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DOI: [10.15293/2226-3365.1806.08](https://doi.org/10.15293/2226-3365.1806.08)

УДК 37.012.85

## ОПТИМАЛЬНЫЕ УСЛОВИЯ ПРИМЕНЕНИЯ ЭЛЕКТРОННЫХ ОБРАЗОВАТЕЛЬНЫХ РЕСУРСОВ В СИСТЕМЕ СМЕШАННОГО ОБУЧЕНИЯ СТУДЕНТОВ ВУЗОВ

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**Проблема и цель.** *Исследуется проблема информатизации высшего образования для повышения эффективности индивидуальной работы студентов. Целью исследования стало выявление оптимальных условий применения электронных образовательных ресурсов в системе смешанного обучения студентов вузов.*

**Методология.** *Методологическая основа исследования состоит из общетеоретических, эмпирических и статистических методов исследования. В статье рассмотрены основные теоретические и научно-педагогические подходы к современному пониманию термина «смешанное обучение». Представлен анализ основных результатов педагогического эксперимента, осуществленного авторами статьи и направленного на выявление оптимального соотношения использования электронных и традиционных методов взаимодействия педагогов с обучающимися. При помощи общенаучного метода системного анализа выявлены и обоснованы ключевые структурные составляющие системы смешанного обучения студентов.*

**Результаты.** *Выявлено, что система смешанного обучения студентов представляет собой взаимосвязь таких элементов, как методологическое, административное (нормативно-правовое и финансово-экономическое), педагогическое, технологическое обеспечение; автоматизация всей совокупности процессов в вузе; контроль соблюдения интересов обучающихся; решение социально значимых задач и всесторонняя экспертиза электронных образовательных ресурсов. Эти элементы находятся с системой в отношении принадлежности. С позиции системного подхода каждый элемент системы смешанного обучения трактуется как система. В то же время электронные образовательные ресурсы необходимо рассматривать как основной элемент смешанного обучения, неотъемлемый от целостной образовательной системы, а не в качестве вспомогательного инструментария для традиционного учебного процесса. Совершенствование применения электронных образовательных ресурсов в системе смешанного обучения способно повысить как уровень успеваемости каждого студента, так и качество образовательного процесса в целом. Для этого требуется оптимизация соотношения использования электронных и традиционных образовательных технологий на уровне: 70 % электронных образовательных технологий и 30 % традиционного взаимодействия преподавателей со студентами.*

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*Заключение.* Авторами обобщаются оптимальные условия применения электронных образовательных ресурсов в системе смешанного обучения студентов вузов.

*Ключевые слова:* смешанное обучение; гибридное обучение; электронные технологии; электронные образовательные ресурсы; профессиональная компетентность; административные механизмы; высшее образование; информационно-коммуникационные технологии.

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DOI: [10.15293/2226-3365.1806.08](https://doi.org/10.15293/2226-3365.1806.08)

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## Digital learning resources: Enhancing efficiency within blended higher education

### Abstract

**Introduction.** *The article explores the problem of digitization of higher education aimed at enhancing students' autonomous learning. The purpose of this research is to reveal the appropriate conditions of applying digital learning resources within blended higher education.*

**Materials and Methods.** *The research is based on general theoretical, empirical and statistical methods. The authors consider the main theoretical and pedagogical approaches to modern understanding of blended learning and report the results of an experiment focused on identifying an optimal proportion of digital and traditional methods of “teacher-learner” interaction. The analysis of the results are provided. Key structural constituents of blended learning are identified and justified by means of system analysis.*

**Results.** *The findings indicate that the system of blended learning comprises the interrelation of the following elements: (1) methodological, administrative (legal and financial), educational and technical support; (2) computerisation of all university-based processes; (3) control of protecting students' rights; (4) solving significant social problem and (5) comprehensive assessment of digital educational resources. According to the systemic approach, each element of blended learning system is a system itself. At the same time, digital educational resources should be considered as basic elements of blended learning and an integral part of the whole education process, but not as an auxiliary tool for conventional education. Improvements in using digital educational resources in the system of blended learning can raise both students' performance and quality of educational process as a whole. The study highlights the significance of an appropriate proportion (70 / 30) of using digital educational technologies and conventional teacher-student interactions.*

**Conclusions.** *The authors summarize the appropriate conditions of applying digital learning resources within blended higher education.*

### Keywords

*Blended learning; Hybrid learning; Mixed-mode instruction; Electronic technology; Electronic learning resources; Professional competence; Administrative arrangements; Higher education; Information communication technology.*



## Introduction

Currently commitment of society to conventional methods and modes of teaching is one of the key factors hindering development of competency-based approach to educational process in higher school. Attempts to preserve traditions in educational process often lead to significant slowdown of electronic learning resources implementation in higher school. At the same time application, electronic learning resources already has become an integral part of present-day educational process. Researches in this area are currently carried out actively both in Russian scientific community and abroad. Electronic learning resources are necessary not only in the context of improvement of efficiency of students' individual work and additional tool for acquisition of competency-based qualifications by students, but also from the point of view of continuous global informatization of society. Thorough analysis of terminology performed on historical data in sphere of education has shown stage-by-stage penetration of information technologies into education.

Lengthy process of stage-by-stage penetration of information technologies into education began before advent of personal computers. Initially investigators searched methods of application of different technical facilities with goal to provide maximum availability of education. For the first time teaching machines (aka – simulators for development of specific practical skills) were created in the early part of XX-th century by American professor Sidney Pressey. After that to the middle of the century first generally available TV courses (which in modern terminology can be described as “remote”) appeared in US. The courses were actively used in American schools directly for academic purposes (1960s). Around the same time first adaptive education systems (prototypes of modern online resources)

appeared. It is recognized that these systems were created by B. F. Skinner. From that time “adaptive system” is implied as pedagogical influence and mutual adaptation of subjects of educational process organized and controlled by teacher [1; 24]. Such systems can be considered as the first experience of combination of conventional and electronic forms of teaching where every learner hones his/her skills at own pace, and teacher-tutor only assigns and corrects his trajectory using techniques of flexible regime of training activity. Wide use of personal computer capabilities in sphere of education began in the West in the middle of 1980s. Only theoretical studies were carried out in Russia in that years – without any attempts of practical implementation.

Although for today online learning modes has sufficiently extended their capabilities and separated from conventional modes completely online learning courses (in fact – extramural training) arouse certain mistrust: of both learners and educational institutions. For this reason, blended learning systems become greatly important in the market for educational services. These systems apply both elements of conventional approach implemented through personal contact of teacher with student and online forms of individual work of learner by means of electronic interaction. “Blended learning” term came into use in professional pedagogical literature in the 1990s.

It should be noted that several similar in meaning terms were simultaneously used in literature up to 2006: blended learning, hybrid learning, and technology-mediated instruction, web-enhanced instruction, mixed-mode instruction and many others. Situation changed only with publication of “The Handbook of



Blended Learning”<sup>1</sup>: Global Perspectives, Local Designs», by Curtis J. Bonk and Charles R. Graham [2; 17]. The Handbook gave clear definition of this term as a combination of “face to face” learning and learning controlled by computer technologies or range of capabilities presented by combination of Internet and electronic mass media with forms requiring physical mutual presence of teacher and learners in the class. Although more than 10 years passed from them moment of its publication, this book is up to date considered the one of most complete and comprehensive researches of blended learning. At the present time, blended learning is understood as combination of conventional intramural form of study with usage of technologies of distance learning which can be the most effective for solution of key pedagogical tasks [3; 19; 22]. Russian researcher Kapustin stated that blended learning should be understood as goal-oriented, organized, interactive process of interaction of teachers and learning students among themselves and with learning tools at that learning process is invariant to their position in space and time. Brian Tomlinson and Claire Whittaker in their book “Blended Learning in English Language Teaching: Course Design and Implementation” came to “blended learning” concept from more philosophical point of view<sup>2</sup>. They consider that virtually any system can be considered as “blended”, and the question consist not in intrinsic features of “blended learning” concept, but rather in that is blended in modern pedagogical systems. Comparison of concepts

which are often used as synonyms (“hybrid learning”, “electronic learning”, “IT-aided learning”) is also presented in their book. These researchers propose to apply different terminology depending on scale of online resource usage. Other authors (D. Randy Garrison and Norman D. Vaughan) hold to the opinion that blended learning is a fundamental change of classical structure for the purposes of increase of students’ involvement and enlargement of access to educational structures in Internet network. They insist on not simple “blending” of technologies, but on complete rethinking of programs of educational subjects for optimization of level of students’ participation in educational process<sup>3</sup>. Interesting definition based on personal experience of blended learning is presented in “Oxford Group” booklets: “Blended learning is seamless integration of online and online learning methods”<sup>4</sup>.

By opinion of authors of this paper, genesis and evolution of blended learning are may be determined by two trends which to some extent contradict to each other: Understanding of e-learning insufficiency for all educational situations and drift of conventional learning methods to innovative process. Besides many researchers point out that key moment and of training by “blended learning” method is selection of proper combination of material delivery techniques, learning organization and application of technologies in rational mixing of forms and methods of learning.

<sup>1</sup> Curtis J. Bonk, Charles R. Graham. *The Handbook of Blended Learning: Global Perspectives, Local Designs*, March 2006, Pfeiffer.

<sup>2</sup> Tomlinson B., Whittaker C. *Blended Learning in English Language Teaching: Course Design and Implementation*. British Council. 2013, 258 p. Available at: [http://www.teachingenglish.org.uk/sites/teacheng/files/D057\\_Blended20learning\\_FINAL\\_WEB20ONLY\\_v2.pdf](http://www.teachingenglish.org.uk/sites/teacheng/files/D057_Blended20learning_FINAL_WEB20ONLY_v2.pdf)

<sup>3</sup> Garrison D., Vaughan N. *Blended learning in higher education: Framework, principles, and guidelines*. Jossey-Bass. 2008, 272 p.

<sup>4</sup> Blended Learning Today: *Designing in the New Learning Architecture*. The Oxford Group, 2014. P. 28. Available at: <http://www.oxford-group.com/pdf/blended-learning-today-2014.pdf>



Modern “blended learning” term is appropriate in cases then some in the process of discipline study are carried out using conventional technologies (for example: lectures, summative control) and other – using distance technologies (for example: network seminars, testing, consulting and individual work). At that as rule technologically heterogeneous constituents of the course are spread out over a time continuum of the course, although that is not an obligatory condition of blended learning. Rationalization and optimization of synthesis of conventional and electronic form in the context of blended learning assume that electronic learning resources are not capable to completely oust a teacher as such. First of all they are aimed to change pattern of teacher-student interaction, define their new roles in learning process, complement educational process and diversify risks related with usage of different learning techniques. At that teacher transforms from translator of new knowledge into consultant helping a learner to build new educational trajectory, to teach him to mine knowledge. Students in turn transform from passive consumer of educational product into active participants of process of creation and acquisition of new competences. In connection with such a transformation of processes organizational and administrative conditions of work in higher school related with implementation of electronic learning resources are changed. At this stage enhancement of efficiency of digital educational resources is required. This is confirmed by opinion of pedagogical community on advantages of digital technologies introduction at all levels of education. Therefore, the object of research is process higher school students learning performed in conditions informatization of education. The goal of this research is

determination of optimal conditions of digital educational resources usage in blended learning system for higher school students. The focus of research is basic elements of students blended learning system in conditions of informatization of higher education. The main tasks of research are determination of real demands of participants educational process in digital technologies usage; finding of organizational conditions of effective application of digital resources in higher school; drawing up recommendation list for professional ICT competency of higher school teachers in modern world.

### Materials and Methods

To achieve goals of research, general theoretical, empirical and statistical methods were used. Among them: methods of system analysis; dialogical polling technique and questionnaire survey; experimental researches in the form of natural experiment with further quantitative analysis of data obtained.

Integrated review of electronic learning resources usage in the context of students’ blended learning shown the fact of common usage of informational technologies for educational purposes and incredibly rapid growth of number of their usage in Russian and international higher schools. Peculiar features for different higher schools consist only in scales of introduction of blended learning system, its methodical constituents and specifics of industrial niches of particular higher schools. Numerous studies carried out by means of questionnaire in Russia and abroad [4–6] show of number of higher schools which use in the activity elements of blended learning in the entirety of higher school institutions<sup>5</sup>. Practically half of educational institutions which at present time has not

<sup>5</sup> *European University Association*, 2014 URL: <http://www.openeducationeuropa.eu/sites/default/files/news/e-learning%20survey.pdf>



implemented electronic learning (about 3 % on number of institutions participating in questionnaire) explain such a behavior by financial difficulties and economic considerations of management, other point to insufficient IT literacy of teaching staff. Furthermore, overwhelming majority of faculty members support and actively use electronic learning resources in their subject areas. More than 70 % of students confirmed unconditional availability of software and all kinds of electronic resources in their higher school institutions. 65 % of respondents from among teachers and students share the opinion that implementation of electronic learning resources significantly improve efficiency of educational process. Analyzing common motivational trend of European and Russian higher schools to blended learning usage inference should be drawn that incentive to electronic learning resources application is drive for the most effective usage of class hours and students' self instruction time, total flexibility of educational process, potential ability to reduce routine work of teachers and financial appeal.

According to the data of "E-learning in European Higher Education Institution" questionnaire held in 250 higher school institutions of 37 EC countries:

- 91 % of teachers use blended learning model,
- 82 % of teachers use electronic learning resources on a par with MOOC,
- 80 % of teachers announce creation of their own EEMC on courses of study,
- 55 % of teachers are convinced that blended learning is good for quality of education.

According to data of "The Sloan Consortium" association conducting survey of US learners:

- 60 % of students conceive that blended learning is far more effective than conventional methods of intramural education,

– 27 % growth in students' performance was achieved in a series of higher school institutions which implemented blended learning.

According to statistics acquired by Australian Department of Education:

–90 % of employers are interested in alumni of blended learning programs in different directions,

–85 % of teachers agree with statement "media sphere is a key to acquiring of knowledge".

According to researches carried out by Ministry of Education of PRC:

– 14 million users of electronic learning resources,

– 15 % annual growth of new users of electronic learning resources.

Researches carried out on territory of Russia show that according to data of questionnaire performed by Tomsk Polytechnic University:

– 76 % of teachers consider it necessary to use electronic learning resources in learning process,

– 65 % of teachers are convinced that blended learning improves efficiency and quality of learning process,

– 40 % of teachers consider blended learning as factor of complementary motivation of students.

According to data of questionnaires held in MESI and HSE:

– 95 % of teachers prefer blended learning to conventional interaction with students,

– 70 % are satisfied by availability of software and all kinds of resources in higher school,

– 60 % of students have a positive view of electronic learning resources and want to learn with their application.

According to questionnaire of students and teachers of NUST MISIS carried out by authors:





- 76 % of teachers support concept of usage students’ blended learning,
- 61 % of teachers have got down to development of their own e-content at the insistence of administration,
- 63 % of teachers consider that blended learning system is more effective from a point of view of student competences development,
- 97 % of students actively use electronic learning resources in educational process,
- 21 % of students would like to increase share of interactive interaction with teachers,
- 71 % of students confided that blended learning does not influence on interest and motivation to,
- 53 % of students make a stand against transition to completely online education system.

In most of cases when it is referred to optimization of shares of conventional and electronic interaction of teachers and students, the majority of respondents stick to the opinion that optimum is 60–70 % [7] of electronic learning resources in total time of a course study. Students of respondent higher schools in turn insist on 50:50 ratio considering that about a half of study load can be successfully transferred in a format of electronic interaction [8].

Thus, the need for search of rational synthesis of conventional and electronic forms of

teacher interactions with students in the process of blended learning/ According to opinion of a majority of researchers, presence of more than half of working time with electronic learning resources is indicative of decent quality of blended learning. To achieve maximum efficiency of educational process, share of electronic learning resource should be from 60 to 80 % in total volume of studied courses [8; 18].

Empirical estimate of ICT influence on process of higher school students blended learning was obtained by means of pedagogical experiment on seven test learning groups of NUST MISIS held in accordance with curriculum for fifth semester Immersion level of test learning groups in electronic learning system varies from 20 to 80 % of usage in educational process with electronic learning resources. These constraints are explained by the fact that presence of more than 80 % of educational online technologies is interpreted as extramural form of study and presence of less than 20 % of educational online technologies to conventional form of study. Results presented in Table 1 were obtained in the process of analysis of interrelation of “performance level” and “quantity of work with electronic learning resources” attributes.

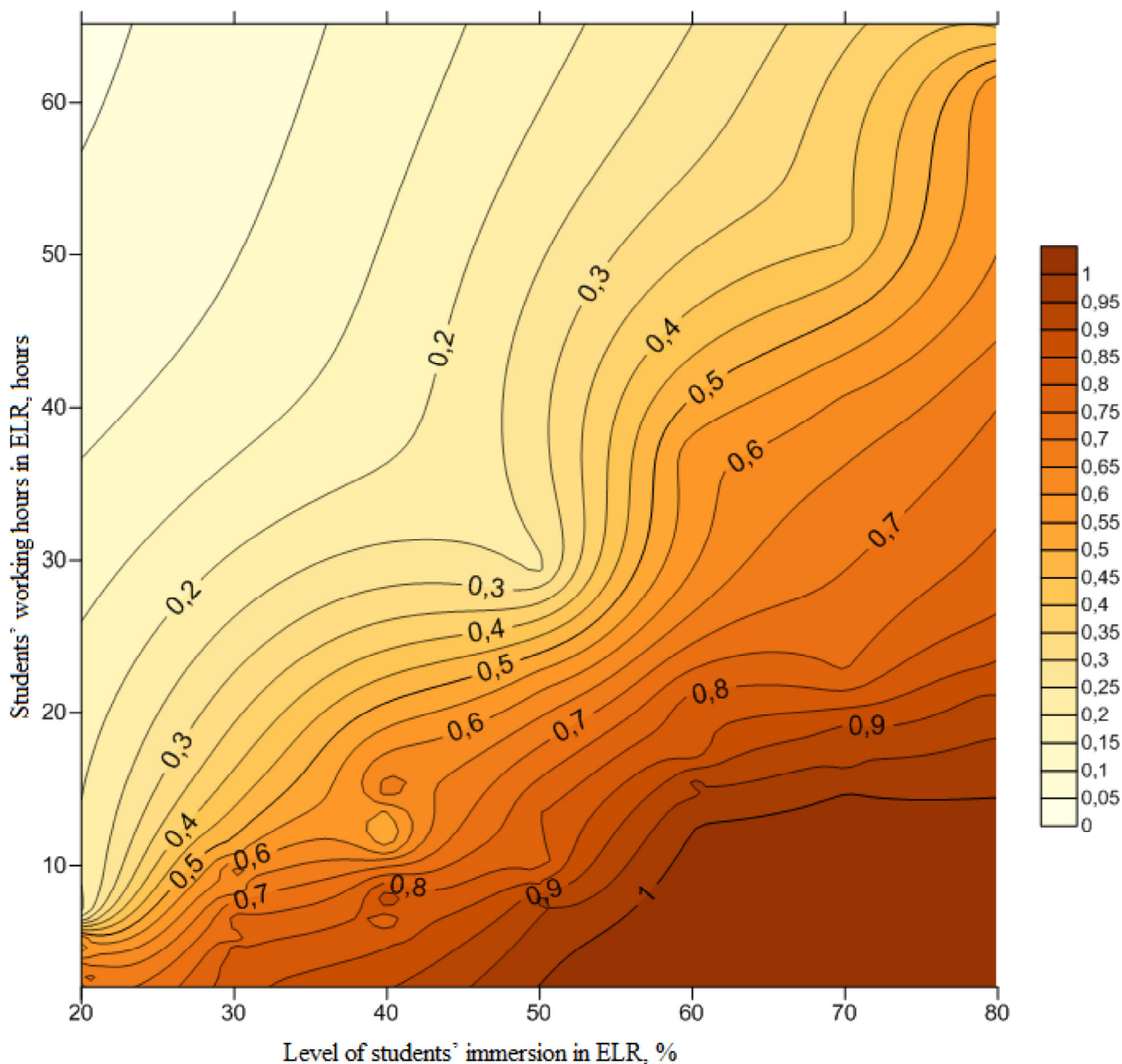
Table 1

**Analysis of interrelation of students’ performance and duration of ELR usage**

<b>Immersion level, % of work with ELR</b>	<b>Average value of duration of work with ELR</b>	<b>Average performance level in group, unit fractions</b>	<b>Correlation coefficient</b>	<b>Determination coefficient</b>
20	3.7793	0.6036	–0.8218	0.6754
30	6.5770	0.7204	–0.8170	0.6674
40	9.4457	0.6950	–0.8342	0.6959
50	10.8563	0.8137	–0.9046	0.8183
60	18.0833	0.8767	–0.9220	0.8500
70	21.1606	0.8744	–0.9747	0.9500
80	27.8641	0.8300	–0.9569	0.9157

Consequently, it was found that students' performance level changes depending on extent of usage ICT in the process of blended learning to specific course of study. The highest average

performance level was achieved by test groups immersed in ICT environment to level 60 and 70 %. In turn, the worst result was shown by test group with 20 % immersion level (fig. 1).



**Fig. 1.** Influence of level of students' immersion in ELR and duration their work in ELR on final performance

Correlation analysis of data array has shown absence of any dependency between total data array on intergroup level. Such situation can be explained by artificial restriction of test student groups in availabilities of information-communication environment usage. An unexpected fact was detected. It appeared that

there exists a rather strong correlational interrelation between performance level and quantity of time spent by every test student in ELR inside every student test group immersed in electronic learning system to a different degree. At that this correlation is obviously inverse, because correlation analysis shows negative



values. However early conclusions about inefficiency of ICT usage are not entirely true. In this case it is more correct to make conclusion that students showing the least success during the semester tried to spend more time in electronic learning system with goal to improve their own performance indices.

On the presented chart surface obscuration value reflects growth of value of analyzed characteristic, Consideration of figure 1 allows for the conclusion that the highest level of summative performance of students is at immersion range of 50–80 % and duration of work of every test student in ELR system up to 15 hours per semester. Increase of duration of student's work with ELR leads to recession of performance level (see most light areas).

Thereupon other stages of pedagogical experiment were carried out: forming stage and final stage. At forming stage of pedagogical experiment approbation of finding obtained on the first stage was carried out. At this stage, 119 students of 3-d course of intramural form of study took part. The main goal of this stage was the testing of hypothesis according to which optimal value of conventional and electronic forms in blended learning is "30/70". All groups participating in forming experiments worked with ELR during 70 % of study time and interacted with teacher in conventional classroom interaction during 30 % of study time. By results of experiment supporting evidence has been obtained. Performance level on groups participating in experiment at 70 % involvement of students in EDR did not descend below 0.74 points per group (which by five-point scale corresponds to average grades "Good" and "Excellent"). At comparison of data obtained by results of forming and final stages it was found that average performance indices on course of study participating in the experiment changed for the better. So, in academic year 2014 students

studying this course have average point 0.7734 unit fractions, and in academic year 2015 situation has changed, and average point of students is up by almost 5 %, amounting to 0.8163 unit fractions.

For validation of obtained results and implementation of final stage of experiment, it is necessary to conditionally exclude factor of course and study features. 138 students participated in this stage of experiment. By results of this stage of experiment it was found that in case of change of course and students' age (course of study), average performance level in the blended learning process in "30/70" is kept on stable high level.

Set of performed mathematical, statistical and graphical studies make it possible to state that achievement of the best indices learning performance at level of involvement of students in work with information-communication technologies from 60 to 80 %. At that increase of duration of work with electronic learning resource inside every group with equal requirements to immersion into the system does not guarantee improvement of learning results but is on the contrary negative characteristic of weak student.

Basing on results obtained in the process of data analysis of questionnaire survey as one of the most effective tools of quality management system, it is possible to draw conclusions of psychological preferences of generalized population of students and teachers about 60–70 % range of electronic methods usage in the process of blended learning. Graphical analysis obviously shows trend to student performance improvement with increase of ELR share in educational process. Thus, at 30 % of conventional student-teacher interaction and 70 % of implemented information-communication technologies the most successful assimilation of course material by students and the best performance at the end of semester is observed.



However, research described above on selection of proper shares of electronic and conventional forms of teacher-student interaction is not the only task in regulations of electronic learning resources usage in higher school. Issues of getting by all teachers of sufficient level of IT literacy which allows them to develop comprehensive educational and methodical complexes on relevant courses of study. This fact is confirmed by State Program of RF “Development of Education” for years 2013–2020 which places the highest value to continuous teacher education system. Teachers need additional competency-based support, necessary above all for search of common language with modern students which are in continuous network communication among themselves.

International requirements developed by UNESCO<sup>6</sup> in partnership with world leaders-

developers of technical systems for support of electronic learning resources and leading experts in sphere of education informatization describe requirements IT literacy of teaching staff [9; 21; 23]. This recommendation is developed considering three generally accepted approaches to informatization of educational process and divide teachers capable to develop and use electronic educational and methodical complexes into three competency-based blocks: “Application of electronic educational resources”, “Knowledge deepening” and “Knowledge creation” [11]. Within every block, capability of teacher to solve a series of tasks on application, creation, simulate blended system of learning or specific course of study [20; 25]. Designated properties of competency-based capabilities of teachers are presented in Table 2.

Table 2

Competencies of teachers in the sphere of electronic learning resources

Modules / Approaches	“Application of ELR”	“Knowledge deepening”	“Knowledge Creation”
Perception of ICT role in education, strategy and concept	Knowing of education politics, base level of IT literacy in professional sphere	Perception of education politics, advanced knowledge in sphere of ELR, continuous professional development	Initiation of innovations in education, individual "knowledge creation", commitment to implementation of innovations in higher school
Curriculum document and evaluation	Base knowledge and skills to create the simplest electronic educational and methodical complexes	Knowledge application, its active use in practice, creation of complex courses in study	Statement and solution of integrated problems of ELR functioning methodology
Pedagogical practices	Pedagogically sound application of ELR, implementation of innovative pedagogical processes in education, involvement of students	Solution of complex and integrated tasks using ELR, usage of personality-centered education, peer-to-peer education	Individual control of IT-processes in education, capability to self-development in the sphere of ELR pedagogy, building of educational paths

<sup>6</sup> UNESCO ICT competency framework for teachers, United Nations Educational, Scientific and Cultural Organization. 7, Place de Fontenoy Available at:

<http://unesdoc.unesco.org/images/0021/002134/213475E.pdf>



Hardware and software tools	Base skills in modern electronic resources and technology of EEMC creation	Application of complex hardware facilities and tools in creation of EEMC, usage of educational cooperation	Extended distribution of technologies, ELR usage in daily teaching activities
Educational process organization and management	Conventional forms of training activity in classroom with usage of information technologies. Separate ELR usage for student individual work	Usage of all ELR features for usage in educational process of blended learning. Proper educational process management on the base of blended learning	ELR transformation and adaptation in blended learning, development of IT management in educational institution, administrative management of student blended learning process
Professional development	Continuous improvement of digital and computer literacy, periodical advanced training	Continuous interaction with students on ELR base, compliance with modern level of IT literacy	Creation of teacher image as ELR consultant, creation of network "knowledge communities", ability to foresee ELR trends

Countries with different growth strategies can use these recommendations or combine strategies at their own discretion. Concerning Russian education system, "Knowledge deepening" approach should be used. Because it is directed primarily on teachers' adaptation to effective use of electronic learning resources in blended learning system, then wide use of this approach will improve efficiency of education. Of course, "Knowledge creation" approach covers a wider range of competences and provides additional resources for teachers' self-development, but:

- at current level of Russian education system development, it is early to apply this approach and stage-by-stage implementation of system for development of specific pedagogical competences related with electronic learning resources is necessary;
- not all higher school teacher is now ready to creation of educational innovations related to electronic resources and transformation of education process from resource management point of view;
- some modules proposed in conditions of "Knowledge creation" approach are more action

of administrative staff of higher school than for faculty members.

Other necessary measure of influence on teaching activities in conditions of electronic learning resource usage is administrative component. Obviously, that for provision of qualitative functioning of student blended learning system, it is necessary not only achievement by teachers of certain competency in the field of creation and support of electronic educational and methodical complexes, but also compliance with criterium of proper administrative organization of the entire process. Administrative support of electronic learning resources in conditions of creation of student blended learning system has a vast number of specific features, but in the final analysis lends itself to the common analysis of management, and by its attributes fits itself to the classic scheme of controlling business-process. It is characterized by set of interrelated measures directed to rendering of learning service to customer. Construction of business-process is performed according to close classical scheme "simulation – execution – control – improvement – simulation".

Scheme of interaction of main blocks was developed by authors of this paper. The scheme providing effective functioning of students

blended learning system in higher school is shown in figure 2.

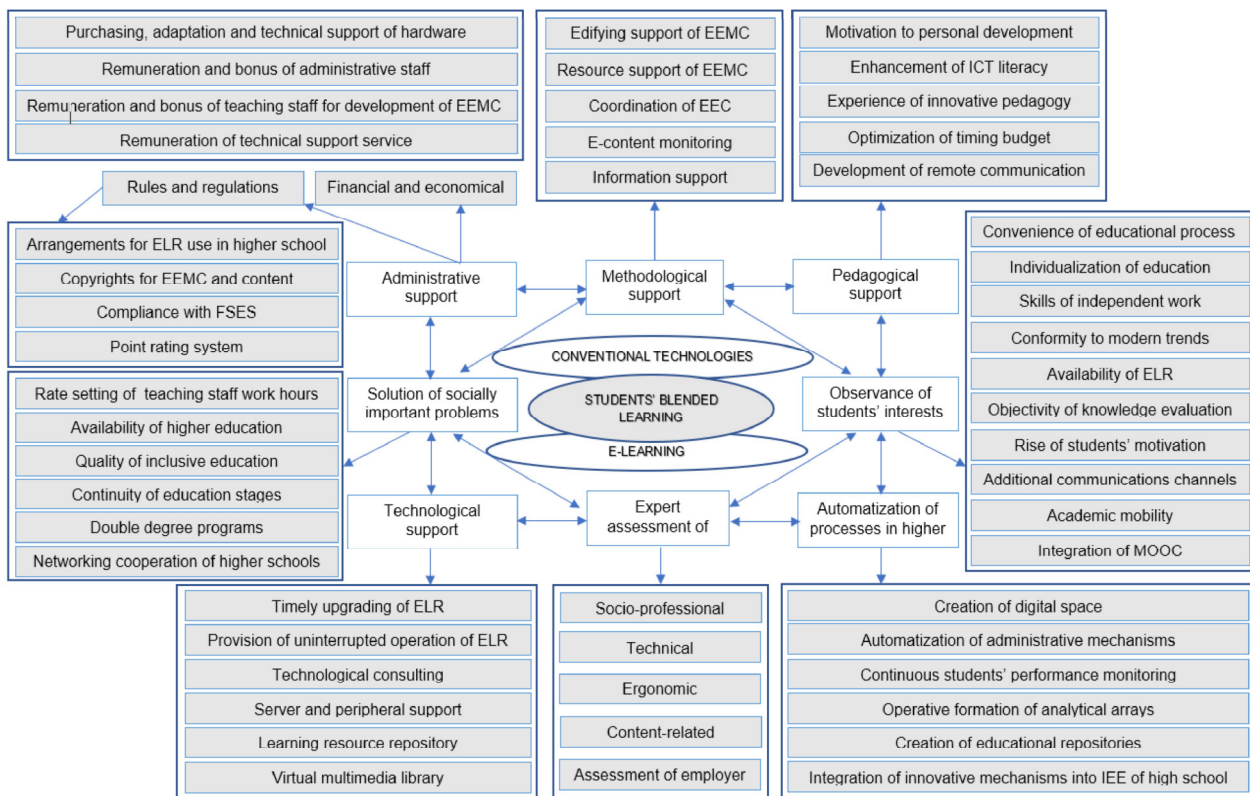


Fig. 2. Scheme of student blended learning system

The vast majority of large higher school institutions of the RF use rules and regulations as main mechanism of administrative regulation of the sphere under research. For example, local Regulations on Student Blended Learning required for regulation and standardization of work with electronic learning resources.

Administrative stimulation of teachers which are professionally ready to creation of electronic educational and methodical complexes can be performed in the form of incentives of various kinds. Moral incentives in this case include system of awarding with certificates, certificates of merits, diplomas and other documents acknowledging active and professional application of electronic learning

resources in teaching practice. One of the most expedient way of solution of material stimulation is inclusion in total bonus of some constituent based on rating assessment of share of used electronic learning resources in student blended learning system. At that both quantitative and quantitative criteria of “student-teacher” interaction can be considered. For example, number of coursed of study assigned to teacher for which electronic support is performed, teacher activity for semester, total time and also frequency and duration of work with electronic learning resource, participation of teacher in webinars and online communication with students, relative number of students using electronic resource in courses of study of specific



teacher, presence of comprehensive and high-quality electronic educational and methodical complex, satisfaction of students with electronic resource and so on.

### Results and conclusions

Scientific results and conclusions set out in this paper may be used at carrying out further developments directed at enhancement student blended learning system functioning in higher education institution. The results and conclusions are also applicable in pedagogical science and practice during development and implementation of higher school education programs. By the results of research it may be concluded that obtained data are of scientific merit - it specifies main milestones of usage blended learning in the sphere of higher education.

1. Existence of real demand of all participants educational process in digital educational technologies and their usage in blended learning format is defined theoretically and verified empirically. Materials contained in this article are indicative of positive responses both on the part of students and on the part of teachers of world's top universities.

2. Organizational conditions of application of digital educational resources in higher education are identified. It is found by experimental, mathematical and statistical methods that rational proportion of digital and conventional educational technologies should be kept at level: 70 % of digital technologies and 30% of conventional interaction "teacher – student".

3. Recommendation list for necessary level of pedagogical IT-competency of higher-school teaching personnel at organization of blended learning is created. The list contains enumeration

of skills on creation and pedagogical application of digital teaching materials.

4. It was detected that main elements of students blended learning in higher school are: administrative, methodological, pedagogical, technological elements, mechanisms for control of student interest observance, solving of important social problems and comprehensive expertise of digital educational resources. Structured combination of these elements represents blended learning system.

Personal contribution of authors in this research consisted of carrying out theoretical and methodological analysis of scientific and pedagogical sources in the area of application of digital educational resources in students blended learning; detection of methodical features of usage digital educational resources in students blended learning; development of forms for carrying out questionnaire survey of students and teaching personnel; direct organization and carrying out of questionnaire procedure and analysis of data obtained; independent carrying out of all stages of pedagogical experiment, including testing and statistical analysis of data; development of methodological recommendations and legal and regulatory framework for creation of effective students blended learning system in higher school.

Certainly, interfering into the structure of learning process the digital technologies are not able to change it. They only can significantly improve and optimize conditions of higher education getting and also promote effective students individual work, improve procedure of teacher-student interaction, provide positive trends for formation mutual competency capabilities of teachers and students.



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Submitted: 04 September 2018 Accepted: 06 November 2018 Published: 31 December 2018



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