects in the field of energy efficiency – the production of modules for solar panels, energy-efficient housing construction and biogas plant.

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**Keywords:** energy efficiency, cluster, innovation, economy, region, development, systemic approach

Energy efficiency and energy saving are topical at all levels of economic development. The purpose of such surveys is to provide necessary preconditions for the formation of the competitive characteristics of the Russian economy and its transition to a new qualitative level.

Modern economic structure is entirely dependent on the energy supply and to produce and to sell products in a modern high-tech economy requires a leading role for the production of energy and its efficient use. Energy, being one of the main types of resources, ensures continuity of production processes in industry, agriculture, construction and other sectors of the national economy. The dynamic development of these sectors often leads to the emergence of energy problems during periods of peak energy consumption. Therefore, one of the axioms of successful presence in the market is that economic system (micro, meso, macro or megawave), based on improved energy efficiency, *ceteris paribus*, more competitive in the present, but also potentially competitive in the future. One of the most important universal laws of development is that any system to strive to achieve results with minimal expenditure of energy. It is widely recognized that energy efficiency serves the least expensive and the fastest environmentally friendly way to meet energy needs, as according to experts the energy saving turns out to be 4–5 times more profitable than production of the same amount of energy.

In accordance with the energy efficiency strategy of Russia and the Federal target Programmer energy efficient economy, the policy framework of the Russian Federation in development of science and technologies priority directions of development:

- energy – saving technology;
- energy efficiency;
- electronics.

In 2009 Dmitry Medvedev first declared from the high tribune in the message to the Federal Assembly on the transfer of Russia to the energy-saving mode of development. Attempts to improve the energy efficiency of production has been made previously, for example in 1996 was adopted the law “On energy saving”. In the further provisions of energy efficiency identified in the Energy strategy of Russia for the period up to 2030, the legal support of the ongoing activities is the Federal Law “On energy saving and on increasing energy efficiency and on amendments to certain legislative acts of the Russian Federation”, governing the innovations in state and municipal, and private sectors. The Russian government is implementing a program aimed at demonstrating effective from the point of view of energy projects in the Russian regions. The experience of the advanced projects will be extended further, to other regions that will result in improved energy efficiency throughout the economy.

For example, according to the Russian news Agency “FederalPress” in many Russian cities and regions are integrated in all projects to energy efficiency “energy Efficient quarter”, “Smart metering” (stimulate energy-efficient consumption by consumers) [1]. In Moscow energy efficiency program is carried out for the period until 2020 – funding attracted more than 117 billion rubles. In St. Petersburg the financing of similar activities exceeded 100 billion rubles and pay special attention to economy in the public sector and to reduce energy consumption among the citizens. In Ekaterinburg operates Russian-German project “Ekaterinburg – energy efficient city”. In Nizhny Novgorod, a program of energy efficiency with funding of 38 billion rubles, Perm – 9,6 billion rubles, in Tyumen – 7,4 billion rubles.

The basis of territorial and sectoral structure of regions is the economic efficiency of

integration of industrial-economic relations of economic subjects for the most complete realization of joint economic potential. A modern form of optimization of production and economic interests of economic entities and other participants of economic relations is the cluster representing a relatively independent economic unit grouped of interrelated companies of the territory, characterized by specific properties. Such organization of joint activity of suppliers of products and services, institutions, infrastructure, helps to strengthen the competitive advantages of the project participants.

The complex nature of cluster organization allows the integration principles at all levels of management:

1) consistency – the correlation of elements and components with the aim of achieving a synergy effect;

2) the interrelationship and sequence of implementation of management functions – coordination, planning, analysis, control, regulate;

3) according to the structural parts of the cluster to strategic directions of development.

In the Republic of Mordovia for the construction and development segments of the regional economy, meeting the highest modern requirements, implemented a number of programs.

1) the region has a program “energy Saving and increase of energy efficiency in the Republic of Mordovia for 2014–2016”. The program is designed to encourage the overcoming of energy barriers to economic growth through the introduction of a complex of energy saving activities: 1) identifying potential energy savings; 2) ensure that the rate of reduction of energy consumption in economic sectors; 3) expanding the revenue side of the budget due to the reduction of irrational consumption of energy. Activities of this Program are balanced and cover all sectors of the economy, serve as a tool to enhance further development of the economy and technological upgrading in the region. Funding for the program is expected in the amount of 1 billion 843 million rubles from the budgets of different levels and extra-budgetary sources.

2) a national program to support the development of the innovation cluster “energy efficient lighting engineering and intellectual lighting control system”. The cluster needs to become a leader in the domestic market. Competitive advantages: a) the leadership in the products they manufacture; b) the growing trend in the lighting industry; c) focus on implementation of a policy of the Government of the Russian Federation on stimulation of ener-

gy saving measures, qualitative change in lighting technology (the introduction of LEDs). The main objectives of the cluster: 1) the development of innovation infrastructure; promotion of innovation-based enterprises; 2) implementation of cooperation projects; 3) increasing the production and export of innovative products.

Currently the cluster consists of several components.

1) Managing company of the cluster – “Technopark-Mordovia”. “Technopark-Mordovia” and data center (one of the largest in Europe), aims to commercialize scientific and industrial developments, the growing needs of the region and the country in the processing, transmission and storage of data in the information structure of the world economy. With the activities of Technopark linked to the dynamic development of energy-saving lighting engineering, electronics and instrumentation, as well as the formation of new industries – optoelectronics, believe that radio Photonics.

“Technopark-Mordovia” has the ability to subsidize costs in areas: 1) cooperation in scientific-technical sphere; 2) marketing, information and PR-support of participants; 3) the development of cluster cooperation with government authorities, development institutions, public organizations, other clusters; 4) organization and participation in exhibition and communication activities; 5) development of production capacity and production cooperation between Cluster participants.

Strategic management and monitoring of programme activities managed by a focal point – Ministry of industry, science and new technologies of the Republic of Mordovia.

2) of the national research Mordovian state University named after N.P. Ogarev. The University implements programs of research in the field of energy saving and new materials, has a unique specialised Lighting Department for training. In the context of research to develop new environmentally friendly and energy efficient sources of optical radiation, materials and components for a new generation of devices of radio engineering, optoelectronics and power electronics.

3) Scientific research Institute of light sources named after A. N. Lodygina. The Institute has developed more than 90% of light sources in the domestic market.

4) More than 10 large and medium-sized manufacturing companies. Their activities are aimed at introduction of energy saving technologies, development of promising sectors of the economy and increasing its energy efficiency: biogas, solar panels, creating “smart” housing.

5) Association of manufacturers of lighting products “Russian light”, which brings together more than 40 lighting enterprises in Russia and abroad.

The structure of the cluster complex and diverse and involves the activation of economic relations with all levels of the budgetary system, economic actors. Financial security is implemented in the following forms:

- budget financing;
- self-financing;
- subsidies.

In 2013–2015 for the implementation of the programme of support for the development of the innovation cluster “energy efficient lighting engineering and intellectual lighting control system” is planned to attract 7 832,1 783 thousand ruble. The Composition of sources of funds were varied:

- 13,5% of Federal budget;
- 64,3% – resources of the regional budget;
- 1,8% – resources of the municipal budget;
- 20,4% of extra-budgetary sources of financing.

In the future the trend of increasing the share of the Federal budget, a slight decrease of the share of the regional budget, the reduction of income from extra-budgetary sources of funds and virtually complete absence of the municipal budget. This trend is due to the fact that the implemented program is characterized as regional in the context of strategic national development priorities of the country.

The members of the Cluster have been or are preparing to implement a complex of 26 investment projects in cooperation with domestic or foreign partners, estimated total cost 10342 million rubles, the growth Rate of performance indicators of the programme (by 2012) are:

- the volume of work and projects in the field of research of 300%;
- the volume of shipped innovative products (works and services) and growth of total revenue from sales of products in foreign markets to 250%.

The efficient functioning of the financial mechanism of the cluster depends on the optimal functioning of its structure and orientation, compliance elements and components of the tasks scheduled. The functioning components of the cluster, the development of economic and technological processes requires a systematic approach of research and consideration of the synergy of interests of economic entities.

Interesting alternative energy project is the placement in the region of production modules for the solar industry with the creation of over 200 jobs. According to experts, solar energy is

the fastest-growing segment of alternative energy. The annual rate of growth in the industry in recent times is over 50%. The creation of the enterprise due to favorable investment and production opportunities in the region and the prospects of market power for Russian villages. The benefits of such power are the minimum risk of environmental disasters, the lack of wear mechanisms, mobility design and ease of maintenance. The participants of this agreement – the government of the Republic of Mordovia, the company “Helio-Resource”, JSC “Electrovypryamitel”.

Next project is designing and building energy-efficient (“smart”) homes. Energy-efficient – house, which reduced energy consumption without loss of quality accommodation. Here, the technology used renewable energy sources that reduce consumption of energy resources. The design of these houses is: heating the geothermal waters; use of solar collectors; the use of insulated walls and glass with a thermionic coating, energy-saving ventilation system, automatic lighting control, the system of energy accounting. In Mordovia the construction of energy efficient homes is part of the implementation of the regional program on resettlement of citizens from emergency housing. It is financed with Fund of assistance to reforming of Glisno utilities [2]. Ensuring the Program is carried out from budgets of all levels, extra-budgetary sources. The financial resources of the Program is 6614,5 million. Structure of funds: 0,6% – to Federal budget; 6,4% are funds from the Republican budget; 0,2% – funds from local budgets; 92,8% of the funds from extra budgetary sources.

Modern large-scale development project is the construction of Russia’s largest biogas plant with a capacity of over 4 MW. This object appears near the capital of the Republic Saransk. In many developed countries there are special storage of solid waste of cities with the purpose of extraction of biogas for production of electric and thermal energy.

Bioenergy [3] is a promising sector of the economy. It allows you to solve the problems of obtaining fuel from biomass and the environment. Large-scale production of energy resources from plant materials non-food uses, processing of agricultural waste and timber industry, woodworking plants, and organic and domestic waste can improve the environmental situation in the country. Biogas is a high quality carrier of energy and can be used in the household, average and small business, for the production of electricity, heating of residential and industrial premises. Economic

and industrial effect bioenergetics is associated with the following factors:

- decrease of consumption of hydrocarbonaceous fossil;
- recycling of production wastes;
- reduction of harmful emissions and greenhouse gases into the environment;
- increasing the energy security of the region, country;
- highly effective fertilizer as an additional product of bioenergy production;
- decentralization of electricity supply.

This technology allows you to create waste-free environmentally friendly production. Raw material for the production of electricity being built in Mordovia biogas plant will be the waste products of cattle and beet pulp. In the enterprise will be interested in the agricultural region. A large part (about 4 MW) electricity will be supplied to network tariffs approved by Regional energy Commission, and the rest will be used for powering farms. Generated heat and byproduct biogas plant – organic fertilizer, will be used in greenhouse farms. This creates a sustainable closed cycle: plants – food products (food) – waste plants. This system provides the region's agriculture fertilizer and feed, and production – energy and raw materials. This reduces the use of mineral energy sources and the release of gases that cause the greenhouse effect, pollution of the environment.

In Mordovia adopted the legal acts aimed at regulation and support of innovative economy and energy-saving technologies: the Law of the Republic of Mordovia “On the Strategy for socio-economic development of the Republic of Mordovia till 2025”, the government of the Republic of Mordovia “On approval of the Program of increasing the investment attractiveness of the Republic of Mordovia for 2011–2015 years”, decree of the Government of the Republic of Mordovia “On the Republican target program energy Saving and increase of energy efficiency in Mordovia Republic for 2011–2020”, the decree of the Government of the Republic of Mordovia “On granting financial support to scientific and technical activity and development of innovative projects in the Republic of Mordovia”, the Government decree of the Republic of Mordovia “On approving the Concept of the Republican target program of scientific and innovative development of the Republic of Mordovia for 2010–2015 years”. The purpose of regulatory and

legal support is the development of scientific and technical potential of the Russian Federation, implement measures aimed at reducing energy consumption while maintaining the corresponding useful effect from their use in the field of lighting engineering and intellectual lighting management systems.

With a view to better realize the potential of the cluster of energy efficient projects in the region, subsequent to the effective decision of tasks it is advisable the use of adequate scientific tools. This is achievable through the implementation of scientific research approaches: the system, process, evolutionary, targeted. Modern approved method of comprehensive solution of financial and economic problems is the program-target method of planning. This method is in the target orientation of activity of economic subjects and planned resource provision – “goal – the way (objectives) – methods (activities) – resources”. The priority is not the current organizational structure and management system elements, software, benchmarks, actions.

In the Republic of Mordovia successfully implementing a complex of programs on formation of the innovative environment and support for priority directions of science, technologies and technics of Russia energy saving and efficiency. The peculiarity of the financial mechanism of the innovation cluster “energy efficient lighting engineering and intellectual lighting control system” is a flexible combination of budget financing, self-financing subsidies. An integrated scientific approach, the cluster method of program planning help you to achieve your objectives in accordance with resources development. This approach allows us to create high-tech background for development of the region for the formation of innovative structure of its economy.

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## INNOVATION ASPECTS OF TRAINING PERSONNEL IN CONTEXT OF GLOBALIZATION AND INTEGRATION PROCESSES

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There are considered the innovative aspects of training specialists with higher education in the conditions of globalization and integration processes in Kazakhstan. There are revealed the major factors constraining the higher school innovative development: insufficient budget financing, backwardness of social partnership of the higher school and the labor market, weak scientific and methodological ensuring of the undertaken educational reforms. There are noted the features of higher geological education and problematic issues of innovative development of geological industry in the context of forming the effective system of the geological studying of the subsoil and completion of mineral resources of the country. There is staticized the need of developing the National system of qualifications and forming the competence-based educational programs taking into account the requirements of professional standards and real production sector. In the conditions of flared globalization the Bologna Process is considered as an effective factor of the national education system rapprochement permitting to build the common space of higher education as the space of understanding and as the capability to speak one "educational" language.

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**Keywords:** Bologna Process, higher geological education, innovation economy, education globalization, social partnership, accreditation and quality

A strategic objective of upgrading Kazakhstan education, as the Republic of Kazakhstan President N. Nazarbayev emphasized, is training competitive specialists. It means that modernization of education in the Republic of Kazakhstan shall go on the way of developing innovative education. The task is paramount, comparable to the transition from the raw economy to the innovative one. The essence of innovative education can be expressed by the phrase: "Not to catch up with the past but to create the future". The main mission of innovative education is training a competent, aware and moral person. It can be reached under the condition when the society estimates the education system as the sphere of employment, as the sphere of profitable investments where there is reproduced the major capital, the intellectual resources.

Within the last two decades the upgrading of higher education was performed in the complicated conditions of the post-Soviet transformations, accruing globalization, inconsistent educational policy: from unification, standardization and regulation to the present excessive academic autonomy of higher education institutions. The Kazakhstan higher school managed to keep in general the scientific-and-educational potential and the common educational space.

Within the last 10 years the amount of education financing increased by 8 times. In the Global index of competitiveness of 2015–2016 of the World Economic Forum Kazakhstan takes the 42<sup>nd</sup> position among 140 countries of the world [1]. Kazakhstan enters the ten countries that are leaders in the index of education

development. In 2013 the Republic took the 27<sup>th</sup> position among 170 countries of the world in the Global index of the youth development. There was formed the first in the country research university: Kazakh National Research Technical University n.a. K. Satpayev designed to become a center of science and development of competences. There is being developed Nazarbaev University designed to become an engine of the higher school innovative development. There is working the network of the National higher education institutions consisting of 9 universities. There are being successfully developed 10 universities of innovative orientation. Kazakhstan became a Governmental member of the European Register of Quality Assurance.

At the same time the higher school innovative development is restrained by a number of circumstances. Despite the positive dynamics of higher education budget financing, its share makes 0,4% of the GDP. For comparison in the EU countries it makes 2%. The public expenditures for scientific research in the RK make about 0,2% of the GDP while in the OECD countries they make 2.4%. Now about 30% of the economically active population have higher education. For comparison in Germany the number is 84%, in Great Britain 65%, in Spain 45%. With increasing the costs for scientific research there is not practically observed the growth of innovative products. Within the last 5 years there is growing the number of scientific publications with a high impact-factor. At this the share of scientific publications of Kazakhstan scientists in the world makes only 0.04% whereas the share of Russia is about

2%, China 10%, the USA 22% [2]. There still remains rather a low social status of the high school teacher, scientist and low patent activity of the personnel. For 1 million of population the number of patent applications in the RK is less than 100. For comparison in Russia it is more than 200, in Germany 600, in the USA 750, South Korea 2 500. The number of research associates, despite its growth in recent years, remains even lower than the real need of the country. For 1 million of population in Kazakhstan there are about 1.4 thousand research associates that is much less than in the developed countries: in Finland 7,8 thousand, in Sweden 5.4 thousand, in Japan 5,3 thousand, in the USA 4,6 thousand.

The educational potential of Kazakhstan economy does not conform to the requirements of innovative economy yet. The specific weight of doctors and candidates of science in the total number of the personnel making about 50% cannot be considered as effective for reproducing the intellectual potential and providing competitiveness of the country. The absence of a competitive strategy of economy, its raw orientation poorly stimulate the need for creative specialists. There is no due demand for intelligence and creative approach. Products are not quite competitive, they do not contain science intensity. The system of the higher school financing does not provide the required quality of education for developing competitive economy [3].

According to experts, for harmonious development of economy the mineral resources shall be 1,25 times larger than the amounts of production. Within nearly a quarter of the century mining companies benefited without putting investments into geological exploration.

The RK President N. Nazarbayev at the meeting following the results of 2012 and the tasks of implementing Kazakhstan-2050 strategy expressed concern in the cost level for geological exploration. In Kazakhstan there are spent 20 dollars, in China 45, in Australia 167, in Canada 203 for one square kilometer. Such scanty costs are caused by the backwardness of the complex infrastructure in the sphere of developing innovative technologies in geological industry and deficit of staffing. Owing to the inefficient mineral and raw policy there are aggravated the issues of raw safety of the country.

Nowadays in Kazakhstan there are operated prospective mineral deposits found in the Soviet period. They are mainly the readily available and near-surface fields. In the subsoil of Kazakhstan, in the deep part, there is a huge potential of mineral raw material resources

(oil, gas, ferrous and non-ferrous metals, uranium, rare-earth elements, etc.). It is necessary to develop complex technologies of geological investigation based on up-to-date methods of geophysics, remote sensing of the Earth, multi-element geophysical and geochemical surveys capable to discover successfully the fields at large depths.

The key problem of the Kazakhstan raw complex is depletion of the ore base in a number of minerals. According to the RK Ministry for Investments and Development, since 2000 resources of copper decreased by 2,4 million tons, zinc and lead by 7 million tons, bauxites by 54 million tons. These indicators are given taking into account a surplus due to exploration works. The level of scientific and technological support of geological exploration both in the studies quality and in their amount decreased to a critical level. There is no development and output of hardware and technological complexes and equipment. There is no reliable scientifically based information of the mineral and raw potential of the subsoil. In geological industry the deficit of qualified specialists is sharply felt. The carriers of geologic-geophysical knowledge are generally people of the retirement or pre-retirement age.

Despite the haste of reforms in the context of the Bologna Process and pessimistic statements, higher education kept the demand for it and remains the most important institution of socialization and personnel reproduction. Nowadays in the Kazakhstan society there is a gradual transition from the idea of education as of a benefit at the expense of the state to the idea as a service and a subject of economic relations. The mass character and availability of higher education promote the emergence of the institutional conflict between the requirement of education quality assurance and safety of the student's contingent as a source of financial wellbeing of a higher education institution. In the conditions of insufficient budget financing the most important managerial decision there becomes minimization of the students expelling from higher education institutions. In this aspect there are needed effective methods and technologies of increasing the students' motivation to active study and effectiveness of training. It is impossible to reduce the level of the requirements below the admissible level. Otherwise a higher education institution will turn into a factory of issuing diplomas. Paraphrasing V. Sukhomlinsky: "it is impossible to turn a higher education institution into an enterprise where students study to pass examinations and the teachers work to get a salary".

Developing an effective education system that is adequate to the requirements of present day economy is the task of paramount importance. The World Bank studies show that 64% of the economic growth of any country are determined by the human capital, 20% by natural resources and only 16% by the physical capital in the form of the main assets and gold and foreign currency reserves.

In Japan, Germany, Sweden the share of the human capital in economic development makes about 80%, in Kazakhstan about 15%. Increasing the duration of training in senior classes by 1 year raises the GDP by 0,44%. So the planned transition of the Kazakhstan comprehensive school to the 12-year cycle has also an economic character. Not accidentally in the West the duration of pre-university (school) education makes 12–13 years.

The transition of Kazakhstan to innovative economy provides changing the demand pattern for university graduates. This challenge orients to the development of social partnership of the higher school and business production in the context of improving quality and competitiveness of higher education.

A high potential of the Republic in strategic raw material resources, in particular oil, gas and metals, as well as in uranium fuel is the basis for implementing the innovative-industrial strategy and Kazakhstan entering the number of the 30 most developed countries of the world.

In the RK Law “Of the Subsoil and Subsurface Use” there is provided the obligatory payment of the subsoil users in the amount of 1% of annual earnings for research and development works [4]. It will permit to increase innovative aspects of the advancing geological studying of the subsoil. It is extremely necessary to take measures for providing geological industry with competitive specialists and forming the system of advanced training and certification according to the National system of qualifications.

In the conditions of globalization higher geological education shall be integrated effectively into the common educational space (the international exchange of students of the geological profile, ensuring comparable quality, recognition of qualifications, etc.). Strengthening the language training is provided in the new generation State standard of postgraduate education (master, doctoral studies) alongside with expansion of the academic freedom of a higher education institution that is especially urgent for the geological sphere of Kazakhstan in which there work a lot of foreign compa-

nies. For years of independence according to the international Bolashak program there were trained more than 10 thousand experts who studied at the leading higher education institutions of the world according to international standards. Unfortunately, among them there are no Kazakhstan citizens who acquired professional knowledge and qualifications in specialties of geologic-geophysical orientation.

Now the most problematic issues of innovative development of geological industry are as follows [5]:

- a low level of the advancing geological studying of the subsoil;
- a low level of development of the prospecting infrastructure including applied science;
- an insufficient level of monitoring the rational use of the subsoil;
- deficit of the professional personnel in the sphere of geological exploration and geophysics;
- imperfection of the legislative and regulatory base in geology and subsurface use.

There are needed complex measures for increasing the investment appeal of geological industry. Forming the effective state system of geological studying of the subsoil and completion of mineral resources for satisfaction of economic needs of the state at the present stage and in the long term prospect shall become a strategic objective of developing geological industry of Kazakhstan till 2030. All these moments should be considered when designing educational programs for specialties of the prospecting profile. At this “professional competences are developed on the basis of professional standards taking into account the requirements of employers and the society social request”.

A successful development of the National system of qualifications provides developing organization-legal mechanisms for mutually advantageous partnership of the education system and the labor sphere. The professional community of employers together with the high school public shall take an interested part in developing high-quality professional standards in which it is necessary to designate the qualification characteristic of the university graduate in the format of the competence-based approach [6].

One of the most important indicators of education effectiveness is the demand for graduates of educational institutions in the labor market. It is no secret that quite often the level of specialists’ readiness and the level of the employers’ requirements do not match therefore young specialists should “study up” at the adaptation stage. In this regard



the following permission of this situation seems quite logical: the employer establishes to education the requirements to the level of the workers' competences needed for it, and educational institutions taking into account these requirements perform training specialists who are demanded for in the labor market and capable to join quickly the production process. The role of some kind of a "transmitter" of the employers' requirements is assigned to the professional standard which provides education with the necessary information of the areas of professional activity of graduates, objects of these activities, their types and tasks, the required competences of future specialists.

In the professional standard there is pledged a professional minimum to which there shall correspond all employees and heads of the enterprise/company therefore it can form the basis for developing standards of organizations. The professional standard can be used in matching, arranging, using the personnel (promotion, career development, personnel reserve, dismissal) and in case of determining the degree of their responsibility. The professional standard permits the employer: to choose the high-quality personnel in the labor market as it forms the basis for determining evaluation criteria in case of workforce recruiting; to provide the quality of the personnel work; to provide the personnel professional growth; to support and improve the quality standards in organizations through controlling and increasing the workers' professionalism; to increase the personnel motivation in the organization; to increase the efficiency of ensuring stability and quality of the work achieving thereby high economic results.

Professional standards serve as the base of certification. The results of training (competence) are reflected in professional standards and are grouped into qualifications. Each qualification, in turn, belongs to a certain level according to the frame of qualifications: national and industrial. When assessing within the procedure of certification, there is established compliance or discrepancy to the requirements of professional standards. In turn higher educational institutions of the Republic of Kazakhstan shall undergo accreditation, i.e. get permission of the state to educational activities: establishment or confirmation of the state accreditation status of the educational institution including that at the level of implementable educational programs, their orientation, as well as compliance of the content and quality of graduates training at educational institutions to the state educational standards.

The paradigm of continuous education assumes the formation of partnership of the educational process subjects. The teacher shall promote knowledge acquisition, abilities and competences, and the student shall be motivated to acquiring this triad. The main task of the teacher consists in that the student wanted to study, to plunge into the active process of training. It is necessary to fight not for all, and for everyone. In other words, the teacher is to teach not all but everyone. In pedagogical practice it means using an individual, personality-oriented approach to teaching.

First of all it is necessary to achieve increasing the social status of the high school teacher. If we do not make the teachers' compensation competitive, then in the next years the higher school will appear in the default condition. Experienced teachers who are now 65–70 will leave or will lose working capacity, and the talented youth (they are not a lot) can leave the scientific and educational sphere or the country in searching for a worthy salary and possible implementation of their creative ambitions.

Transition to per capita financing (money at a higher education institution is brought by a student) turned each student in the carrier of financial resources. In the conditions of insufficient financing of the higher school the educational policy of a higher education institution is formed proceeding from the principle: maximum increase in the students' contingent and minimization of expelling. Such an educational policy does not promote improving the training quality.

Increasing the prestige of the engineering profession is urgent. Nowadays the training share in the sphere of engineering and technologies in the total number of students in the EU countries makes 36%, in Russia 30,6%, in China 32%, in India 31%, in Kazakhstan at the level of 19% [2]. It is reasonable to increase the amount of the state order for technical trajectories of training, to increase the threshold point of the entrants, as well as the standard rates of training financing in knowledge-intensive technical specialties, in particular geology and investigation, geophysical methods of search and investigation.

In the conditions of globalization the importance of the country is determined not so much by mineral raw material resources as by its economy competitiveness which level depends on the development of the knowledge-intensive and high-tech production and rates of its innovating. The decisive factor in providing this is the expanded reproduction

of knowledge, inconceivable without higher education. Budget costs for education is not a burden for the state but the investment into a person, the most profitable to the society in the long term.

Famous classic of political economy A. Smith wrote: "A person who got education owing to great work and time can be equated to one of the expensive machines". As American scientist E. Kohn determined, between expenses for education and growth of the national income per capita there is a close correlation. About 20% of the USA economy growth are reached by increasing the level of education and qualification of the population.

In current trends there is reflected the increased value of higher education and recognition of the high role of universities in the economy forward development. The world is at the stage of transition to the sixth technological way today. In the number of leaders there will be countries which timely reached this stage. The state program of industrial-innovative development (SPIID) assumes the high-tech post-industrial society with the developed intellectual potential. In the present world there is affirmed the thesis: education is the first link in the chain leading to developing high technologies.

The competitive strategy of Kazakhstan in the context of Strategy-2050 shall be based on developing the scientific and educational capacity of the country. Unfortunately, this potential does not completely conforms to the requirements of the knowledge-intensive economy. Competitive line items of Kazakhstan in the world economy are still rather low. There is no due demand for intelligence. Products are not quite competitive, they do not contain a lot of science intensity and technological effectiveness.

The process of globalization, despite its objectivity, represents the most complicated transformation of the world system in which there is a danger of selecting the unified and simplifying integration models. The Bologna Process which Kazakhstan joined in 2010 is an example of the integration vector of globalization. It required considerable changes in the educational policy [7].

Despite a number of the contradictory moments, the Bologna Process is considered as a capability to speak one "educational" language and as an effective factor of the national education systems rapprochement on the basis of mutual dialogue. The ability to think of general categories and to operate with close value systems permits to build the common space of higher education as the space of understanding.

The expanded autonomy of higher education institutions in forming educational programs and selecting technologies of training is fixed legislatively. The expansion of the degree of freedom assumes the increased requirements to the higher education quality and the need for its objective confirmation. It makes necessary carrying out a systematic monitoring of the efficiency of higher education institutions activities. In this aspect a special role is assigned to independent accreditation of higher education institutions and educational programs. Since 2017 there will be performed transition from the state certification of higher education institutions to accreditation. It provides developing the effective system of education quality assurance including internal and external control.

The point of intersection of higher education institutions and employers interests becomes independent accreditation of educational organizations and educational programs [8]. Accreditation permits to estimate the activities of higher education institutions not only in the context of quality assurance, but also from the line item of satisfaction of all interested consumers of educational services (students, employers). It becomes the working tool demanded for and attractive to various target audiences. In the course of accreditation higher education institutions reveal strong points of the activities and get competitive advantages in the education market. The revealed weak points permit a higher education institution to correct the educational policy and to make strategically correct decisions for training popular specialists. The procedure of accreditation forces the business community to become not only a customer but also an appraiser of the quality of educational services (knowledge, abilities and professional competences).

The processes of globalization are capable to work in the multi-vector directions. The active market rhetoric, expansion of the paid sector of higher education and the academic autonomy of higher education institutions negatively influence the quality. There is leveled the most important thesis of higher education as a public benefit to please the market conditions. It is not necessary to be guided blindly by the western samples without considering the Kazakhstan realities.

The universities, realizing innovative education, shall train specialists who alongside with a clear civic stand and modern outlook have profound knowledge and professional competences adequate to the developing

new technological way and conforming to the requirements of dynamically changing economy.

The effectiveness of the undertaken reforms depends on the accurate statement of the criterion functions and scientifically based methodology of step-by-step upgrading the higher school in the direction of quality assurance and competitiveness. It is necessary to bring the level of budget financing of the higher school to the Central European standard rates, to provide measures for increasing the social status of the high school teachers, developing the conditions for the fixed growth of their professional competence.

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*Materials of Conferences*

**DIAGNOSIS OF SUBJECT  
COMPETENCES IN BIOLOGY  
OF FOREIGN STUDENTS  
FROM THE PREPARATORY FACULTY**

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A serious problem of preparation of foreign citizens for admission to Russian medical universities is the formation of subject competences in biology in Russian language. To obtain the objective information and to evaluate the level of competences formation of foreign students one should use an effective system of evaluation. A unique monitoring system has been developed at the preparatory faculty for training foreign citizens of Rostov state medical University and is successfully used here. It includes a variety of training activities, which perform the diagnostic function. Monitoring includes 3 levels. The **Ist** level is represented by current tests on the studied subjects of the biology course. The second monitoring level is referred to the extraclass activities and is voluntary for students. It is carried out through participation in interdepartmental conferences and the biological contests. Level III is the final exam which is held in a written form and includes different types of tasks. Monitoring of students' progress is carried out with the help of the rating system of knowledge assessment. The final rating is the sum of annual and test results with the maximum 180 points. Participating in conferences and contests on biology, the student can obtain additional (creative) points (up to 30 points). The final grade is given according to the following scale: less than 91 points (< 51%) – mark “2”; 91–126 points (51–70%) – “3”; 127–153 points (71–85%) mark “4”; 154 points (more than 86%) mark “5”.

The use of the described monitoring system enables us to diagnose the degree of biology subject competences formation of foreign students from the preparatory faculty after mastering their Russian language course and a biology course in the Russian language. The sufficient level of biology subject competences allows the graduates of the faculty to successfully master the curriculum of the first-year medical universities together with native Russian students.

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**ACTIVE METHOD OF TRAINING  
IN REALIZING COMPETENCE  
APPROACH IN PREPARING DOCTOR  
OF GENERAL PRACTICE**

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**Urgency:** The basic principle of postgraduate training for doctors of general practice (GPD) is continuous professional development. For the successful future work a GPD must possess an optimal set of qualities – so called competences. Realization of competence approach in training GPD is assisting them in achieving their primary objective – become a qualified competitive specialist at a labour market. Transition towards competence approach in organizing educational process within training GPD is not possible without facilitation of active methods of education, and this aspect always remains an urgent problem.

**Work objective:** Department of GPD uses methods of interactive education for internship and postgraduate education. These methods imply methodics of “small groups”, “brain attack”, “set of signs” in an envelope, method of “blank sheet”, role-playing game. This objective of an active methodic should and must be used in process of one class.

The method of “brain attack” or “brainstorm” is efficient for classes with large number of students. We implement it in discussion of a disease etiology. This process provides for formation of competence “knowledge” Role-playing games are used at the stage of studying clinic, diagnostics of a surgical disease. Roles of a patient, doctor, head of department, narrow specialists, invited for consultation, are played. The problem of establishing a diagnosis is solved in process of role-playing game. The “Set of signs” in an envelope is applied in holding differential diagnostic of a disease. Students are provided with a set of signs, symptoms of various acute surgical disease groups, from which they must select symptoms of one disease that corresponds to thematic of class, outline the most significant and typical signs of the studied disease. For example, a lot of disease symptoms according to one author (Kocher) are present in case of acute appendicitis, penetration of ulcer stomach disease, etc., and this method helps students to carry out differential diagnostics. This method stimulates discussion within group and forms the competence “skill”. Method of “blank sheet” is useful in discussing treatment and prevention of chronic disease among patients with vascular pathology, for example, chronic

thrombophlebitis of surface veins or varicose trophic ulcers, etc. In this case every GPD must write a treatment protocol, characterize indications and contraindications, side effects of medications. Then treatment protocols are discussed in a group, recommendations on disease prevention are mastered. Method of “blank sheet” forms competence “skills”. The formed competences are subjective to an obligatory evaluation. For “boundary control” and “final control” of DPG knowledge in a certain section of the educational programme method of “small groups” is implemented. This approach is also useful in case of lack for thematic patients, discussion of rare nosological forms of a disease, defining diagnosis according to medical documents (history of disease, etc.) A special feature of active training forms is involvement of doctors into solving the set problems at the foundation of “group dynamics” methods.

**Conclusion:** Active methods of training and realizing competence approach in educating GPD will provide for making the most efficient decisions in process of carrying out their professional duties and achieving their primary objective – become a qualified and competitive specialist at labour market. In practice some of GPD department graduates have become organizers of hospitals, military surgeons.

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#### THE INTEGRATED PROGRAM IN THE RUSSIAN LANGUAGE AT GENERAL EDUCATION SCHOOL

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The article deals with the integrated educational programs that are being introduced into Kazakhstan general education schools, their characteristic being integration of school subjects, unity of students' learning and up-bringing, teaching them to apply their knowledge in problem solving; a Russian language textbook concept is described in the context of integrated education in which the Russian language is considered as a subject with a special status among others, as an important tool in forming students' personality, their intellectual, emotional and moral development; characterizes the methods of learning using the works by Olzhas Suleimenov at Russian lessons which contributes to the forma-

tion of students' creative attitude to the word and critical thinking.

#### Integrated educational programs

Integrated educational programs are being introduced into Kazakhstan general education schools [1]. These programs are characterized by integration of several subjects, unity of learning and up-bringing, teaching students to apply their knowledge in educational and professional problem solving. It reflects the integration of scientific knowledge that implies a shared vision on the problem from the point of view of the Humanities (or natural sciences), as phenomena, objects and processes in the world around are closely connected. The advantage of this program is that it is focused on active learning, and it fully meets the requirements of our century that is filled with information.

#### The teaching aims of Russian at school

The Russian language is not just a subject; it is a means of studying other subjects, experiencing the surrounding reality, a powerful weapon in self-development and socialization. Therefore, in teaching Russian we should not just give information about the language itself, but teach students to use it in different situations and teach them how to learn themselves. The integrated approach to teaching Russian allows overcoming the learning practice that reduces oral and written speech acquisition to the ability of making orthographic, punctuation and other types of word, sentence and text analysis.

The change in the objective – the integration of subjects – has led to changes in the content of the Russian Language subject and in the system of its realization in the textbook. In creating “Russian Language” textbook for 7<sup>th</sup> grade we gave priority to the principles promoting various types of oral activity acquisition – listening, reading, speaking, and writing. It is the language that helps people communicate, receive and store information, become familiar with the people's culture, history and belles-lettres. That is why at the Russian Language lessons it is important not only to give knowledge about the Russian language but to form the skills to use this knowledge in practice. In other words, at the Russian Language lessons it is necessary to talk not *about* the Russian language but *in* the Russian language.

“Russian Language” textbook for 7<sup>th</sup> grade includes the following topics: “Climate and Its Change”, “Customs and Traditions”, “Knowledge: The World and Foreign Language Learning”, “Do the landscape and climate influence on the national character?”, “Youth Culture: the Internet and Social Network”, “Problems of Social Security for the Homeless”, “Genetically Modified Foods”, “Victory Day”, “If I were the Ruler of the World...”. The contents of the textbook integrates information on the Russian and Kazakh literature, geography, history, cultural studies, ethnography, social studies, computer science, etc. based on which students study the Russian language, acquire functional

literacy that encourage students to utilize their abilities and socialize successfully.

#### Works by Olzhas Suleimenov at the Russian Language lessons

In the textbook we turned to the creative work by Olzhas Suleimenov, a public man, poet, writer, writing in the Russian language, who has been doing his years long research in linguistics, semiotics, literary studies, etc. using the works by Olzhas Suleimenov at the Russian lessons enables to create a learning atmosphere that contributes to the formation of creative people who can think critically, who have a fine appreciation of a word, who are able to embrace the world on a large scale, as a cosmopolitan, and perceive their motherland as the beginning of everything.

Studying the Topic 10 called “How to Study?” of Chapter 3 “The World and Foreign Language Learning”, students consider such questions and ‘actions’ as How to study? What is motivation? How to put smart questions in learning? How to set smart goals in learning? How to train memory, attention and concentration? What types of knowledge are there? How and where to find information? Why is our century called the Information Century? Why is it important to study continuously, retrain and adapt to the ever increasing flow of information?

In this topic we study the poem *Волчата* (“wolf cubs”) by Olzhas Suleimenov that is studied at Russian Literature lessons (Exercise 231) [2, p. 26]. The exercise offers to identify the type of knowledge (of common life, practical, scientific or literary) it includes, what information can be obtained from it [3].

The poem deals with the problem of violation of harmony in nature that leads to man’s self-destruction. In order to identify the main idea of the poem, one can hold a conversation using the following questions: What problem is raised by the author? What is the main idea of the poem? What feelings did the she-wolf cause in the wolf hunter? Why didn’t the wolf hunter touch the wolf cubs? What is the tragedy described in the poem? Why wasn’t the person guilty of the she-wolf’s death mentioned in the poem? Can a person decide whether an animal should live or die? etc. At the end of the discussion using the questions students make a conclusion that the poem shows the interrelation between the world of nature and the world of man, that his nature is revealed through his attitude towards animals. Olzhas Suleimenov’s idea that wolf cubs learn the feeling of revenge “with their mother’s thick milk growing cold” sounds like a warning to people.

After the conversation you can use one of the methods of developing critical thinking – “RAFT” (“Role (the addresser of the text) – Audience (the addressee of the text) – Form (the genre of the text) – Theme”). This method teaches to analyze your actions and ongoing events, to express your attitude towards the world, to consider the problem from different points of view, to solve it, to arrive at well-

founded conclusions, to exercise judgment, and to utilize their creative skills. Students are offered to create different reading “scenarios” of the poem.

R – role	wolf hunter	wolf cubs	onlooker
A – audience	hunters	animals	students
F – form	conversation	short story	report
T – theme	“Man and Nature”		

Working in groups, students discuss the given scenarios of Olzhas Suleimenov’s poem interpretation and create their own texts from the given person to the designated addressee in the given genre, give their own opinion about the main idea and the moral (“Live with the feeling of love to nature, people and home grounds!”). It is necessary to point out to students the importance of getting into the role of the wolf hunter, the wolf cubs, and the onlooker; take into account the conditions the personage is found in. A monitoring is carried out after presenting the results of the work: the most important moments created by each group are defined and discussed.

Such an integrated lesson provides students with the opportunity to utilize their skills in identifying new in the known, to go beyond the usual, to offer unconventional solutions to the problem showing the flexibility and originality of thought.

Studying the Topic 14 called “Russian and Kazakh Nature” in Chapter 4 “Do the landscape and climate influence on the national character?” the poem *apples* (“apples”) by Olzhas Suleimenov is given (Exercise 326) [2, p. 95]. The integrated lesson on this poem can be held using such methods of developing critical thinking as “The Oak of Predictions” or “Bloom’s Daisy”.

Before reading the poem the work with “The Oak of Predictions” is carried out. This method – “The Oak of Predictions” – was adopted from the American educator J. Bellans. We have changed its name as the oak in the Russian culture possesses a great significance: it is a symbol of strength wisdom and eternity. The rules of working with this method are: the theme is written down on the trunk of the oak – “The poem *apples*”; suppositions of what the poem is about and of what the title suggests are written on the branches; the leaves contain arguments for one’s own opinion. Such work helps develop creative thinking, the skill of matching arguments and facts, thinking of the perspective, developing visual and logical thinking. After reading the poem students answer the question of whether their guesses written on “The Oak of Predictions” coincide with the content of the poem.

The poem analysis can be carried out using the six questions on the six petals of the “Bloom’s Daisy” that are organized according to students’ levels of cognitive activity – knowledge, understanding, application, analysis, synthesis and evaluation. This method develops students’ ability to ask questions

that require several answers, encourage contemplation, a dialogue and help state the problem [4].

“Daisy” questions should deal with the content and the main idea of the poem. They can be of six types: simple (Where do the events take part? How does the poet describe the setting? What do the apples represent? What are the parts of the poems? What changes have the “shaggy”, “angry” men undergone?), specifying (Is it true that the apples are the symbol of the Sun and Almaty? If I get it right, the poem is entitled *apples* because...), interpretational (explaining) (Why was the land called “so tenderly”: “snowstorm”? Why is the apple compared with the Sun? Why does the poet address the mother?), creative (Can “the rosy shining smell” of an apple “blaze up”? can one look at “the apples cheeks as children’s”? What would happen if the hero took a tomato or a watermelon out of the backpack instead of an apple?), evaluative (What is your attitude towards apples?), practical questions (e.g. What would you do if were in this situation? What would you take with you when you visited your friend in order to remind him of his motherland?).

#### Conclusion

Thus, integrated educational programs are focused on not only students’ knowledge acquisition but on students’ ability to analyze the information, evaluate it and after giving their own opinion to use it in their future educational and professional life. In this case students are fully involved in the learning process as its active participants, and the teacher’s role is reduced to that of a coordinator.

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#### SPECIFIC FEATURES OF BILINGUAL SPHERE MEDICAL UNIVERSITY E-LEARNING

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The purpose of the research is to study specific features of bilingual sphere medical university e-learning. The e-learning basic elements in medical

school foreign students’ educational process were considered as the research object. Research methods: supervision, reflection, analysis, questioning, interview. Material. Results of first-year foreign students’ testing served as material of our research. In total 244 first-year students of Kursk state medical university were interviewed. Examinees studying medicine in English were grouped according to the rate of academic progress. Results. Medical university foreign students’ demands of e-learning basic elements in educational process are analyzed in the article. Advantages and limitations of e-learning basic elements in bilingual sphere of medical university are studied, problem of e-learning usage in complex with university traditional methods of teaching is considered. The aspect of e-learning effectiveness in international students’ cultural and professional competence formation is studied with respect of examinees educational activity.

E-learning is defined by UNESCO as students’ education based on internet and multimedia technologies. Pedagogical research results proof that university e-learning stimulates students’ cognitive activity [2, 5], improves their educational results [4, 6], allows to use modern science and technology achievements in educational process, optimizes process of independent work [3] and provides effective students’ self-control. At the same time it should be noted that specific features of bilingual sphere university e-learning are a little investigated [1] in spite of the fact that relevance and demand of such works are extremely high as:

– firstly, universities of Russian Federation at present are accepting the considerable number of foreign students to study in intermediate language as English most often acts.

– secondly, owing the fact that high school e-learning various elements are actively used in educational process of international faculty students differing basically on scientific knowledge, language skills and cultural background.

In this regard the purpose of the research is determined as specific features studying of bilingual sphere medical university e-learning. The e-learning basic elements in medical school foreign students’ educational process were considered as the research object.

Material and methods. Results of first-year foreign students’ testing served as material of our research. In total 244 first-year students of Kursk state medical university were interviewed. Examinees studying medicine in English were grouped according to the rate of academic progress: 27% of all students were included into the group with high results of educational activity, 70% – into the group of average academic rate, and 3% of all students were in the group with poor educational results. The experiment was held in constant conditions for all groups of students: the research was held at 11 a.m. in the academic auditory. The research duration was about 12 minutes. The medical faculty students performed the testing independently. The testing was built on the basis of original author test including 12 questions.

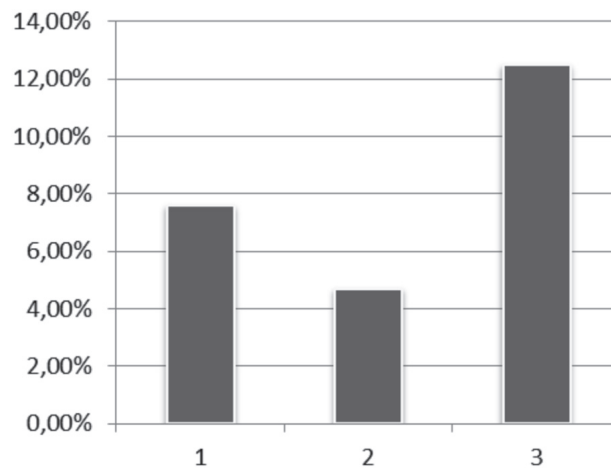


Fig. 1. Number of first-year foreign students that esteems multimedia lectures as ineffective element of medical school educational process. Note: 1 – high educational rate students (4,7%); 2 – average educational rate students (7,6%); 3 – low educational rate students (12,5%)

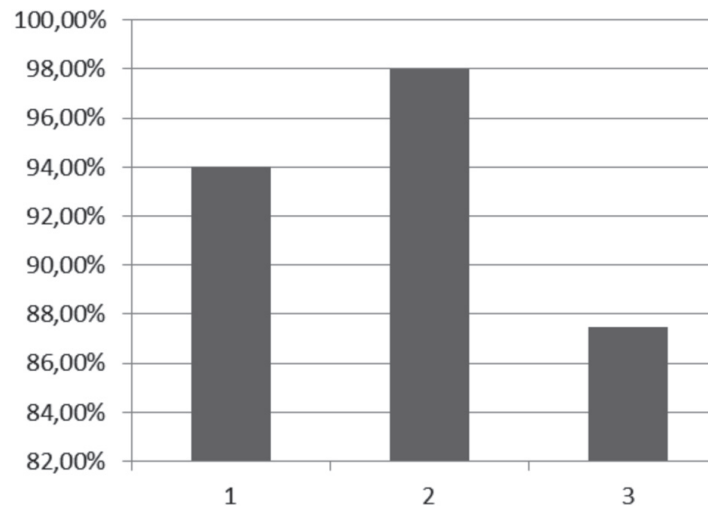


Fig. 2. Number of first-year foreign students that considered educational computer tasks as effective medical school educational component. Note: 1 – high educational rate students (94,0%); 2 – average educational rate students (98,2%); 3 – low educational rate students (87,5%)

Results. At the initial stage of the research examinees studying medicine were asked to arrange the e-learning basic elements according to the frequency of their use in university educational process. international faculty students put e-learning elements in the following order:

- multimedia lectures;
- electronic manuals;
- computer testing;
- laboratory works on the computer;
- problem tasks on the computer;
- university website information.

Next stage of the research the examinees started to esteem the effectiveness of e-learning elements.

According to the research results multimedia lectures are considered by 91,8% of first-year foreign students as useful component of medical school educational process (fig. 1).

However, 4,7% of students with good results of studying, 7,6% foreigners with high academic rate and 12,5% first-year students with poor educational activity results esteem multimedia lectures as ineffective. For comparison: to the opinion of 100% of domestic students with low academic rate multimedia lectures is irreplaceable component of university educational process, the great instrument of representing and visualizing the information. To our mind, the fact that low educational rate foreign



students do not appreciate the value of multimedia lectures in university educational process can be explained by difference in basic scientific knowledge, namely in computer skills, between foreign students. If Brazil and Malaysia representatives masterfully use modern computer technologies, students from India and Sri Lanka experience serious difficulties in computer usage. Students admit the fact that e-learning is unusual for them, and causes rejection at first. Fidelity of our thought is also confirmed by foreign students' testing results in the question about educational computer task expediency. Educational computer tasks are considered as effective medical school educational component by 96,7% of international faculty students: by 94% of students with high rates of the academic progress, by 98,2% of students with good results of studying and by 87,5% of students with poor educational results (fig. 2).

Computer tasks are difficult for the first-year students with low results of educational activity, because they do not have enough knowledge in software and computer technologies. Exactly the same difficulties low academic rate students face in computer laboratory works performing. They are considered as inefficient by 11,5% of poor educational results students. Computer testing is considered effective by 91% of international faculty students. 100% of students with low academic rate expressed opinion of sufficient objectivity of computer testing results. To our mind, definite algorithm of testing programs does not cause rejection by foreign students. The accurate test questions formulation, computer testing programs option of choosing between possible answers removes a linguistic barrier, eliminates psychological discomfort of foreign students. Summarizing all that has been said, it should be definitely noted that there are some specific features of e-learning in bilingual sphere. E-learning first of all is demanded by high academic rate foreign students, and it frightens off students of international faculty with poor educational results because its novelty. Insufficient base of computer knowledge does not allow foreign students with

low results of educational activity to be completely included into e-learning process.

In our opinion, such measures as accurate algorithmization of work, gradual introduction of new e-learning elements, the main attention to computer testing, detailed explanations of electronic manuals usage promote ensuring psychological comfort of foreign students, formation of positive reaction of international faculty students to e-learning, will allow the international faculty students to take all the advantages of e-learning.

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## ADJECTIVE-BASED MODALATES AT THE INTERSECTION OF DIFFERENT WORD CLASSES: LEXICOGRAPHIC ASPECT

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The article presents the results of lexicographical studies of adjective-based modalates at the intersection of different word classes. According to the materials of the Russian language dictionaries, the analysis revealed some trends in the functioning of short adjectives such as *really, probably, truly, certainly*, which do not correlate with usual adverbs in modern speech. The article shows contextual conditions of their use in the syntactic function of the predicate in a two-member sentence (in rare cases – the main part of an impersonal sentence), as well as convergence in the anteposition with affirmative particles, and when used in the interposition with contextual adverbs. Besides, the paper characterizes the status of adjective-based introductory-modal words at the intersection of modalation and particulation transposition processes as well as of modalation and contextual adverbialization. The results of the research can be used to create transpositional Russian grammar, as well as to study controversial issues of theory of transitivity and syncretism in the classroom for Russian grammar in high school.

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**Keywords:** Russian language, grammar, transposition, modalation, part of speech, adjective, adverb, predicative, particle, modal word

Among the words and phrases, transposed in inter-part-of-speech semantic and syntactic category of introductory-modal units, adjectives, adverbs and predicatives occupy a special place. Depending on the type of correlation with the words of different categories, they can be divided into: (a) adverbs such as *by the way, on the contrary, conversely, in addition, in contrast, certainly, in general, by no means*, etc., which do not correlate with short adjectives and predicatives with the meaning of the condition and / or evaluation; (B) short adjectives ending in *-o, -e* such as *really, of course*, etc., which do not correlate (except speech adverbialization in the position between the subject and predicate with adverbs and predicatives; (C) short adjectives ending in *-o* such as *evident, clear*, etc., which correlate with predicatives, i.e. able to act in the impersonally-predicative position, but without correlates among adverbs; (D) short adjectives ending in *-o* such as *strange, surprising, amazing, pitiful, said* etc., which correlate with adverbs and predicatives; (E) short adjectives ending in *-o, -e* such as *definitely, looks like*, etc., which correlate with adverbs, but without correlates among predicatives; (F) short plural masculine and feminine adjectives such as *guilty*, which correlate with etiquette interjections, but without correlates among adverbs and predicatives; (G) long neuter adjectives in the positive and (analytical) superlative degree of comparison such as *the main, the primary, the most, the least, the worst, the best, most important*, etc., which correlate with abstract adjective-based nouns or substantives; (H) adjectives and / or adverbs, including the predicative function, in synthetic and analyti-

cal forms of comparative degree such as *more correctly, more precisely, easier, shorter, better, more strictly*, etc. and analytical form of superlatives such as *most correctly, most precisely, most likely, most probably* etc. Being used in the introductory-modal meaning, adjectives and adverbs often retain their grammatical meanings of comparative and superlative degrees of comparison, allowing the speaker to evaluate the linguistic form of the expressed idea as the more / most accurate, correct, concise etc.; cf.: *(put it) shortly* (about semantics of relative and irrelative degrees of quality, ref. the research of Yu.L. Vorotnikov [23–24]). In addition, modalates can correlate with nouns such as *fact, truth*; predicative verb form such as *I think, they say, just imagine, look*, etc.; semi-predicative verb form such as *apparently, to put it mildly*, etc.; substantive representation such as *apparently, evidently, to tell the truth*, etc. (ref. [11, 14–17, 19–22]).

As a result of the transposition into introductory-modal words and expressions, linguistic units of different classes weaken to some extent and sometimes completely lose their semantic and grammatical characteristics – semantics of the part of speech, meaning of grammatical forms, function as a member of a sentence, thus getting isolated from the paradigms of respective categories and acquiring in the introductory position a particular subjective modality which reflects the position of the mode subject on the reported information (about the types, levels and limit of the transposition of linguistic units in the system of parts of speech and inter-part-of-speech classes also ref [7–10, 12–13, 18, 21]).

Among introductory-modal words and expressions a few short adjectives such as *indeed*, *likely*, *genuinely*, *of course* occupy a special position, and they do not correlate with usual adverbs in the contemporary Russian language. They are usually used in the syntactic function of predicate of a two-member sentence (in rare cases – as the main part of an impersonal sentence; see below for *likely*, sometimes approximating affirmative particles in anteposition, and contextual adverbs in interposition. Cf. syncretic contexts of their modalization and particulation (1), as well as modalization and contextual adverbialization (2):

(1) **Indeed**, this is talented!;

(2) *The poet is talented, indeed.*

When building a scale of transition [S(hort) adj(ective) -> S(hort) adj(ective) m(od) -> s(hort) adj(ective) m(od) -> s(hort) adj(ective) M(od) -> M(od)] for these short adjectives we take into account only the “pure” modalization contexts and combined modulation contexts in the periphery of introductory-modal units (1) with the transposition process of particulation, although the special symbol [O(ften)] for approximating particles is not indicated on the scale [cf. graphic explication of the stage: s(hort) adj(ective) M(od)]. Examples of intersection of the transposition processes (2) of modalization and contextual adverbialization are evacuated outside the modalization scale, which records the main transposition vector of short adjectives toward introductory-modal words.

Lexicographical development of syncretic word forms such as *indeed* can be very controversial, as such word forms can be found in different contexts at the attraction of various aspects of short adjectives, adverbs, predicatives, particles and introductory-modal words. Thus, in the Great Academic Dictionary of the Contemporary Russian Literary Language the adverbialized short form of the adjective *indeed* in the function of a modal adverbial modifier is recorded as an adverb with the meaning “really, indeed, in fact, precisely” (3), provided that in one dictionary entry it goes with the original adjective denoting “existing, that exists in reality; not imaginary, real” (4) [4, p. 654–656]. It is noted that the adverb is often used in the meaning of an introductory word (5) [ibid: 656]. Cf. examples from the Great Academic Dictionary:

(3) *Our achievements are really striking, and the work program for the future is also tremendous* (Kirov. Articles and speeches, 1934);

(4) *Vasya stayed with the colonel, he didn't separate from him..., he protected him from all dangers, real and imaginary* (K. Simonov. Maturity);

(5) *In front of me there was something humming, and for a moment I thought that I heard a human voice. I listened carefully: indeed, it was a human voice* (L. Tolstoy. The Cossacks).

In the Concise Academic Dictionary of the Russian Language *indeed* in the function of a modal adverbial modifier is also treated as an adverb, but in a separate dictionary entry (ref.: [1, p. 378]). This adverb in the position between the subject and predicate is assigned the meaning “really, truly, indeed” [ibid]:

(6) *She was standing with her back to me. I didn't see her face, but I felt that she was really upset and, maybe, there were tears in her eyes* (Katerli. Bronze spinning wheel).

As in the Great Academic Dictionary, the Concise Academic Dictionary illustrates the introductory function of the word *really* with antepositional contexts where the word form approximates not only introductory-modal words, but also modal, affirmative particle such as *yes*:

(7) **Indeed**, the battery overlooked almost the entire arrangement of the Russian troops (L. Tolstoy. War and Peace) (≈ ‘yes’).

Almost the same pattern can be observed in the “Great Dictionary of the Russian Language”, edited by S.A. Kuznetsov [5, p. 246], where, however, the introductory function of the adverb *really* is comprehended not as a meaning of an introductory word, unlike the previous academic dictionaries, but as an independent introductory word expressing sureness. As an example, it also contains a sentence with a word form *really* used in the anteposition to the predicative basis of the statement:

(8) *This time, indeed, he is right.*

In the “Explanatory Dictionary of the Russian Language” by S.I. Ozhegov and N.Yu. Shvedova [6, p. 157], introductory-modal use of the word form *really* is connected with an adverb which is interpreted as an introductory word, as in the “Great Dictionary of the Russian Language” although within the same dictionary entry with a capital adjective *existing*, just as it is presented in the “Great Academic Dictionary of the Contemporary Russian Literary Language”. Some inconsistency in the interpretation of the word form *really*, as we have seen, is connected primarily with a different comprehension of its introductory status: sometimes it is regarded as an introductory meaning of an adverb, sometimes as an independent introductory word. The degree of remoteness of the adverbial word form *really* from the semantic structure of the original adjective *existing* is interpreted in different ways, which is reflected in their lexicographical description within the same

or different dictionary entries. These fluctuations can be partly explained by contextual and functional character of the adverbialization of this short adjective, which is not related to the violation of the semantic identity of the original adjective item. In fact, it is difficult to imagine any other contextual conditions for the adverbial use of the short form of the adjective in question, except the ones where the function is implemented modal circumstances (see above examples [2–3, 6]).

As for other short adjectives such as *genuinely*, *likely*, *certainly*, the different degree of their modalization, sometimes combined with adverbialization and particulation in the dictionaries mentioned above, is also interpreted inconsistently. Let us mention some differences of such kind. Thus, in the “Concise Academic Dictionary of the Russian Language” adverbialization of the short adjective form *genuinely*, i.e. transposition into the adverb with the meaning “truly”, is illustrated by contexts with its antepositional use, which is not connected with the position between the subject and predicate, unlike *really* (see examples [2–3]). Cf.:

(9) *There have always been reasonable people who can distinguish pseudoscientific trumpery from **genuinely** scientific discoveries* (G. Markov. Siberia) [3, p. 196].

Introductory-modal use of the word form *genuinely* is recorded in this dictionary under the dictionary entry of the adverb *genuinely* related to the adjective *genuine*, *authentic* [Ibid: 196]. For comparison, it should be mentioned that in the “Great Dictionary of the Russian Language” edited by S.A. Kuznetsov [5, p. 870] the adverbialized form *genuinely* is recorded within the dictionary entry of the adjective *genuine*, and its introductory use is not recorded at all.

Regarding the short adjective *probably* it can be mentioned that it is subject to modalization and particulation only. The cases of its approximating adverbs were not recorded. Its introductory-modal function is comprehended in the Concise Academic Dictionary of the Russian Language in a separate dictionary entry, see: “*probably*; introductory. *Apparently, probably*” [5, p. 152]). In the “Explanatory Dictionary of the Russian Language” by S.I. Ozhegov and N.Yu. Shvedova [6, p. 75] introductory-modal use of the word form *probably* is recorded within the dictionary entry for the adjective *probable*, *acceptable*; in the same dictionary entry there are separate cases of use of the short adjective in the contexts of modalization (10) and particulation (11). Cf.:

(10) **Probably**, *he won't come* (introductory word meaning probably, likely’);

(11) *Is there going to be the lecture? – **Probably*** (particle meaning confirmation with a shade of doubt).

Besides, this dictionary draws the readers’ attention to the possibility of introductory-modal use of analytical form of the superlative adjective *most likely*. Cf. contexts of use of grammatical homonyms:

(12) *I think she is waiting for my death to get hold of my flat then... or – which is **most likely** – they have plotted it together in the social services office, to kill me slowly with a poison, to sell my flat and share the money* (E. Rusakov. How I was dying) (adjective meaning ‘probably’ in the analytical form of the superlative degree);

(13) *Through a door crack in the corridor, twenty metres from him, he saw a lit place where, **most likely**, the nurse on duty was sitting at her desk* (P. Galitsky. Shagal’s price) (adjective-based introductory-modal expression meaning “highly likely, certainly”).

It is obvious that the mode subject’s degree of certainty in the reality of the information transferred in the constructions with introductory-modal expression *most likely*, compared with introductory-modal word *probably* is a little higher.

Cf. modalization contexts of the adjective in question in the positive (14) and superlative (15) degree:

(14) **Probably**, *the gentleman-at-arms didn't have to be really witty to consider himself the winner over the invincible together with his marshal* (Yu. Davydov. Blue tulips);

(15) **Most likely**, *a tremendous storm carried this vessel far to the south*. (A. Belyaev. Island of lost ships).

It should be added that sometimes the adjective word form *probably* is subject to functional predicativation as the main part with an adjacent infinitive in the impersonal sentence; cf.:

(16) *Do your best in your job; you are quite **likely** to be successful in your career* (M. Borisova. Two little dicky birds) [modal-evaluative predicative meaning “it is possible (to be successful)”].

Just as a short adjective *probably*, the adjective word form *certainly* passes the parallel process of adverbialization at the transposition into the category of introductory-modal words and phrases, which is consistently observed in contemporary dictionaries. The sustainability of its introductory-modal use meaning categorical reliability is reflected lexicographically as a separate dictionary entry. Thus, in the Concise Academic Dictionary of the Russian Language there is an entry: “*Of course...*

Introductory word. Needless to say, without a doubt” [23, p. 89]:

(17) *Of course, you don't care about me* (A.N. Tolstoy. Sisters).

The adjective-based modal particle affirmative is recorded in the absolute position in the same dictionary entry:

(18) *“This method is really expensive!” – “Certainly!”* (M. Gorky. Egor Bulychev and others).

The degree of semantic digression of the introductory-modal word *certainly* from the short initial adjective *final* is much higher as compared to the above-examined modalization cases of adjectival word forms *indeed, genuinely, of course*. Cf.:

(19) *He is just twenty-four! And whose time is endless? Right!* (T. Solomatina. Big dog, or «Eclectic picturesque Babylonian story about the hidden» (short adjective with negation meaning ‘endless, limitless’);

(20) *Doubtless, the case was charmingly rare: a young Russian scientist goes to Germany – the place that provided the latest scientific achievements – to bring Russian achievements there.* (D. Granin. Bison) (introductory-modal word meaning doubtless’).

The introductory-modal word *certainly* gets a similar lexicographical development in the “Great Dictionary of the Russian Language”, edited by S.A. Kuznetsov [5, p. 449].

### Conclusion

Thus, the analysis of typical contexts of the use of short adjectives such as *действительно (really)* in contemporary dictionaries shows how contradictory from the grammatical viewpoint word forms can be which are in one way or another exposed to modalization in the areas of interaction between different word classes (adjectives, adverbs, particles) and interclass categories (introductory-modal words and predicatives).

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## SUBSTANCE OF DIFFERENCES BETWEEN ECOPROFESSIONAL, ECOLOGICAL AND PROFESSIONAL CONSCIOUS OF THE SPECIALIST

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Substance and nature of the definition "ecoprofessional conscious" and the issue of formation of the specialist's ecoprofessional conscious are considered in this article. Comparative characteristics of the ecoprofessional conscious, ecological conscious and specialist's professional conscious are given in the text. An analysis of native and foreign literature is held by several ways: state, issues and perspectives of ecological, professional conscious. Levels of the integration of ecological and professional students' preparation are also considered there.

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**Keywords:** ecoprofessional conscious, ecological conscious, professional conscious, structural components of conscious, levels of the integration of ecological and professional preparation

Nowadays in all kinds of human professional activity, which are dangerous for environment, it's necessary to pay attention to past years' mistakes and try to avoid similar actions, that have already become a part of human bad experience. We can get it by paying more attention to formation ecoprofessional conscious of human in interest of stable development.

We consider that the ecoprofessional conscious (EP conscious) is an integral psychic formation, that reflects interaction between specialist and Nature which is based on ecoprofessional knowledges, self-awareness as a part of Nature and comprehension of the environment through the prism of EP attitude to it, where the main rule is a positive position of a rational using natural and global resources, intentions, ecologically and professionally providing expedient activity in aim of stable development and coevolution man and nature [8].

Ecoprofessional conscious turns into a more advanced block in educational sphere, in a source of global transformations due to professional conscious that can lead to natural balance destruction during reflecting and converting the ambient space. The development difference of professionalism and ecological conscious. The society needs formation of ecoprofessional specialist's conscious in conditions of modernization economic into environmentally friendly and introduction of nanotechnologies in manufacture.

Psycho-pedagogical researches shows that the solution of the integration of students' ecological and professional preparation, that is based on philosophically-ethical, psychological, pedagogical levels, requires opening the genesis of ecological, professional conscious and conscious in general.

Different aspects in the systematic registration of the conscious problem can be noted from conscious sphere researches made by

G.V. Akopov, V.M. Behterev, F.E. Vasilyuk, L.S. Vygotski, V.A. Ganzen, A.A. Gostev, V.P. Zinchencko, A.N. Leontyev, A.V. Petrovski, V.I. Panov, S.L. Rubinshtein, K. Yaspers, I. Ajzen and M. Fishbein etc.

Philosophically-psychological aspect: the main difficult is to determine the essential characteristic of the conscious because it binary opposes to matter and directly or indirectly participates in different derivatives of this opposition: psychic – corporeal, subjective – objective, individual – social, interior – external, regular – spontaneous, dependent – independent, necessary – free etc.

Philosophically-methodological aspect: the most interesting decisions were made by V.M. Behterev [2] (objectivistic overcome ontological dualism by substantial explanation of the conscious) and by K. Yaspers (rational thinking submits to existential thinking – contemplation).

General psychological aspect: on the one hand the conscious is endowed with limit wide, it consists of psychic processes, states, features, on the other hand it consists from full uncertainty of appearance (a conscious is determined by view sentences and has a variety of definitions in native and foreign educational literature for psychology).

Psychology-applied aspect: conscious doesn't have enough space in the different sectors of psychology, except of psychotherapy and partly pathopsychology. Also there are such collocations as economic conscious, political conscious, electoral conscious, legal conscious, moral conscious, professional conscious, consumer conscious, ecological conscious etc.

Analysis of signed aspects in systematic formalization of conscious's problem allows to make a conclusion that a set position of high engagement and conscious's small demand of

theoretical and applied works isn't an accident for existing system of psychological knowledge and practice, moreover, the conscious works not only as basic category but as distinctly operationalizing definition in a whole range of new native psychological ways. As for general decision, education has a main role in creating new ecological point of view, it's propagation and statement in the social conscious. A search for solutions in the sphere of ecoprofessional conscious of students is in the way of decision about it's structure and levels of development.

From this point of view a problem of the conscious structure is topical. Analysis of conceptions by G.V. Akopov, V.M. Behterev, F.E. Vasilyuk, L.S. Vygotski, V.A. Ganzen, V.P. Zinchenko, A.N. Leontiev, V.N. Myasishchev, A.V. Petrovski lets determine different ways of determining and describing a structure and levels of conscious. Leded analysis of conscious structure shows that the majority of authors mark four main psychological characteristics in the structure of individual conscious: complex of knowledge, distinction between subject and object, goal-setting of activity, attitude to the world, people and itself. The last one usually is in composition of emotional experiences.

Measuring nowadays situation in ecological education, it is clear, that the main attention is devoted to the problem of ecological development of person conscious. A lot of aspects of ecological conscious gained fairly deep comprehension in the native psychology and pedagogy. In particular famous native scientists view ecological conscious as:

- Complex: of views (individual and group) about interrelations in the system “man-nature” and in the nature; of subjective (personality) man's attitude to the world of nature; of appropriate strategies and technologies of man and nature interactions; of life values in ethical point that dictate a necessary of ecologized values (S.D. Deryabo, V.A. Yasvin) [4];

- Conscious of the certain student, i.e. in it's actual form in which ecological conscious's structural components contains signs of it's different types (anthropocentric, ecocentric, природоцентрический) (A.V. Gagarin [3]);

- Integrative education of personality, that is structurally presented as a complex of elements that can be combined in basic groups reflecting aspects: cognitive or intellectual-cognitive; perceptual-affective or emotional-volitional; motivational-behavioral; value-orientation (V.I. Panov, A.V. Ivashenko, A.V. Gagarin) [5];

- Deep and brought to automatism understanding of indissoluble man and humanity connection with nature, man's wellbeing addictions from integrity and relative immutability of native human habits. (N.F. Reimers) [6];

- Continuously changing complex of sensual and mental images that are directly reflected in the analytically created categories and phenomena, directly fixing individual or social ecological experience that anticipates ecological practice (V.A. Skrebec) [7] etc.

After critical rethinking and adding existing definitions of the “ecological conscious”, we decided that the component “ecological intention” is included to the ecological conscious.

Due to researches works it is the fact that the ecological intention in relation to overall level of ecoprofessional conscious's formation helps ecological knowledge becomes ecological intention and ecological behavior in the future.

In the result of analysis of the professional conscious's content that was hold on the base of timing, it was found that the professional conscious is understood as:

- Central category in the high educational preparation (N.N. Nechaev);

- Professional knowledge and skills, development of individually – typological features of the personality, style features of the work (A.P. Egorshin, A.N. Mitin);

- Professional qualities, professional aims, plans, professional relations, prognosis, evaluations (A.Y. Kibanov);

- Appearances of the personal conscious, related to it's professional activity, which are determined by place and value of this profession in professional structure of the society; by personality attitude to profession, its representatives and structure of the society; by professional ideals; by levels of professional knowledge and skills; by expression of professional skills; by professional perspectives, achievement; by positive and negative experiences in professional activity etc (G.V. Akopov) [1].

In a broad sense, the definition “ecological conscious” includes all of those appearances of conscious of personality that are bounded with all of kinds of its interaction with the environment because the structure of the ecological and professional conscious consists of: cognitive processes with help of which people can increase their knowledge; the world of feelings which includes relation, stands, intentions providing goal-setting activity. Signed structural components of ecological conscious (cognitive, value-motivational, orientation and connotative) are relevant to components of professional conscious [9].

At the same time of new millennium it is obviously that existing ecological education is based on analytical knowledge about environment and narrowly pragmatically and consumer focused and that's why it couldn't cardinaly change the mindset of the majority of society. As the result objective necessity of transitioning to a new stage of its development is appeared. Ideas of coevolution and stable development must become a methodological basis of a new paradigm formation.

In that point of view an issue of integration of ecological and professional preparation has a special relevance. Formation of ecoprofessional students' conscious is the key tool of a paradigm about human civilization transitioning to the model of stable development and educational process includes formation of knowledge, relations, stands, intentions steady translating a personality eco-oriented activity of becoming professionals.

Its methodologically important to mark that ecoprofessional conscious is a developing phenomenon in the psychology and has got an opportunity to appearance and development in its basis. Because of it ecoprofessional conscious as an object of psychology can be a subject of diagnostic of its availability or lack and a subject of purposeful formation.

Integration of ecological and professional preparation, first of all, is expressed in that a student does three interrelated functions: firstly, a student is an effective "working" integrator, the activity of whom is determined by positive integration acceptance of ecological and professional preparation; secondly, in integration personality of a student is a splicing factor that unites components of integration; thirdly, changes in the development of EP conscious, qualitative characteristics of its "growth" are an aim and a result of integration of ecological and professional preparation [8].

Premises of integration of professional and ecological preparation are:

- Paradigm shift of professional conscious from consumer XIX–XX c. to eco-professionally expedient XXI c.;
- Educationally-professional motivation of students to get higher education;
- Specialist as an owner of professional conscious is also included in the system of ecological relations, and as an owner of ecological conscious – system of ecological values;
- Indestructible connection of the sphere of professional relations, in which human, is included during the process of professional activity and ecosphere;

- Evolution of human as a subject (owner) of conscious (cognitive, value-motivational, orientation and connotative components);

- An effect of successive complementarity of components in integration of ecological and professional preparation [9];

According to theoretical and methodological concepts and premises of integration we mark integration modular units. In our research content of integration is performed by modular units interaction of which provides with receiving appropriate integral result. Modular units are owners of integration and act as its interacting elements on all three marked downward invariant levels which present phased ecoprofessional preparation.

So main modular units of ecological and professional prepare integration are professional: cognitive, value-motivational, orientation and connotative components.

One of the central issues of the research is an identification of integration levels during formation of EP conscious. By integration levels of ecological and professional preparation we mean quality varieties of integration. The index of character of relationships between whole and its parts is a basis of identification of levels of ecoprofessional and ecological preparation.

An essence of three integration levels is performed in the research. In our point of view, an integration of ecological and ecoprofessional preparation can consist of some levels: convergent; reciprocal; coherent and each of these fits a stage of ecoprofessional preparation.

*A convergent integration level of ecological and ecoprofessional preparation* is a structural expedient organized connection between modular units and professional preparation which is hold to students' self-development. **Convergence** (from lat. Converge – get close, meet) – similarity of ecological and ecoprofessional integration components, getting the same directionality. Converged similarity can't be deep that's why it can be attributed to the first stage of ecoprofessional preparation.

Converged level of integration is performed by cooperation, community, similar way of activity, integration of efforts in the system, which is hold to multiplication of the final result.

The result of such integration of the first stage is when a student gets those knowledge that reflect connectivity of professional and ecological preparation as a system, where all the components are bounded. Conceptual parallelism of this kind of integration allows the existing of two synchronously moving



categorical systems, – “professional” and “ecological”.

Reciprocal integration level of ecological and professional preparation is a process of alternation, interaction in which when one becomes stronger, then other one becomes weaker, such form suggests permanent interaction between ecological and professional preparation components, it can be attributed to the second stage of ecoprofessional preparation. Reciprocity (from lat. Reciprocus – recurrent, reverse, mutual, alternate) is a process of interaction where if activity of professional preparation modular units becomes stronger, then activity of ecological preparation modular units becomes weaker.

During the solution of reciprocal synthesis problems we can't ignore the fact of struggle between modular units of ecological and professional preparation (cognitive, value-motivational, orientation and connotative) for their confession as a system basis modular units of integration.

In the result of reciprocal level of integration ecological and ecoprofessional preparations create a double-stranded model.

Reciprocal level is a finding out an overall platform of ecological and professional preparation convergence. At the junction of almost existing ecological and professional knowledge students get new and systematically complementing and expanding it, moving through the spiral by the principle of concentricity.

The positive side of the reciprocal level is an attempt of full consideration of EP preparation. Disadvantage is incommensurable amounts of ecological and professional knowledge, relations, stands and intentions and changes of their domination in the professional activity.

Coherent level of ecological and professional preparation integration is a process of interpenetration, splice of ecological and professional preparation modular units, in the result of what EP conscious is developing. Coherency (from lat. Cohaerentio – connection, clutch) is an agreed passing of come processes in the space and time, which are directed to the splice, interpenetration, implication of ecological and professional preparation modular units [9].

A process of coherent integration level of ecological and professional preparation includes phenomenon of splicing.

Splicing (from eng. Splice – glue) – a process of compound of ecological and professional preparation modular units.

Coherent level is a process of stringing some (majority) of integrable ecological and professional preparation modular units on the single kernel that acts like a self-generated core. In our opinion, such a self-generated core is an EP intention. As the result we have close interrelation between this core and other integrable components and between the latest one.

Coherent level of integration is the highest level of interrelation of ecological and professional modular units, which is based on indissolubility of components, new objectivity, monoobjectivity, new structure, new functions of components entering the relation.

Coherent level is the third stage of ecoprofessional preparation, directly related with ecological intentions in professional activity.

In this way integration of this level is not just a union of parts in a whole, it's a system leading to the quantitative and qualitative changes, to EP conscious formation of students – future specialists.

Coherent level as two previous levels has an ability to include elements of other integration levels. The main feature of this integration is an objective immediate directionality to getting an applied result.

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*Materials of Conferences***SELF-ORGANIZATION OF CENTRAL RUSSIAN UPLAND LANDSCAPES WITH ANTHROPOGENIC LOAD IS REDUCING**

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Man lives in an environment that is modified and adapted to his needs. The Calls to go back to nature does not stand up to any scrutiny because of the changed environment and the human nature. Many mistake anthropogenic landscapes for the naturals, forgetting that they had formed in their present form under the influence of human activities. But as soon as the human influence is weakened, the system that creates them begins the processes of self-organization. Central Russian Upland landscapes are man-made. Convenient economic and geographical position attracted people. Natural landscapes experienced a profound transformation over the tens of thousands of years. Currently, only seven percent of the studied area is forested, with most of them planted by man. Feather grass steppes are plowed up and turned into agricultural landscapes. To understand the reasons which led to the current state, it is necessary to analyze the state of the ecosystem over time.

Some indirect information about the dynamics of the natural ecosystems of the territory under the influence of anthropogenic and natural factors can give us the materials of archaeological research. They show that the person has been actively integrated into the natural ecosystems of the territory already in the Paleolithic. The found artifacts provide insights into the climatic conditions of the time, as well as the interaction between man and his accommodating landscape. About two thousand years ago Sarmatians lived here. Sarmats engaged in sheep and therefore lived there, where there were the best pastures for the year-round grazing. The reason why the Sarmatians left the area was climate change, winters became snowier. Year-round grazing became impossible. The climate became cooler and wetter, and therefore favorable for the growth of forest vegetation. In all likelihood, these reasons have caused an increase in forest area in the study area. And the Sarmatians are replaced by migrating tribes, preferring to lead sedentary lifestyles, and whose activities further interacts with the natural environment and, consequently, more than transform it. In this area, the iron ore deposits are fairly close to the surface. The population is actively using the resources that are found in their ecosystem and engages in metal smelting. For smelting, iron ore was needed and it became a charcoal derived from wood harvested in the surrounding

woods. Forest ecosystem condition, as determined by conjugated bonds with the river ecosystems of the Don Basin. The Don River since ancient times has been an important trade and transport route. The ships were built in the shipyards of the Don river and its tributaries. Now it is hardly possible to calculate how many hectares of forest have been reduced to their construction. But no one doubts that the natural regeneration of forests does not keep pace with deforestation and forest species composition changed [2]. At the same time with deforestation plowed feather grass steppes. In the late 18th century, a type of feather grass vegetation was already rare [1].

In the 90s, of XX century, there was an economic decline in Russia. It minimized the production landscape and consequently began to change radically in the direction or close to the dynamic state. The ecosystems of meadow-steppe vegetation returns feather grass (*Stipapennata* L.). Succession begins to develop in the direction depending on the nature of the habitat and the competitive ability of the systematic units, which can settle here [1].

My observations show that the reduction of anthropogenic load forest and steppe vegetation is beginning to recover, due to the kind of seed bank, accumulated in ecosystems. And recovering those species, which are typical for the area. It is known that oak prefers soils formed on the source rocks containing calcium. I observed how on unexploited, but not yet re-cultivated deposits of limestone (Sitovka quarry), the undergrowth of oaks originated. There is a self-restoration of the pine forests growing on the territory, in the alluvial deposits in the river valleys. All of these processes suggest that even a modest reduction in human activity triggers self-organization of the landscape. We see de-mutation – the process of restoring ecosystems to a state close to its original state after a material breach of the composition and structure.

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*Materials of Conferences***THE MATHEMATICAL COMPETENCE MODEL IN ASPECT OF STUDYING E-LEARNING EFFICIENCY**

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The article contains the results of elaboration of three-dimensional mathematical competence model. The author of the article provides that the suggested model represents the real university students' mathematical competence development level and its separate components, providing various factors influence studying on process of mathematical competence formation. The model is easily realized in educational process. The model can surely be used in practice.

To the opinion of modern pedagogical researchers, mathematical competence is students' personal integrative characteristic, including mathematical base for studying biological and medical subjects and also students' ability to use the mathematical knowledge for solving the professional practical tasks and theoretical problems [1, 2]. Mathematical competence has the complicated multicomponent structure [3, 4]. Cognitive, performing, motivational and personal mathematical competence components are the base of modern mathematical competence model [5]. Each of mathematical competence structural components demands its own criteria and indicators system [6], that rather difficult to realize in practice. In this regard, functional components mathematical competence model elaboration was defined as our research aim.

Research tasks are:

- analysis of mathematical competence structural components;

- elaboration of three-dimensional mathematical competence model.

Medical university clinical psychology students' mathematical competence was chosen as the research object.

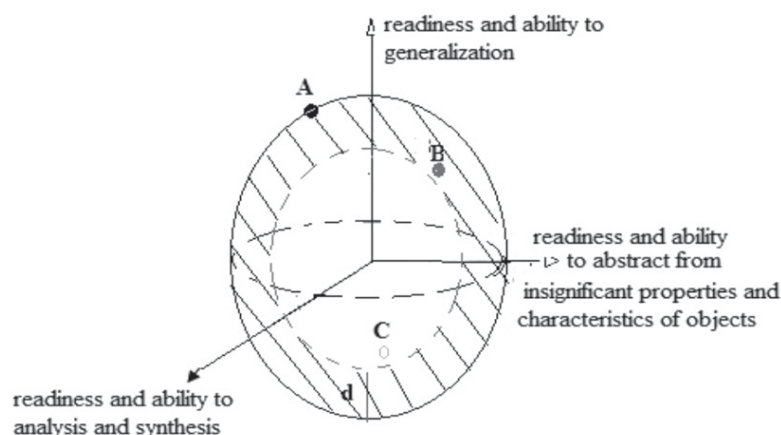
**Materials and methods.** The testing of second-year clinical psychology students was carried out. 10 second-year clinical psychology faculty students were involved into mathematical e-learning testing after passing the mathematical course examination. The research was held at 11 a.m. in the academic auditory. The research duration was about 50 minutes. The clinical psychology faculty students performed the testing independently without using any electronic devices. The testing was built on the basis of Atmhouer intelligence structure test including the scale of mathematical abilities determination and a questionnaire "Thinking type".

To solve mathematical task the examinee is to be ready to demonstrate firstly his ability to analysis and synthesis, including

- to allocate various elements in its structure;
- to give them an assessment;
- to systematize;
- to define hierarchy.

Secondly, the ability of manipulating abstract symbols and concepts is required. Hypothesis and strategy of solution also have the abstract form for examinee. Thirdly, students' ability to generalization is necessary condition of mathematical tasks solving.

It's known, that mathematical task assumes specific conditions, and big variety of the same task in fact is possible. Respectively, the task solving strategy always has the generalized character.



Three-dimensional representation of model of mathematical competence

Thus, the successful mathematical tasks solving requires three cognitive components possession:

- readiness and ability to analysis and synthesis;
- readiness and ability to abstract from insignificant properties and characteristics of objects;
- readiness and ability to generalization.

The listed components, in our opinion, can be considered as the mathematical competence main structural components based on cognitive, performing, motivational and personal mathematical competence. Taking into consideration these three functional components, we can represent the mathematical competence model in three-dimensional space (figure).

The main functional components are used as coordinate axes of medical students' mathematical competence model:  $K_1$ ,  $K_2$  and  $K_3$ , where  $K_1$  – is readiness and ability to the analysis and synthesis,  $K_2$  – readiness and ability to abstract from insignificant properties and characteristics of objects,  $K_3$  – readiness and ability to generalization.

Each functional component has its own contribute into the level of students' mathematical competence. The received level of students' mathematical competence is realized as a point of a sphere according to the equation:

$$R^2 = K_1^2 + K_2^2 + K_3^2. \quad (1)$$

External sphere radius  $R_{external}$  is calculated according to the formula:

$$R_{external} = \sqrt{K_{1max}^2 + K_{2max}^2 + K_{3max}^2}. \quad (2)$$

$K_{1max}$ ,  $K_{2max}$  and  $K_{3max}$  are the maximal possible level in each mathematical competence component respectively.

Internal sphere radius  $R_{internal}$  is found from the expression:

$$R_{internal} = 0,6 R_{external}. \quad (3)$$

Thickness of sphere layer  $d$  is determined by the formula:

$$d = R_{external} - R_{internal}. \quad (4)$$

The sphere space between internal and external radii points medical school students' mathematical competence level corresponding to educational standard. The points inside the sphere out of chosen area indicate insufficient level of students' mathematical competence.

We consider that the suggested mathematical competence model can serve as the additional tool of students' mathematical competence level assessment, supplementing and expanding the criteria and indicators systems.

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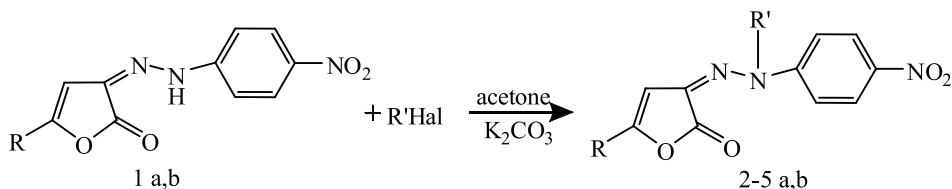
## Short Reports

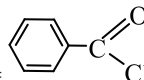
3-ARYLHYDRAZONE-3H-FURAN-2-ONES  
IN ALKYLATION AND ACYLATION  
REACTIONS

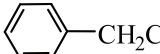
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3-aryl (hetaryl) hydrazone-3H-furan-2-ones constitute an important class of heterocyclic compounds, a promising object for further research in the field of heterocyclic chemistry [1]. Their structure contains several reaction centers, allowing them to enter into both electrophilic and nucleophilic reactions; introduction of various substituents into their hydrazone fragment or heterocycle increases their reaction potential [2].



**1 a,b:** R=Ph, Tol; **2 a,b:** R=Ph, Tol; R'=  Cl; **3 a,b:** R=Ph, Tol. R'= Et;

**4 a,b:** R=Ph, Tol. R'= n-C<sub>3</sub>H<sub>7</sub>; **5 a,b:** R= Ph, Tol. R'=  Cl.

Examination of the spectral data of the compounds obtained confirms the reaction proceeding by the NH-moiety without affecting other possible centers. The IR spectra of the compounds identified as 5-aryl-3-(2-benzoyl-2-(4-nitrophenyl) hydrazone)-3H-furan-2-ones (**2 ab**) contain three intense absorption bands within 1,800–1,500 cm<sup>-1</sup>: for the C=O bond of the furanone cycle (1,800–1,750 cm<sup>-1</sup>), for the C=O bond of the benzoyl fragment (1,640–1,600 cm<sup>-1</sup>), and for the C=N bond (1,690–1,675 cm<sup>-1</sup>); any average-intensity bands within 3,300–3,100 cm<sup>-1</sup> corresponding to the stretching vibrations of the NH bond of a hydrazone group are absent.

The IR spectra of the compounds identified as 5-aryl-3-(2-ethyl-2-(4-nitrophenyl) hydrazone)-3H-furan-2-ones (**3 a, b**) also lack the absorption band of a NH group (3,300–3,100 cm<sup>-1</sup>) but contain the absorption band of the C=O group (1,800–1,750 cm<sup>-1</sup>). The <sup>1</sup>H NMR spectrum shows a series of signals characteristic of the ethyl group protons: 2.79–2.84 ppm (2H q), 0.85–0.88 ppm (3H t); and no <sup>1</sup>H singlet of a hydrazone group within 11.00–12.80 ppm.

The <sup>1</sup>H NMR spectra of the compounds identified as 5-aryl-3-(2-propyl-2-(4-nitrophenyl)

hydrazone)-3H-furan-2-ones (**4 a-b**) contain a series of signals corresponding to the propyl group protons: 3.55–3.59 ppm (2H t), 1.75–1.45 ppm (2H m), and 0.85–0.88 ppm (3H t).

The <sup>1</sup>H NMR spectra of the compounds identified as 5-aryl-3-(2-benzyl-2-(4-nitrophenyl) hydrazone)-3H-furan-2-ones (**5 ab**) show a 2H singlet of the CH<sub>2</sub> group in the benzyl radical around 4.35 ppm, as well as a multiplet of aromatic protons within 7.32–8.26 ppm, but no <sup>1</sup>H singlet of a hydrazone group.

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