

## TECHNICAL AND METHODOLOGICAL PROBLEMS OF FORMATION OF THE EDUCATIONAL SPACE OF DIGITAL UNIVERSITY

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### Abstract

The digital transformation of the economy and the information society affects all aspects of human activity, both in his personal life and in professional and social activities. One of the important aspects of the ongoing global changes is the transformation in education. This is a multifactorial problem that concerns not only technical, technological, methodological solutions, but also serious changes in the mental sphere, both for teachers and students. And here it is necessary to take into account the age of the students, and their preparedness for using various infocommunication solutions in the organization of education, and the readiness of relevant educational and methodological materials, and so on and so forth.

Currently, there are a large number of examples of the implementation of infocommunication technologies in education at various levels, starting with preschool education. However, in this article we will focus on considering what seems to be effective in teaching at the level of higher education. This allows us to count on the appropriate level of students' competencies in terms of computer skills and readiness for more independent mastering of the discipline. At the same time, we note that the problems studied and the proposed solutions can be used at other levels of training with appropriate refinement and adaptation.

**Keywords:** educational space, digital university, educational materials, electronic lectures, electronic courses, information and communication technologies, elements of artificial intelligence, SMART lecture, presentation.

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## 1. Introduction

The basis for studying any course in a higher educational institution is a textbook or teaching materials that replace it, if the course is new and based on rapidly changing source content. It should be noted that the textbook is a fairly voluminous information resource used very long time, characterized by the fundamental presentation of the material, the necessary rigor and completeness. Given the real time allotted to presenting the course materials to students by the teacher, we can confidently say that the teacher can and should present the most important and significant provisions of the course in lectures, leaving certain sections for students to study independently, as well as to study on practical and laboratory exercises.

So, the theoretical basis of the course is a textbook, and the form of its presentation to students by the teacher is a lecture, which in the future we will consider as an electronic lecture.

Since the creation of a textbook, its writing and publication takes a very long time, it is the electronic lectures of the teacher that are the more mobile and adequate form of bringing updated modern information to the students on the course.

Without rejecting the general possibility of presenting educational information by traditionally reproducing it on a blackboard with chalk, or a felt-tip pen, or a sticker on the screen, we will point out a rather simple, but very effective and well-thought-out form of presentation, namely, in the form of a PowerPoint presentation. At the same time, the lecturer, depending on the course and readiness of students (students) to work independently, should determine the methodology for recording what is being presented to them.

## 2. Educational space of digital university

As practical studies show, the effectiveness of students memorizing and reproducing educational information is higher if they, in addition to listening

to or viewing educational material, write it down and form an individual lecture notes, compared with the case when the teacher gives them pre-prepared material that does not require individual improvements. At the same time, the formation of an individual lecture notes for a student takes a certain amount of time, resulting in “losses” in the speed of presentation of the material. So the teacher in preparing the presentation should take into account the willingness of students to perceive information not only in lectures, but also with independent study.

Based on the significant experience in teaching technical disciplines in higher education, it should be noted the need for phased control of the assimilation of material by students. To do this, in a lecture-presentation, i. e. PowerPoint has a built-in software testing complex that can be used both on-line and off-line [1, 2].

Given the widespread and practical use of various electronic gadgets, especially in the youth environment, the creation of electronic courses is a paramount task. Online education is currently the most common and promising learning format. Electronic courses allow you to have access to educational materials and gain knowledge at any time, anywhere and on any device [3–5].

At the same time, along with electronic textbooks, which cover the entire material under study most deeply and fully, electronic lectures are becoming increasingly important, the main advantage of which is: sufficient completeness of the material presented in a particular discipline with video and audio explanations, constant availability using various electronic devices (computer, laptop, tablet, smartphone), the ability to quickly select any section for a more in-depth development, the ability to independently control the learning of the training methods and material.

In the prepared electronic lecture, which is being formed, inter alia, with the involvement of selected and tested resources of the Internet, all the basic material for studying this course [6] should be presented, which can be supplemented by other electronic resources aimed at consolidating and testing knowledge, obtaining practical skills. In total, this will be an electronic educational and methodical complex, which we will call *SMART lecture* (presentation), meaning the implementation of content in PowerPoint presentations with an integrated testing complex and elements of intelligent data processing.

Access to the created resources is usually carried out through distance education systems, which, in the context of Russian language content, must meet certain criteria.

The most important criteria for distance learning systems:

- installation on any hardware and software platform;
- system security;
- simple, intuitive interface;
- the presence in the system of functions used for organizing e-learning using distance learn-

ing technologies — development and editing of courses, a set of course elements;

- support for the Russian language;
- the modularity of the course (in modern e-education systems, a course can be a set of micro-modules or blocks of educational material that can be used in other courses. Knowledge objects can simply be transferred from one course to another, a completely different course from it. The purpose of creating these objects is reducing the time for developing courses, since by creating one object, it can be reused again and again);
- integration of external modules to expand the functionality;
- support of international standards (IMS, SCORM) used in e-learning;
- the possibility of organizing a point-rating system.

### 3. The most famous distance learning systems (DLS)

With all the diversity, we will point out the most commonly used software solutions for organizing e-learning in the form of an “electronic dean’s office” that provides organizational and administrative functions.

Modular Object-Oriented Dynamic Learning Environment (Moodle) — a free distributed Learning Management System (LMS). It is focused on the organization of interaction between the teacher and students. Suitable for organizing distance learning courses, as well as for supporting full-time studies. Moodle has been translated into dozens of languages, including Russian, and is used in almost 50 thousand organizations from more than 200 countries.

Claroline LMS is a platform for e-Learning and e-Working that enables teachers to create effective online courses and manage web-based learning and collaboration. Claroline LMS is released under an Open Source license. It is used in hundreds of organizations in 90 countries. The program interface is translated into 35 languages, among which there is Russian. Allows you to create and administer courses online.

The Finnish Eliademy project makes it easy and simple to create your own distance learning courses that can be used in educational activities:

- Eliademy — the functionality is essentially simple and intuitive, there is no such abundance of buttons and possible actions, as there are in Moodle.
- Eliademy is not only a platform for creating courses, not just an LMS system. This is also MOOC — a place where Mass Open Online Courses are provided, to which anyone can register. In addition, at Eliademy not so long ago an opportunity appeared for universities and organizations to create paid courses, but for anyone who wants it, the platform remains completely free.

Microsoft Learning Content Development System (LCDS) is a free tool that allows members of the

Microsoft Learning and Certification community to create high-quality, interactive courses for networking and Microsoft Silverlight Learning Snack presentations. With the help of the LCDS system, any member of the Microsoft training and certification community can publish e-learning courses and Learning Snacks presentations by filling out convenient LCDS forms that allow you to easily create highly customizable materials, interactive tasks, questionnaires, games, test papers, animations and demo videos and other multimedia resources [7–10].

The development and establishment of various solutions for creating an electronic educational environment required the establishment of certain standards, which is quite justified, since their formation takes into account the experience gained and the search for the best solutions.

#### 4. LMS Standards

The most common standards are SCORM (Sharable Content Object Reference Reference Model) and IMS QTI (IMS Question and Test Interoperability) [11, 12]. These standards contain requirements for the organization of educational material and the entire distance learning system. They make it possible to ensure compatibility of components and the possibility of their repeated use, namely: the training material is presented in separate small blocks, which can be included in different training courses and used in a learning system regardless of by whom, where and by what means were created.

Tools for creating a SCORM course can be conditionally divided into three types:

- editors of electronic courses in the form of separate installation programs;
- cloud services that do not require installation on a computer;
- applications that are integrated into PowerPoint.

Depending on the discipline developed by the teacher, various solutions can be recommended. For

example, the discipline associated with the study of the anatomical features of a person, obviously, will require other technical and software approaches in comparison with the study of mathematical analysis. In addition, the complexity and associated cost of producing the content, as well as the “lifetime” of this content without the need for updating, should be taken into account.

Based on a fairly large experience of teaching in a higher technical educational institution, we note that in a significant number of cases, it is very effective to use PowerPoint-based applications for forming electronic courses, which is justified by at least the following reasons:

A. Teachers do not have to spend time studying a new program. Many already have experience in creating and presenting in PowerPoint, which means that they can create effective electronic content in a short time with relatively low cost of producing it.

B. The basis for the electronic course will be any presentation that the teacher uses in the classroom with students. You can easily add videos, polls, tests, sound and video accompaniment to the presentation.

C. The licensed PowerPoint environment is widespread and will not require additional costs for the right to use it.

To create a SCORM zip archive, iSpring Suite can be used, which is an add-on and is displayed on an additional PowerPoint tab. It will take only a few minutes to turn a regular presentation into a professional training course [13, 14].

#### 5. Methodological basis for creating a course in the form of a PowerPoint presentation

At the first stage of creating the course, the teacher must carry out preparatory structural operations, shown in Figure 1. When planning the volume (number of slides) in the training course, one should take into account their difficulty in mastering, the duration of the audio and video accompaniment. In the presence of tests — an approximate time for their passage, etc.

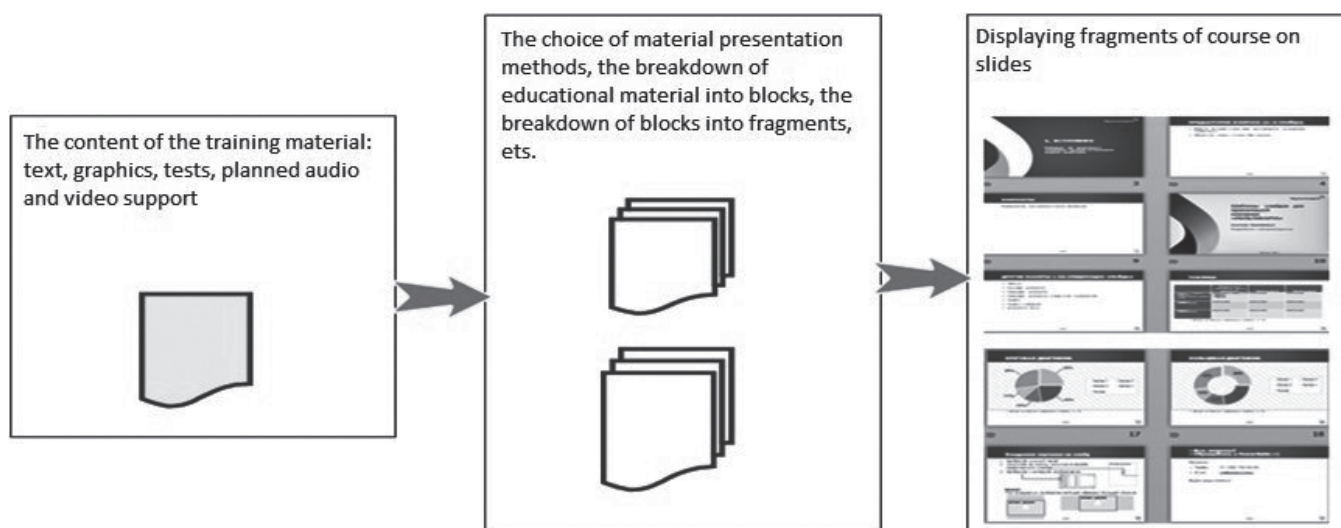
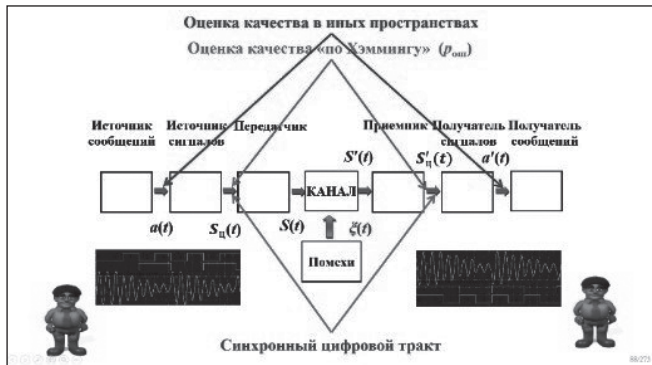


Fig. 1. Preparatory steps for creating an electronic course

Коды делятся на *линейные* и *нелинейные*. Кодовые комбинации линейных корректирующих кодов отображаются точками (векторами) линейного пространства с присущей ему аксиоматикой. Практически все известные схемы корректирующего кодирования основаны на линейных кодах.

Различают *разделимые* и *неразделимые* корректирующие коды. В разделимых кодах всегда можно выделить информационные символы, содержащие передаваемую информацию, и проверочные символы, которые служат для коррекции ошибок, возникающих из-за помех в каналах связи. Неразделимые коды не имеют четкого разделения кодовой комбинации на информационные и контрольные символы. К ним относятся коды с постоянным весом и коды Плоткина. Разделимые блочные коды, в свою очередь, делятся на *систематические* и *несистематические*. В систематическом коде позиции занимаемые информационными и проверочными кодовыми символами образуются как линейные комбинации от информационных символов. Систематические коды более удобны на практике, чем несистематические коды, у которых в комбинациях не содержится в явном виде информационных символов. К систематическим кодам относятся: коды с проверкой на четность, коды с повторением, корреляционные, инверсные и итеративные коды, коды Хэмминга, Голея, Рида-Маллера, Макдональда, Варшавова и другие.

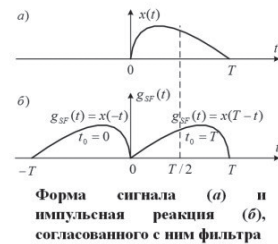
a



c

Импульсная реакция оптимального линейного фильтра определяется формой сигнала  $x(t)$  и в этом смысле согласована с ним. Таким образом, импульсная реакция согласованного фильтра  $g_{SF}(t)$  с точностью до постоянной  $C$  — есть зеркальное (относительно вертикальной линии в точке  $t = t_0/2$ ) изображение полезного сигнала  $x(t)$ .

b



$g_{hF} = \frac{P_a \cdot F_a \cdot P_{\xi}}{P_x \cdot \Delta f_x \cdot P_{\xi}} = g_h \cdot \frac{F_a}{\Delta f_x} = \frac{g_h}{\beta_F}$  — обобщенный выигрыш с учетом мощностей и полосы частот.

$g_h = \frac{\beta_F}{\delta_{p,a,\varepsilon}^2 \cdot \beta_F}$ ;  $g_{hF} = \frac{1}{\delta_{p,a,\varepsilon}^2 \cdot \beta_F}$  — выигрыш и обобщенный выигрыш через удельные величины.

В системах с непосредственной передачей, когда  $x(t)$  пропорционален  $a(t)$ , т.е.  $x(t) = k \cdot a(t)$ ,  $\Delta f_x = F_a$  и  $h_{p,a,\varepsilon}^2 = h_{p,x,\xi}^2$ , выигрыш и обобщенный выигрыш — одинаковы.

$k_{пф} = \frac{|a(t)|_{max}}{\sqrt{D_a}}$  — пик-фактор,  $D_a = \sigma_a^2$  — дисперсия (средняя мощность) сообщения на выходе приемника. При нормировании  $|a(t)|_{max}=1$  имеем  $P_a = D_a = \frac{1}{k_{пф}^2}$ .

d

Fig. 2. Presentation slides in the form of:  
a text message (a), with the presence of graphs (b), diagrams and pictures (c), formulas (d)

The presentation consists of slides of varying complexity. We show this by the example of the presentation of the course “General Theory of Communication”.

A number of slides are text messages that are displayed sequentially on a slide in the form of some definitions (Figure 2, a). This is the simplest and least time-consuming slide option. A more complex option is to create slides with the addition of formulas, pictures, structural, schematic diagrams and graphs (Figure 2, b — d). This will require additional skills for creating images and grouping them, as well as working with the formula editor.

The next presentation complexity variant is the creation of dynamic multimedia slides, which in certain cases makes it possible to present educational material very clearly. A number of processes can be most efficiently explained only with the help of such a presentation, since static still images and graphs with corresponding textual explanations for them do not provide that completeness and clarity of demonstration of ongoing processes, in comparison

with a dynamic multimedia version. Figure 3 shows creation of a multimedia slide, which presents the method of analog-to-digital signal conversion. Creating such slides requires a lot of experience in PowerPoint. However, this solution will make it possible to make the material much more understandable and accessible, discussed, for example, in [15, 16].

The most difficult is to create a testing system, while it is desirable to have different test options: a test with a choice of one or more answers (answers do not change their location the next time they enter the testing part); a test with the choice of one or more answers (the next time you enter the testing part, the location of the answers changes); test with calculation and input of the calculated number or its selection from the proposed options; test with building a logical chain of answers; conformity test. When implementing tests, it is possible to measure the response time, and also take into account the number of correct, erroneous and missed answers, and based on these results, you can display certain comments and recommendations on the screen during the study, including the transition

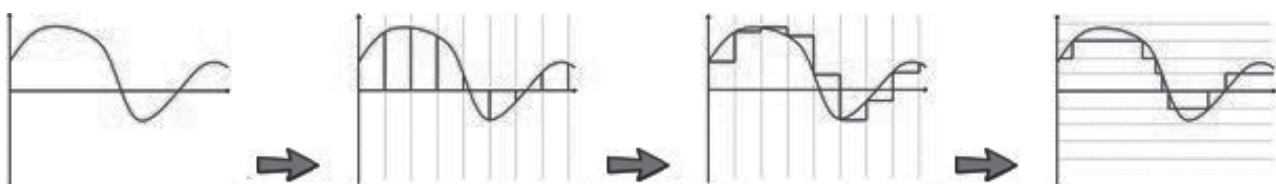


Fig. 3. Creating a multimedia slide



to solving a similar problem, but in a different presentation and other numerical data.

This work requires professional programmer skills. To do this, you must have the skills to work in the Visual Basic for Application (VBA) environment. VBA is an environment with a programming language, it is integrated into PowerPoint. It should be understood that a program written in VBA (macro) is an external software component for office applications and can be perceived as a security risk. Therefore, to save and run it, the corresponding .pptm format and setting the permission in the File-Parameters section are required. In the VBA environment in PowerPoint, it is possible to create custom forms (a kind of analogue of slides) which, following a specific scenario, can perform quite complex processes, many-variant tests consisting of several forms.

As an example, based on the practical experience of making PowerPoint presentations in a number of disciplines taught at the Moscow Technical University of Communications and Informatics (MTUCI), we can cite the following quantitative assessments: a course on the General Communication Theory, consisting of 42 hours of lectures, of which 18 hours — the first part of the course and 24 hours — the second part of the course. A total of 300 slides were prepared, of which 120 slides in the first part and 180 slides in the second part of the course. The total volume of the presentation without sound was 63.4 MB. At the same time, the volume (weight) of one slide varied significantly depending on what information was reflected on this slide: from 25.4 KB to 5.5 MB (Figure 4). The average weight of each slide without sound is 211.4 KB.

When adding sound, the file can be recorded in different formats, for example, mp3 with various parameters (single-channel (mono) or two-channel (stereo) encoding; sampling frequency (8; 16; 22,050;

32 kHz, etc.); bit rate (8; 16; 32; 48 kbps, etc.)) or wma. Practice has shown that a single-channel mp3 format with a sampling frequency of 22.050 kHz and a bit rate of 48 kbps is preferred, as it has the best ratio of sound quality / file size / playback on most devices.

The added soundtrack increases the volume of the entire presentation to approximately 319.8 MB. The weight of one slide with sound can vary from 150 KB (duration of sound accompaniment ~ 20 seconds) to 6 MB (duration ~ 14.5 minutes). The average weight of each slide with sound is 1.1 MB (duration ~ 3 minutes).

Thus, for approximately one hour of lectures on a discipline of general professional profile, there are 7–8 slides, the average volume of which is ~ 8–9 MB (duration ~ 25–30 minutes).

The most important addition to SMART lectures in the training course is sound accompaniment. With the help of sound, you can significantly expand the information presented on the slide, give explanations, bring the electronic version closer to the “live” lecture, while the most accurate and compact presentation of the material is essential, since in most cases this determines the duration of the slide display, the order of appearance or the disappearance of possible graphic structures. In addition, the sound file has a “weight” and a long sound fragment significantly increases the total volume of the course.

For voice recording, you can use the freeware MooO Voice Recorder or similar.

In the process of preparing materials for electronic lectures, it may be necessary to use a finished or recorded video file. Not all formats can be implemented in PowerPoint. The most universal solution is the AVI or WMV format. If PowerPoint does not allow you to insert an audio or video file, you must convert it to the recommended format. You can use various editors or open resources on the network, for example, CloudConvert.

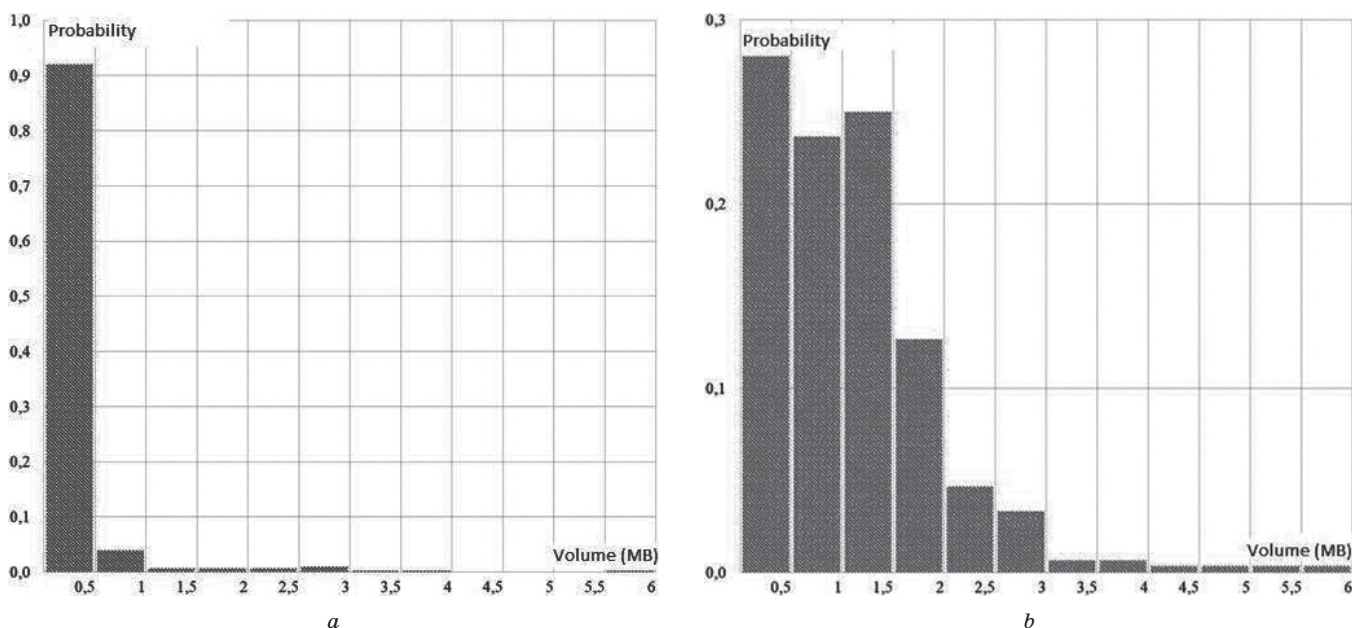


Fig. 4. A probabilistic estimate of the number of presentation slides from their volume: without sound (a); with sound (b)

## 6. Elements of artificial intelligence in electronic SMART lectures

The electronic lectures created using the method proposed above are formed on the basis of a textbook, as well as other updated electronic resources, and are used for a concentrated display of the studied discipline. But in addition to the traditional presentation of the material in the form of texts, graphs and formulas, the presentation uses multimedia and game plots. In addition, electronic lectures can be structured into sections and “equipped” with a temporary sensor that records the student’s time spent studying a particular block of electronic lectures, testing questions or tasks. This information, together with the initial individual data about each student, allows you to build his “training portrait”, and then his “training path”, reflecting the level of his training, possession of certain skills, knowledge and skills. In addition, one should fix its “individual speed” of studying electronic materials, which in general can serve as a very reliable assessment for developing recommendations on the ongoing process of studying the discipline. For this, these data are aggregated in a special program unit that implements intelligent data processing, with the development of advising recommendations for both the student and the teacher. At the first stage, the model of linearly independent  $n$ -dimensional space was chosen as the implemented model, where the coordinates are used to select the appropriate indicators for the quantitative assessment of the results of studying the discipline, taking into account testing and the passage time of individual blocks of the electronic lecture with the possibility of changing the weight of each parameter. Further, in the process of accumulating “knowledge” with an increasing number of students passing through this system, a procedure for comparing results and developing recommendations is built. Moreover, this information is taken into account later in the analysis of the individual “educational portrait” of the student [17].

The ongoing convergence of communication networks [18, 19] reflects the logical path of telecommunications development in the context of deep integration processes with information technology [20, 21] and the economic feasibility of the evolutionary replacement of past technologies by more advanced ones.

The basic principles of modern info-communications are: globalization, personalization, mobility, interactivity and information security. It should be noted that at the dawn of its emergence, telecommunication systems were local, not mobile (fixed) and not always interactive, and the problem of information security was utilitarianly narrow, expressed as preventing access by unauthorized persons to transmitted and received information. However, the subsequent development and penetration of infocommunications in all spheres of human activity approved the above principles with a special significance for the principle of information security, since due to the global nature of infocommunications they turn out to be a powerful

mechanism of influence not only on production, but also on social processes, the formation of a new infocommunication culture in society.

We also note that, starting from 2009–2010, traffic, according to Cisco, generated by computers, was equal to traffic created directly by people [22], which is due to the expansion of tasks that are “entrusted” to computers without human intervention. And although the payment for traffic from computers continues to be borne by people, its growth is becoming more noticeable and growing, which will become even more obvious with the implementation of ideas for the formation of a “digital economy”, when the management of many processes will be entrusted to networked computer systems.

It can be noted that today and in the foreseeable future, network users are people, computers, various sensors that capture individual environmental parameters, for example, street images, temperature, humidity, speed of moving objects, etc. (Figure 5).

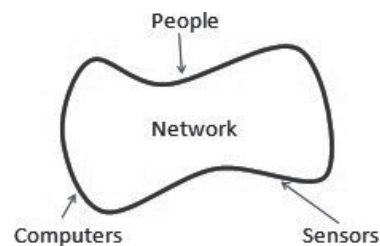


Fig. 5. Network Users

However, in the end, all this should work in the interests of man, ensuring his comfortable and safe existence.

In [22], data are presented showing that:

A. “Currently, more than half of the world’s inhabitants have an Internet connection. 51.2 percent of individuals or 3.9 billion people used the Internet.

B. There remains a general trend towards increasing access to and use of ICTs. It is expected to achieve a 70 percent level of Internet penetration by 2023 and a 75 percent level by 2025.

C. Mobile access to basic telecommunication services has further strengthened its dominant position.

D. Broadband access continues to show steady growth. Penetration rates increased from 4.0 contracts per 100 inhabitants in 2007 to 69.3 contracts per 100 inhabitants in 2018.

E. At present, almost the entire population of the world lives in the signal reception area of a mobile cellular network.

F. Internet access from home is gaining more and more popularity. In 2018, almost 60 percent of households had Internet access at home, much more than in 2015, when there were less than 20 percent.

G. Lack of ICT skills is a serious obstacle to people’s access to the Internet.

“The increase in indicators for expanding the capacity of international channels and Internet traffic was higher than the indicators for increasing access to ICT and the share of the population using the Internet” [23].

This statistics demonstrate the increasing role of ICTs or info-communications in human life and, therefore, the need for compliance with this network infrastructure, as well as methods and devices for a person to access the network. Network infrastructure implements its development through convergence, and human access is proposed to be implemented through a certain integration of access methods.

A modern mobile phone incorporates the ability to send both text, audio, and video messages, as well as data. At the same time, certain differences in access to the implementation of these opportunities should be noted. The greatest integration is achieved in instant messengers. However, for this it is necessary to install a specific program and continue to work only in this specialized environment, for example, Skype, Viber, WhatsApp, etc. It is proposed to use a different login principle, namely, not by downloading a specific program and then working in this external and not controlled environment, but through a standard browser, which is widely used on the Internet when accessing various resources. This will create universality and uniformity, as well as significantly expand the capabilities of such a messenger, for example, access to the most various programs and applications, databases, multicast, webinars, remote cameras and so on.

This project, called the Integrator, was implemented as a result of cooperation between the Moscow Technical University of Communications and Informatics, PJSC Rostelecom and the company AS.

When you enter the Integrator via the Internet from a mobile phone or computer, the appropriate registration takes place (if necessary, by entering the appropriate password and recognizing the person's face), as shown in Figure 6.



Fig. 6. Screen shot of the user

Further, depending on the status: "Lead" or "Participant", access to the corresponding "Work Room" is formed.

With the status of "Lead", the study has the form shown in Figure 7.

In the upper right corner, the presenter sees his image, which is broadcast to all "Participants" and thus organizes the webinar mode. Below the video image, there is a list of connected "participants" and Chat for text communication between the "Lead" and "Participants".

In the center there is a window on which the "Lead" can display both video from remote cameras and any

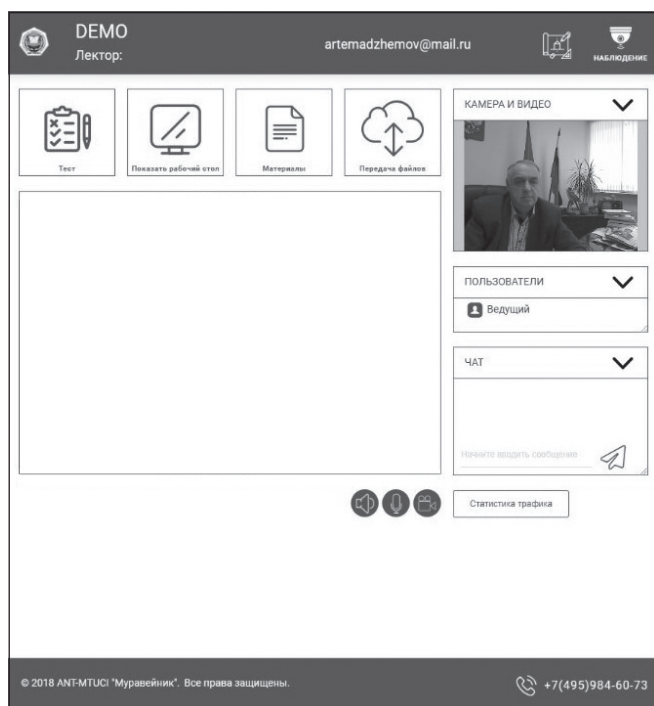


Fig. 7. Lead screen shot



Fig. 8. Screen shot of participants



information contained in this device or taken from a database. File transfer and so on.

The “Participant” receives video, audio and text messages from the “Lead” in the webinar mode. At the same time, there is the possibility of interactive communication via Chat, as well as by “Raising Hands”, i. e. sending a corresponding request to the “Leader” for video and audio communication.

Having seen the “Raised Hand” request, the facilitator can grant such a right and then an additional image of the “Participant” appears on the screen, which all “Participants” see and the corresponding communication takes place (Figure 8).

The number of “Participants” is limited by the server’s capacity, and the number of “Participants” who raised their hand at the same time on the common screen is additionally limited for reasons of screen dimension. Conducted use of the system in the teacher-student mode showed the advisability of sequentially granting the right to “display” the hand raised for only one “Listener”, since the simultaneous “display” of two or more “Listeners” is unconstructive.

This system of «advanced messenger» can be widely used. For organizing e-learning and counseling, for conducting operational meetings, for organizing conferences and discussions, for the usual communication of people both in the “one on one” mode and in the “one with many” mode.

## 7. Conclusion

Currently, the Integrator system has been used for two years to conduct classes at MTUCI using the developed SMART lectures (presentations). Practical operation allows you to begin to accumulate data that objectively reflects the “learning path” of students and the formation of individual “training portraits”.

The Integrator system is a domestic software product that meets the requirements of information security, the safety of personal data of teachers and students.

A survey of student satisfaction with this remote technology showed that out of a maximum of 100 % student satisfaction with SMART with lectures prepared by the authors of this article, student satisfaction with real communication with the teacher was 97.4 %, and student satisfaction with communication through the Integrator — 89.7 %. These data confirm the high demand for e-learning and, in particular, through the Integrator system.

It should also be noted that the main advantage of these technologies, called by students, is their great availability, dynamism and mobility. The main disadvantage was the unfamiliarity of communicating with the teacher through the information and communication environment, the reduction of the usual human interaction, which once again confirms the need to take into account mental changes in the formation of the learning space based on modern information and communication technologies.

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## ТЕХНИЧЕСКИЕ И МЕТОДОЛОГИЧЕСКИЕ ПРОБЛЕМЫ ФОРМИРОВАНИЯ ОБРАЗОВАТЕЛЬНОГО ПРОСТРАНСТВА ЦИФРОВОГО УНИВЕРСИТЕТА

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### Аннотация

Цифровая трансформация экономики и информационного общества затрагивает все аспекты деятельности человека — как его личную жизнь, так и профессиональную и общественную деятельность. Один из важных аспектов происходящих глобальных изменений — трансформация образования. Это многофакторная проблема, которая связана не только с техническими, технологическими, методологическими решениями, но и с серьезными изменениями в области психики — как преподавателей, так и студентов. И здесь необходимо учитывать возраст учащихся, их готовность к использованию различных инфокоммуникационных решений в организации образования, а также готовность соответствующих учебно-методических материалов и т. д.

В настоящее время имеется большое количество примеров внедрения ИКТ в образование на разных уровнях, начиная с дошкольного образования. Тем не менее в этой статье мы сосредоточимся на рассмотрении того, что кажется эффективным в преподавании на уровне вузовского образования. То есть мы предполагаем соответствующий уровень компетенций студентов с точки зрения компьютерных навыков и готовности к более самостоятельному освоению дисциплины. В то же время отметим, что изученные проблемы и предлагаемые решения могут быть использованы на других уровнях обучения с соответствующей доработкой и адаптацией.

**Ключевые слова:** образовательное пространство, цифровой университет, учебные материалы, электронные лекции, электронные курсы, информационно-коммуникационные технологии, элементы искусственного интеллекта, SMART-лекция, презентация.

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