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Integration of Learning Forms as a New Paradigm of the Educational Information Space[*]

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Abstract. The research is devoted to the study of a new paradigm in the educational information space, based on the integration of traditional and IT-oriented approaches in organizing the educational process. The realities of the modern world dictate new requirements for the learning process. Training courses and the educational process itself should be easily transformed from a traditional form to distance learning and vice versa. The presence of numerous e-courses and textbooks does not solve this problem, since they have a rather rigid structure and do not allow switching to traditional lectures and practical exercises within one course. To solve this problem, it is advisable to use new forms of integration of various forms of education; this novelty presupposes a paradigm shift in the educational process. The new paradigm lies precisely in the integrative understanding of the process of acquiring knowledge, simultaneously or sequentially (according to a previously worked out scheme or system that is formed in the learning process), switching to distance learning. The model of the proposed training course includes mobile elements, suggesting both traditional and remote forms of teaching material. It is proposed to study the possibilities of using the new paradigm for a breakthrough in domestic higher education as the basis for a future digital breakthrough in the economy. Given the conditions when a remote way of obtaining and providing knowledge is the only possible one, we get the results of a forced, real and large-scale experiment that will provide a basis for research in many areas of knowledge related to pedagogy, sociology, psychology, healthcare, IT-technologies.

Keywords: Integration, Paradigm, Paradigm of Information Educational Space, Mobile Element, Traditional Form, Distance Learning, Remote Learning.

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1 Definitions and Concepts in the Integrative Approach

Integration in education is understood and applied to refer to various processes and phenomena. Understanding integration for the proposed model means the combined, simultaneous use of different approaches in the learning process to obtain a pre-planned learning outcome. These different approaches are connected with the space-time conditions of interaction between the student and the teacher.

For this study, it is important to determine the rest of the conceptual apparatus. By traditional (classical) teaching we mean the presence of students and a teacher in the classroom for conducting classes: lectures, seminars, laboratory work. By distance learning, we mean the spatial and temporal separation of a student and a teacher, with the possibility of simultaneous access to an IT platform for negotiations (online consulting, online lesson, where the spatial separation remains).

Distance learning courses involve the availability of ready-made educational materials, developed with the use of computers and most modern IT technologies. Direct contact with the teacher within the framework of distance learning is either absent or reduced to online consulting hours.

In turn, remote learning involves the separation of the subjects of the educational process only in space. The teacher continues to contact students using all kinds of conference platforms and cloud services, where the student and the teacher are present at the same time, repeating the traditional teaching model. It can be assumed that distance and remote learning are two forms passing into each other, where the proportion of Spatio-temporal interaction between teacher and student is constantly changing. Within the framework of this study, differentiation of distance and remote learning is not assumed, since the goal is to propose a new paradigm of the educational information space.

2 Integration in Education and Knowledge Assessment

Integration in education is studied in various aspects [1, 2, 3], but the perspective of the proposed approach lies in the fact that the paradigm, as the scientific rationality of the application of mobile parts of the information content of the training system, will not only be taken as the basis for the formation of separate training courses but will form the basis of new state standards. It is important to take into account the opinion of the scientific community: teachers, sociologists, lawyers. Only through scientific research can we start the process of transition to a new paradigm in education, and the process of integration and globalization, which has been launched in society, is dominant [4, 5].

Scientific research reveals the qualitative and quantitative aspects of assessment, information, and statistical measurement methods, the reliability and efficiency of various approaches to distance education, and the reliability of the software and hardware learning environment [6, 7, 8].

Using classical theoretical research on the basics of organizing control and assessment, as a special type of pedagogical activity, as well as researching the technology of

assessing knowledge based on programmed control and the function of checking and assessing knowledge in the educational process, the requirements for the knowledge, skills, and abilities formed, control methods, types taking into account knowledge in the traditional education system, it is possible to create an effective educational process that will lead to a breakthrough in domestic education, will provide the foundation for the digital economy and the growth of the high-tech sector of the Russian economy [9, 10].

3   Educational Process as a Dynamic Structure

The integrative approach as a new paradigm will be considered within the framework of this study in the aspect of content, filling the educational process. The educational process in the educational space, as an object of research, will be considered not as a single and indivisible, but as assembled from mobile elements, however, possessing the emergent properties of its ancestor - the traditional educational process.

So, the model of the training course in the traditional presentation includes the following components (Fig. 1). The normative-target component defines the goals and objectives of the discipline based on the Federal State Educational Standards and curricula of the course. Based on the principles of the competence-based approach, a set of formed competencies is distinguished. The content component includes a list of topics and sections of the course, a schedule for mastering topics, lectures, and practical training materials. The selection of the course content is determined following the formed competencies.
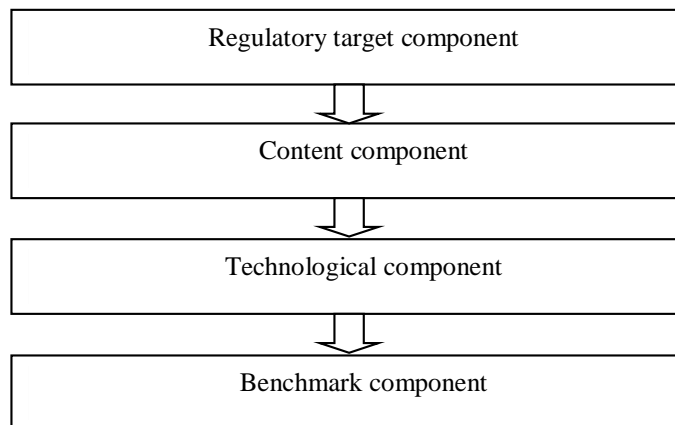
Fig. 1. Traditional course model.

The technological component of the model is aimed at introducing information technologies into the learning process. In the traditional presentation of the material, the teacher usually uses various multimedia tools, as well as test sets for computer assessment of knowledge. However, the percentage of the use of IT technologies in the training course can be quite small and limited only to the electronic form of text documents.

The last component of the model is control and effectiveness. This component includes tasks for intermediate, midterm, and final control of knowledge, questions and tasks for self-control, a list of questions for the test and exam, criteria for assessing the acquired knowledge.

The structure of the e-learning course designed for distance learning has features that do not allow integrating elements of the traditional presentation into it. The distance course contains the following elements: educational content, course navigation system (hyperlinks to course sections, tools for managing course elements: lectures, assignments, tests), communication tools (news forum, online consultations, e-mail), transfer of completed tasks (cloud storage, e-mail), additional tools (calendar for studying sections and completing tasks, information lines), security tools.

For the traditional training course to be easily transformed into the format of distance learning, if necessary, let us expand its model with mobile elements inherent in distance learning. The mobile element can also be called hypermobile or mobile. Similar mobile elements can be used in the classical learning process. However, the number and depth of use of these elements must meet some criteria. Otherwise, the quality of training may be reduced.

The study of this issue includes some subtasks:

- development of a training course model with mobile elements;
- determination of criteria for the share of use of mobile elements;
- statistical analysis of data from students' questionnaires on the use of mobile elements.

Expanding the model of the traditional course with movable elements will not only redistribute the teacher's working time from the development of new one-type tasks to scientific and educational activities but also add new forms of students' independent work, self-education, and self-control.

The model of the training course with mobile elements is based on the normative-target component (Fig. 2). Here the required competencies are determined, the tasks for the implementation of their formation are set. The substantive component of the model extends the traditional educational content with sets of presentations of lecture material. For practical exercises, sets of the same type of tasks are required. To do this, a file with job templates and a file with specific values of the template fields are placed in the cloud storage. The student is assigned a certain set of specific values, the combination of which with the template allows generating a unique case.

The technology component of the extended model is represented by various conferencing platforms: Microsoft Teams, Zoom, etc. The use of such platforms allows you to switch to remote work at any time without changing the course structure. Within the framework of the platforms, it is possible to conduct lectures supported by presentations, practical exercises using task tuples from cloud storage, surveys, and online exams.

The test and score component, along with the criteria for assessing knowledge and sets of test items generated from cloud storage, contains tuples of computer tests (for example, developed using Google Forms), chatbots for preliminary testing of knowledge in the exam.

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The main problem of implementing the proposed model is to determine the proportion of using mobile elements in the training course. The transformation of individual components of the training course into a remote format should improve the quality of teaching, and not reduce the effectiveness of perception of the new.
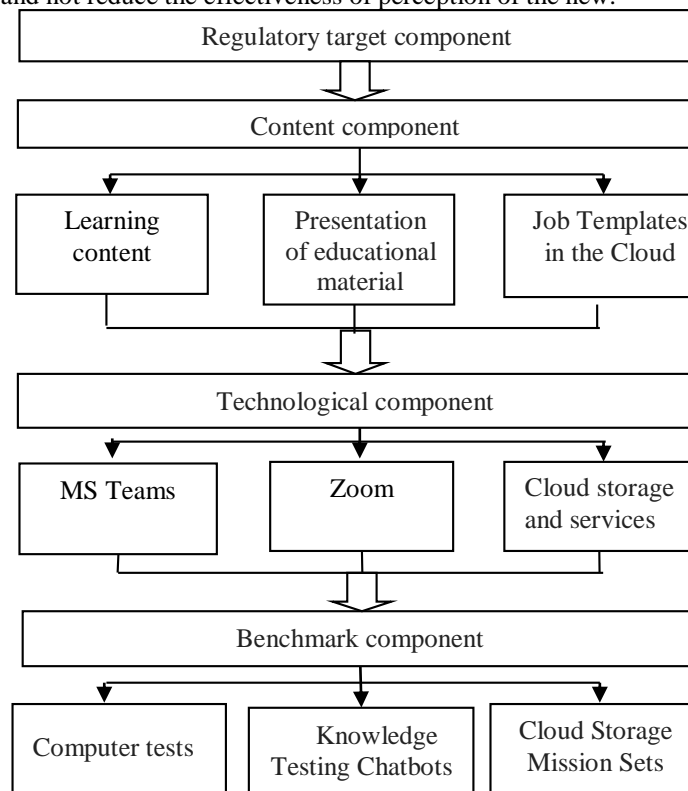
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┌─────────────────────────────────────────────┐
│           Regulatory target component          │
└─────────────────────────────────────────────┘
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│              Content component                 │
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┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│   Learning   │ │ Presentation │ │ Job Templates│
│   content    │ │of educational│ │ in the Cloud │
│              │ │   material   │ │              │
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│            Technological component             │
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│   MS Teams   │ │     Zoom     │ │Cloud storage │
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│             Benchmark component                │
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│Computer tests│ │  Knowledge   │ │ Cloud Storage│
│              │ │Testing Chatbots│ │ Mission Sets │
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Fig. 2. Curriculum model with mobile elements.

Let us highlight the criteria for the effectiveness of using mobile course elements:

- the level of the general and professional competence of students;
- the level of professional orientation, the student's attitude to the chosen profession;
- the level of educational motivation, the attitude of students to the studied discipline;
- the level of educational activity in the classroom;
- the level of mental independence;
- the level of creativity.

The combination of such substantive criteria is reflected, first of all, in the degree of academic performance of students. Besides, the approbation of the most used mobile elements of training courses was carried out during the period of self-isolation (spring semester 2020). Based on the results of training with students, a survey was conducted,

and then analysis and calculation of the effectiveness of distance learning were carried out. The main criteria assessments of students reflect satisfaction with the learning process, the individual significance of the results, and the achievement of the planned goal of the training course.

4   Materials and Methods.

On the example of the discipline "Programming Methods", read at the Kuban State University at the Faculty of Computer Technologies and Applied Mathematics in the areas 01.03.02 Applied Mathematics and Informatics and 02.03.02 Fundamental Informatics.

Let us briefly dwell on the features of the learning process in a remote format at the Faculty of Computer Technology and Applied Mathematics.

Lectures and practical classes were held on the Microsoft Teams conference platform (Kuban State University, hereinafter KubSU) and ZOOM (North Caucasus branch of the Russian State University of Justice, hereinafter SCF RPGUP), and for students of the University of Justice, corporate e-learning system "FEMIDA". Lectures were supplied with presentations, a virtual board was used. In practical classes, students received sets of generated assignments from cloud storage. For example, for the educational topic "Binary Search Trees" (KubSU), the following task template was located in cloud storage (further, for example, this topic was used).

Build a binary search tree containing integer values in nodes. Find $Z1$ nodes of the tree, the values of which are $Z2$, and then all $Z3$ $Z4$ with the found value. Print the resulting tree in $Z5$ traversal.

A fragment of the table of template field values that allows generating sets of tasks of the same type is as follows (Table 2).

Table 1. Sets of template values.

Z1	Z2	Z3	Z4	Z5
sum	Even numbers	leaves	To replace with	Direct
quantity	More than the number K	Interior nodes	To increase by	reversed
Product of numbers	Positive numbers	Odd node values	To decrease by	Interior
Sum	Double-digit	leaves	To replace with	Interior
Quantity	End with 3	three-digit node values	To replace with	Direct

So, using the first row of the table (assigned to a certain student) allows you to generate the task: "Build a binary search tree containing integer values in the nodes. Find the sum of the tree nodes whose values are even, and then replace all the leaves with the found value. Show the resulting tree in a forward traversal. "

Students received sets of individual assignments and demonstrated the solution process using a conference platform. Frontier testing was carried out based on sets of computer tests, as well as the performance of control tasks in a programming environment. At the end of the training course, students were given individual creative projects, the solution of which involved searching for additional information in electronic textbooks and the Internet, developing an algorithm for solving the problem, and its software implementation in a programming environment. The results of the execution were uploaded by students to cloud storage.

Before the exam, using a chatbot developed based on a neural network, preliminary testing of the theoretical knowledge of students in the studied discipline was performed. The exam in conference mode was conducted in the following form: question, reflection, answer. Thus, the final grade for the course was formed from three components: the result of creative practical work, the result of preliminary testing of theoretical knowledge, online conversation in conference mode.

Practical skills in a wide range of IT technologies are also necessary for humanitarian students (in this study, legal). The above methods and techniques of distance learning were used in the course "Information technology in legal activity" and "Legal informatics" for students of legal specialties.

In two universities of the city of Krasnodar (SCF "RGUP" and KubSU), a survey was conducted, the participants of which were students of legal and technical specialties. 328 people were interviewed, among whom 180 are studying at the Faculty of Law, 148 are getting an IT profession.

The purpose of the survey: to study the opinions or responses of students on the use of remote or distance learning and the introduction of a new paradigm of education in the future.

Students of IT directions after the course "Programming Methods", and law students, following the results of studying the course "Information Technologies in Legal Activity" / "Legal Informatics" remotely, were asked to answer some questions in "Yes/No" formats or on a scale -le: (-) worse, (0) no change, (+) better.

The questions are grouped into three main categories following the forms of pedagogical influence and reveal different characteristics of students' attitudes towards distance learning (Fig. 3).
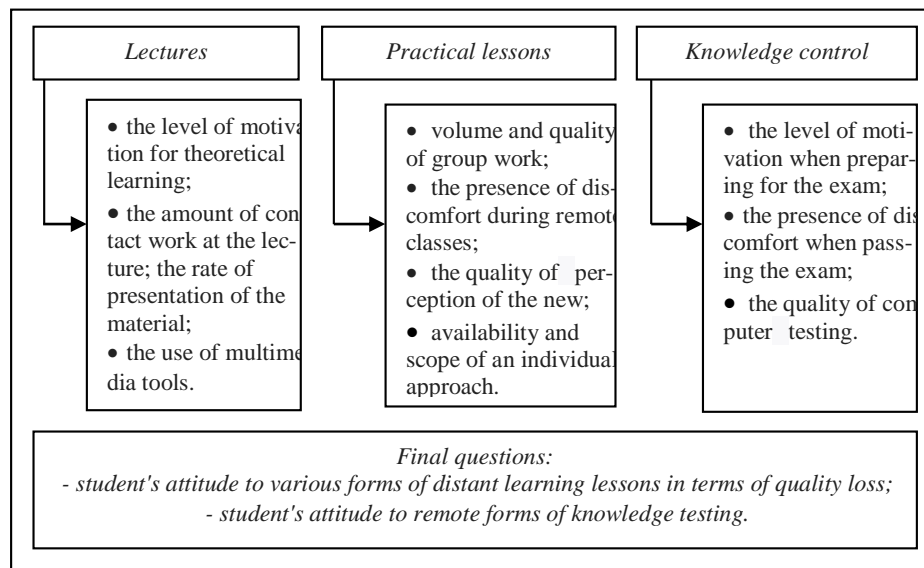
Lectures	Practical lessons	Knowledge control
• the level of motivation for theoretical learning; • the amount of contact work at the lecture; the rate of presentation of the material; • the use of multimedia tools.	• volume and quality of group work; • the presence of discomfort during remote classes; • the quality of perception of the new; • availability and scope of an individual approach.	• the level of motivation when preparing for the exam; • the presence of discomfort when passing the exam; • the quality of computer testing.

Final questions:
- student's attitude to various forms of distant learning lessons in terms of quality loss;
- student's attitude to remote forms of knowledge testing.

Fig. 3. Structure of the questionnaire.

The questionnaire offered to students is shown in Fig. 4, the numbering of the questions in brackets corresponds to the questions in the diagram below.

Dear Student!

You are invited to fill out a questionnaire that will help to adjust the volume of distance components in the training course "Programming Methods" / "Information Technologies in Legal Activity" / "Legal Informatics".

When answering the questions of the questionnaire, it is necessary to circle the items "Yes" or "No", in some questions you will choose one of the proposed answers.

	Question:		
1	Do you consider your level of motivation to lecture remotely sufficient? (1)	Yes	No
2	Is the share of your contact with the lecturer enough in the remote class? (2)	Yes	No
3	If the lecture was delivered in person, would you ask the lecturer more questions?	Yes	No
4	Is the pace of presentation of lecture material in remote form acceptable? (3)	Yes	No
5	Is it true that the use of the presentation during the lecture increased the acceptance of new material? (4)	Yes	No
6	Do you think that the level of your attention when presenting lecture material in a remote format is the same as in a face-to-face lecture? (5)	Yes	No
7	Have you experienced any discomfort in the absence of face-to-face communication with classmates in practical classes?	Yes	No
8	Do you consider the level of group discussion of the proposed tasks in remote class sufficient? (6)	Yes	No
9	Have you experienced any psychological discomfort while completing the task at the virtual board?	Yes	No
10	Assess the level of perception of new knowledge in remote learning in relation to full-time learning:	(-) in remote mode, perception is worse (0) did not change, (+) in remote mode, perception is better	
11	Estimate the share of an individual approach in practical training:	(-) below full-time, (0) no change, (+) above full-time	
12	Rate the level of psychological comfort when passing the remote exam.	(-) uncomfortable, (0) normal, (+) better than in person	
13	Do you think that the motivation for preparing a remote test / exam is not lower than for full-time study? (7)	Yes	No
14	Do you think that the quality of computer testing of knowledge identification is not lower than face-to-face conversation with a teacher? (8)	Yes	No
15	Do you think that the lecture course "Programming Methods" / "Information Technologies in Legal Activity" / "Legal Informatics" can be listened to remotely without losing the quality of knowledge assimilation? (9)	Yes	No
16	Do you think that practical training in the course "Programming Methods" / "Information Technologies in Legal Activity" / "Legal Informatics" can be conducted remotely without losing the quality of knowledge assimilation? (10)	Yes	No
17	Do you think that the exam on the course "Programming Methods" / "Information Technologies in Legal Activity" / "Legal Informatics" can be carried out remotely without losing the quality of checking the acquired knowledge? (11)	Yes	No

Fig. 4. Questionnaire.

5   The Results of the Survey Were Processed by Statistical Methods.

So, the goal has been set: to evaluate the new paradigm of the educational information space from the point of view of students, to study the attitude of young people to distance learning as a necessary phenomenon, to assess the demand in the youth environment of this format, to find a response or refusal, to receive a message what needs to be done and refined in the scientific, pedagogical, philosophical and social terms, so that the elements of distance education become useful for students and do not cause a decrease in the quality of education, a negative attitude in modern society: on the part of employers. on the part of young people, as well as on the part of parents.

The results of the statistical study are presented in Table 2.

Table 2. Results of student questionnaire results.

Question	Quantity of answers (%)			I_k
	yes	no	unchanged	
I. Lectures				
1	66,67%	33,33%		0,33
2	95,24%	4,76%		0,90
3	14,29%	85,71%		-0,71
4	95,24%	4,76%		0,90
5	85,71%	14,29%		0,71
6	38,10%	61,90%		-0,24
II. Seminars				
7	38,10%	61,90%		-0,24
8	71,43%	28,57%		0,43
9	38,10%	61,90%		-0,24
10	4,76%	52,38%	42,86%	-0,83
11	19,05%	14,29%	66,67%	0,14
III. Knowledge control				
12	9,52%	19,05%	71,43%	-0,33
13	61,90%	38,10%		0,24
14	33,33%	66,67%		-0,33
IV. Final questions				
15	71,43%	28,57%		0,43
16	80,95%	19,05%		0,62
17	47,62%	52,38%		-0,05

To analyze the results of the questionnaire, the percentage ratio and indices of satisfaction with the use of a remote learning format, introduced by analogy with the index of

satisfaction with the teaching profession, proposed by N.V. Kuzmina, were used. [eleven]. Each index is a value that can range from –1 to +1. We have considered the indices of satisfaction with distance learning for all sections and questions of the questionnaire. All indexes are calculated using Microsoft Excel.

In the first section, six questions make it possible to assess, from the student's point of view, the feasibility of using elements of distance learning in lectures. 95.24% of the respondents believe that contact with a lecturer in remote mode is not inferior to full-time training. 95% of students are satisfied with the pace of the lecture. The multimedia presentation of new information in lectures is supported by 85.71% of students. The index of satisfaction with the use of the remote mode capabilities in lectures (based on questions 2-5) is 0.81. Questions 1 and 6 revealed the level of motivation of students to work at lectures, the level of their attention. 61.9% of students noted that the level of attention with a remote lecture format is reduced. 33.3% are unable to motivate themselves to remote lecture work. Question 15 from the section "Final questions" showed that 28.5% of respondents do not believe that a lecture course can be attended without losing the quality of knowledge. It can be concluded that for students who are stably motivated to learn, the remote mode of lectures is not an obstacle to mastering new ones, however, a third of the contingent can significantly lose in the quality of acquired knowledge.

The questions of the second section are aimed at identifying the level of intragroup interaction of students in practical classes. The questions in this section make it possible to determine the degree of psychological comfort based on the self-assessment of students, the proportion of individual communication with the teacher, the level of group discussion of the assigned tasks. On average, 61.9% of the respondents believe that they did not experience discomfort during practical exercises on the conference platform, they took part in a group discussion of tasks and the course of solutions. 14.3% of the respondents indicated that the level of an individual approach to a student in practical classes has become lower, for 66% it has not changed. Only 4.76% of students noted that the level of perception of new knowledge during remote practical classes became lower than during full-time ones. The rest of the respondents either indicated an increase in this level, or its stability. To question 16 of the final section on the possibility of conducting practical classes remotely without losing quality, 81% of the respondents answered positively. In general, the index of satisfaction with learning in practical classes in remote mode is 0.53. Thus, the partial transfer of practical training in the field of technical areas of training to a remote format does not impede the perception of something new.

The third section allows you to determine the satisfaction of trainees with measures of knowledge control in remote mode. 71.43% of students did not experience psychological discomfort when passing the exam and passing the test remotely using a conference platform. However, 38% indicated that the motivation for preparing for the remote exam was reduced. 66.67% of the respondents believe that the quality of computer testing of knowledge is lower than a face-to-face survey of a teacher. Opinions about the possibility of high-quality remote e-replacement were almost equally divided (47.62% for and 52.38% against).

By questioning students-programmers and students-lawyers, it was found that the majority of them approve of the addition of the traditional form of presentation of educational material with remote forms. They show interest in this format, want to work with it, note the rationalization of cognitive activity due to the capabilities of conference platforms. However, using the remote mode is overwhelmingly practical. The introduction of a remote format can be considered as an additional form of group lessons. Lectures and oral examinations are of higher quality traditionally, using the capabilities of various multimedia and IT technologies.

Graphical interpretation of the survey results is shown in Fig. 5. The diagram contains data on the main questions of the questionnaire:
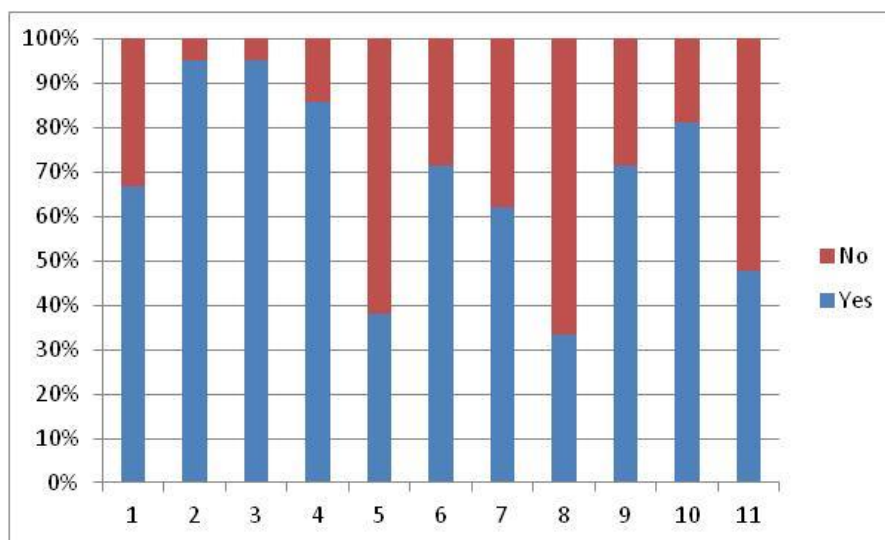

Fig. 5. Diagram of student questionnaire results.

It follows from the diagram that more than 50% of students have a positive attitude to distance learning and allow the use of certain elements of training in a similar format. Approximately 80% of respondents believe that practical training in remote form has many positive aspects. 50% do not consider the quality of the oral exam on the conference platform.

6   Results and conclusions.

The results obtained make it possible to say that an integrative approach to creating a new paradigm in education and a new filling of the educational information space has started in our society and requires not only scientific understanding and empirical verification but also legal assessment and state support. This approach allows the teacher and the student to have more time for self-development, skills improvement, and knowledge accumulation.

The absence of a complete denial of the integrative approach and the borderline result (40-50%) suggests that spontaneous immersion in the distance and/or remote forms of education as a response to the challenges of the current situation in connection with the pandemic can also be considered a positive moment on ways of forming a new integrative paradigm of educational information space and society.

The following conclusions can be drawn from the conducted research:

1. The proposed integrative model of the educational process makes it possible to preserve all the advantages of traditional education and to introduce mobile elements into the educational process, increasing its quality.

2. The new paradigm of the information educational process makes it possible to switch completely to distance learning forms very quickly (if necessary, the reasons for which can be different: from global to personal, for example, a teacher's illness or the need to participate in a serious scientific event) without losing the quality of the educational process. Moreover, the quality of the educational process and the quality of assimilation of the material, in this case, are not the same. Within the framework of this study, the task was not to evaluate the psychological aspects of distance learning and to rank students according to their motivation and responsibility for the process of their education.

3. Modeling the ratio of mobile and traditional content for each discipline and field of knowledge remains an open problem, the solution of which requires a separate study.

4. Each discipline of the educational cycle must have a 100% mobile version (the mobile version is educational and methodological material completely consisting of hypermobile or movable elements, there is no traditional form of material presentation), but it can only be specially used in this form as directed by the management of the educational institution.

5. The proposed integrative approach for the new paradigm of the information educational space can be applied to the state and legal regulation of educational activities.

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