

Digitalization of Modern High School in the Perspective of the Paradigm of Smart Education

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ABSTRACT

The article is dedicated to the problem of the transition of high school to a new paradigm of the formation of the information society by digitalizing the educational process. Readers are offered the results of an empirical study, aimed at answering the question of whether online learning really forms new educational attitudes for modern students, that correspond to the values of the information society - readiness for the autonomous production of knowledge and improvement of skills for solving non-traditional tasks, or students only go through this experience only as a more convenient, resource-saving form of study. In addition, studies assessed the social effectiveness of today's online education.

Basic provisions of the concept of smart education, the results of developments in the field of economics of higher education, elements of the theory of social representations, principles, and methods of the institutional tradition of the sociology of higher education were used as the methodological framework of the study.

The results of a set of sociological studies, undertaken to test the main hypothesis, are presented. The first was aimed at identifying the social ideas of digital education among students, who had never studied online. The second continues in the form of monitoring satisfaction and self-assessment of a student learning experience in specific online courses on the disciplines, included in the main educational programs of one of the leading technical universities in Russia.

The authors of the article revealed a great interest and generally positive attitude of students, regardless of the presence or absence of their corresponding educational experience in online learning. Most students of online courses noted, that it is more interesting and effective to study this way, however, classes in a traditional form provide more solid and clear knowledge. At the same time, whether is there a transition of higher education to the principles of a smart paradigm is being carried out at the present stage of the digitalization of higher education remains unclear. Firstly, there is no sufficient data on a significant increase in the effectiveness of educational activities. It is possible only to record the growth of student satisfaction with their academic performance. Secondly, there is a problem of self-organization of the system. Finally, the degree of readiness of students, who have completed online learning, to independently produce knowledge and solve non-standard problems is not clear. Rather, on the contrary, the more difficult the mastered professional discipline becomes, the more students need the help of a teacher. Hybrid formats are recognized as the most functional option for teaching students, especially senior courses of both levels of education.

Keywords: *sociology of higher education, smart education, digital educational environment of the university, online education at the university, the social effectiveness of education, social ideas of students about digital education*

1. INTRODUCTION

In the information society, the need for a new educational paradigm increases in direct proportion to the increase in individual attempts to explain what is happening in a computerized socio-pedagogical space. This tragic situation, created by the coronavirus pandemic, gives a particular edge to this need. A new educational paradigm in the conditions of world catastrophes, associated with the isolation of subjects of all spheres of human activity, can and should become the kernel, allowing to build a

hierarchy of priorities for teaching efforts, set clarity and validity to the requirements of the components of the educational process, and reduce uncertainty for all its subjects.

We dare to confirm, that there is no clear understanding of educational values, attitudes, criteria, and decision-making models, characteristic of the information society. Moreover, the key question is whether there can even be unity in understanding this, given the fragmentation and pragmatism of knowledge itself and the individuality of communication processes, that are characteristic of modern society. Nevertheless, the most accepted in the

professional academic community is the provision, that the central idea of the new educational paradigm is to shift the focus of education from the process of transferring/receiving knowledge to the cognitive activity of the student himself, increasing his ability to take independent actions when creating new knowledge and improving skills. This idea is proposed as an intellectual justification and a goal-setting vector for transition educational process in universities to a digital environment, because against the background of a noticeable increase in the attractiveness and accessibility of higher education, aggravating a problem of its massification, online learning formats are considered to be almost the only means of individualizing the learning process. Among the prerequisites, that form such a situation, economic, technological, and social are especially distinguished.

The dominant prerequisites for the transition of higher education to the digital environment are most often recognized as economic, associated with the assessment of the large financial costs of higher education. This topic has been developed in studies on the economics of higher education in the United States since the 1960s [1, 2]. The global trend of the late XX - early XXI centuries to reduce state funding for the HE system further strengthened the economic assessment of replacing learning sessions from offline to online formats. Back in 2012, the American research company ITHAKA, when assessing the economic consequences of the transition of learning programs to hybrid forms, concluded that the savings in the long term would be 36–57% [3].

However, these conclusions and statements are true only regarding the use of MOOC as a “live”, visualized textbook, supplemented by test procedures, for mass audiences. ITHAKA specialists obtained their results by introducing the number of students for one educational program into the model as a basic variable. Naturally, the rejection of restrictions on the number of students, attending the course, leads to lower costs. But is it possible to remove such a restriction in the case of an educational process, tending to individualization? Probably not. Rather, on the contrary, individualization will require narrowing the audience and / or attracting an entire team instead of one or two teachers.

In addition, researchers note, that in connection with the introduction of online courses, universities require new technical equipment and special training for teachers. This, in turn, will increase costs. It is confirmed, that the re-equipment causes costs only at a time, but it is worth noting, that digital technologies and the technology, that ensure them, are rapidly changing, and this puts users in constant resource dependence. Finally, the costs of online formats are constant due to the need for legal support of intellectual property [4], when creating and introducing new products into mass use.

All of the above casts doubt on the economic assessment of the advantages of the digital format in the transition to individualization of education. It can be confirmed, that economic reasoning is valid if, using online formats, higher education maintains a traditional paradigm in its

functioning, for example, introducing mass online courses in the practice of the educational process as digital transmitters of knowledge to large dispersed audiences. If the principles of activity in high school are changing in the direction of a new educational paradigm, including the individualization of studies, then the costs of education only increase.

The technological prerequisites for using digital formats to individualize higher education tracks look more obvious. The use of modern ICTs almost infinitely expands the possibilities of individualizing education. Firstly, they significantly facilitate the construction of non-linear, asynchronous educational tracks, which can be adopted both to the challenges of the environment and to the student's personal requests. Secondly, they create the conditions for the implementation of a multilayer educational process within a specific discipline, when the teacher can easily “build on” the material to the audience, based on the level of its preparation and preferences in the form of performing tasks [5] and stimulating it to independent learning.

At the same time, the technological leap generated a number of questions about the goals, role scenarios of the subjects of education, and the possibilities to assess the results of the functioning of the new educational environment. Along with the shift of goals, there have been changes in the repertoire of roles of subjects of teaching activities. So the teachers, who found their calling as lecturers, got access to a much larger audience, instead of focusing on the quality of education, strongly focused on improving the image components of teaching. As interviews with representatives of technical support of online courses during their design show, when designing them, far from all creator authors elaborate assessment methods, setting as their priority the attraction of a massive and branched audience, rather than checking the degree of students mastering the material. In this regard, there are several niches for the new roles of subjects of educational activity - the compiler and developer of control procedures, the moderator of group discussions on the network, the reviewer-consultant, etc. All new roles of subjects of teaching activity require specification of criteria for assessing quality and effectiveness.

The social prerequisites for the possibilities of using online education formats are associated with the “digital” lifestyle and social values of generation Z. University students most often become leaders of their generation in the digitalization of all spheres of life. Educational courses in a digital format support the value of freedom in the educational process, making its chronotope as accessible as possible. In the future, a certain part of students will choose an academic career - they will become teachers and are unlikely to change their attitudes and ideas regarding the familiar and seemingly most effective forms and methods of mastering knowledge.

The study of the prerequisites and conditions for digitalization of high school, firstly, showed, that for all the identified contradictions, it is inevitable due to the youth's sustainable choice of a “digital” lifestyle. Secondly, the result of this study was the formation of the

concept of smart education as a basis for a new educational paradigm.

Although the concept of smart education began to be discussed about 10 years ago, and the period of implementation of ICT in educational practices of universities is several decades, experts note, that the SMART concept has not yet been systematized and so far is an open interdisciplinary research field [6]. Sociologists of higher education contribute to the discussion, focusing on the functional capabilities and social dysfunctions of the current, responding to changes in the educational environment, determined by digital technologies. Sociological studies of smart education form, in particular, around the following issues. Can learning using information technology give results comparable to the results of the traditional model of higher education? Is there a difference in the effectiveness of learning in the traditional way - in the classroom compared to digital learning? What in the digital and traditional formats of the educational process should be assessed from the point of view of students? [3]

The article continues the sociological discussion about the socio-cultural and pedagogical features and effects of the digitalization of higher education and offers readers the results of an empirical study of the direct experience of online learning of students of a modern technical university in Russia. The main hypothesis of the study was to check whether online learning really forms students' new attitudes, that correspond to the values of the information society - readiness for the autonomous production of knowledge and improvement of skills for solving non-traditional tasks, that are independently set in response to changing external conditions, or whether students are going through this experience only as a more convenient, resource-saving form of employment. In addition, based on the idea of institutional sociology, that the social effectiveness of education is related to students' satisfaction and their level of confidence in possessing the mastered competencies, the purposes of the authors' study were satisfaction analysis from taken online courses and generalization of the results of their study.

2. METHODOLOGY OF THE STUDY

Working in the context of modern sociology of higher education, the authors integrated the provisions of several methodological approaches to the problem.

Firstly, developments in the field of higher education economics were considered (W. G. Bowen, W. J. Baumol). Particular attention was focused on discussions on the criteria and indicators of "productivity" of higher education, problems of increasing the availability of education, and activation of social mobility of talents in connection with online learning [7].

Secondly, the ideas of the theory of social ideas (S. Moscovici) were used to prepare the measurement procedures and interpret the results [8]. According to this theory, the structure of social ideas has three dimensions: the information plane and the planes of ideas and attitudes.

These structural components integrally influence the choice of patterns of behavior in a new social situation for an individual and determine the methods of his adaptation to it [9].

Thirdly, the provisions and principles of the institutional approach set the methodological framework (E. Durkheim, P. Berger and T. Luckmann, F. Collin). First of all, with its help, the composite structure of the concept of "effectiveness" of educational activity was considered. Such constituent parts as economic, organizational, pedagogical and social types of effectiveness were distinguished. Particular attention was paid to the operationalization of the concept of the social effectiveness of the educational process, as a result of which the following study objectives were set: a comparative analysis of students' preferences in the choice of various educational formats; assessment of student satisfaction with online courses and the results of their studies on them; identifying the problems and benefits of online learning.

As secondary sources, articles of experts in the field of digitalization of higher education and empirical studies on similar issues were used [see 10-13].

of membership queries than a smaller model. However, this is not proportion with the model size. The efficiency of our framework depends only on the time of a counterexample (indicate that the probabilistic safety property is violated) appears in conjectured assumptions. The earlier a counterexample appears, the more efficient our framework performs.

In Table 3, the component sizes of the M_1 and M_2 is also denoted as $|M_1|$ and $|M_2|$. The performance is measured only by total runtimes (Time), because both methods have the same amount of MQ if the model satisfies the properties. Because of the cost of early detection, we can find that our methods need to spend more time than Feng et al. [23] and cost grows with the model size. But compared with acquirement of optimization in Tables 1.

3. RESULTS AND DISCUSSION

To test the main hypothesis, the authors undertook a series of sociological studies. The first was aimed at identifying the social ideas of digital education among students, who had never studied online. The study was conducted at the beginning of the 2018-2019 academic year in the form of a questionnaire of first-year graduate students of one of the leading technical universities in Russia.

The second started in the 2018-2019 academic year and continues to be conducted in the form of monitoring satisfaction and self-assessment of student learning experience in specific online courses on the disciplines, included in the curricula of the main educational programs of the studied university (hereinafter referred to as monitoring). Written surveys are conducted at the end of academic semesters, starting from the 2018-2019 academic year. Students of all undergraduate and graduate courses are questioned, in which traditional classroom studies are

either fully / or partially (hybrid format) replaced by online analogs, developed by teachers of the same university.

In the 2018-2019 academic year full-time students of the first, second, and third years of undergraduate studies, as well as full-time students and distance students took part in the survey. Most of them learned online for the first time. Target audience in the 2019-2020 academic year composed of full-time students of the second, third and fourth year undergraduate and graduate students of the first and second courses, for many of whom taking online courses was not the first experience of digital learning.

As a result of the preliminary questionnaire survey and the first stages of monitoring, it was supposed to compare the students' opinions on the transition of higher education to a "digit" and identify dynamic tendencies in the change in their social ideas during the acquisition of online learning experience. In addition, it was necessary to obtain an assessment of satisfaction with the taken online courses and the effectiveness of learning them from respondents.

The results of a questionnaire survey of first-year graduate students in technical faculties, who did not have a systematic online learning experience.

The number of surveyed respondents, who did not have a systematic online learning experience, was 133 people, that is, about 20% of the number of first-year graduate students of the studied university. Graduate students do not

have a systematic online learning experience, but are generally positive about the digitalization of education, seeing the future behind it. They show, although passive, but a clear interest in online courses. At the same time, there is ignorance, and, as a result, respondents underestimated some resources of digital education. For example, the possibilities of returning and reviewing a video clip of a lesson, using forums for more active and differentiated feedback, etc. are underestimated.

The results of the first stage of monitoring (2018-2019 academic year). 438 respondents took part in the survey.

Identification of students' preferences in the choice of learning formats. As a result of comparing the respondents' attitudes to a traditional classroom, hybrid, and online formats, it was found that, regardless of the course, direction and form of learning, students prefer online formats (66%). Only 10% of respondents prefer classroom activities. At the same time, the following tendency is characteristic of full-time students: the older the students, the more they tend to a hybrid educational format and the less they prefer "net" online courses (see table 1) The majority of full-time and distance respondents find it difficult to answer regarding preferences regarding for choosing a learning format (45%).

Table 1 Preferences of students in choosing a hybrid learning format

Course of Study	I prefer courses that combine online classes with classroom lessons with a teacher, %	I prefer online courses, %
2	43	21
3	57	16

Answering the question about their desire to replace some of the disciplines with online courses or hybrid formats, about half of the respondents said, that they would replace 2-3 disciplines in a semester. Moreover, the older the students, the smaller the percentage of people, who want to replace classroom studies with online courses, and the greater the percentage of people who stand for a combination of formats. The introduction of hybrid formats for all disciplines of the semester was desired by a third of full-time and distance students (32%).

Assessment of students' satisfaction with various aspects of online courses and the results of their taking them. In general, it can be confirmed, that all respondents are satisfied with the studied online courses. The number of learning materials, involved in mastering the courses, was described by respondents as sufficient. The vast majority of respondents rated the level of tests and tasks as optimal. To identify the most significant aspects of the educational process in an online format, the respondents were asked

the projective question "If you had to prepare an online learning course, what would you pay special attention to?" The most important aspects for students of online courses are the clarity and consistency of the presentation of learning material; course usefulness for the specialty; course entertaining.

The last places in the hierarchy of importance were occupied by the appearance and diction of the teacher and feedback (fig. 1). It is interesting, that assessments of significant aspects of the online course of students and teachers-authors of online courses diverge. In an interview with the authors of online courses, which is part of the monitoring program and is carried out in parallel with student surveys, teachers are primarily concerned with how they present the material in terms of the image they create (diction, appearance on camera, etc.).

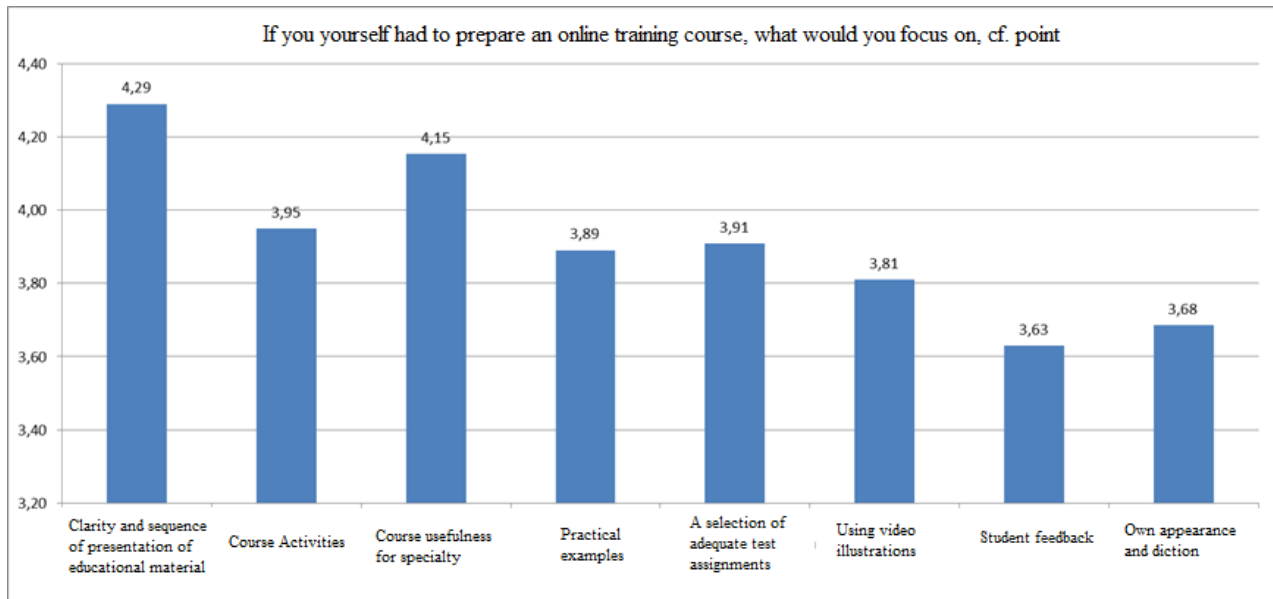


Figure 1 Hierarchy of importance of various aspects of an online course for students

Assessing the results of mastering online courses in the 2018-2019 academic year, most students called their knowledge level average. They expressed the opinion, that digital learning is more interesting and provides better

academic performance, but classroom learning provides more solid and clear knowledge of the subject (fig. 2).

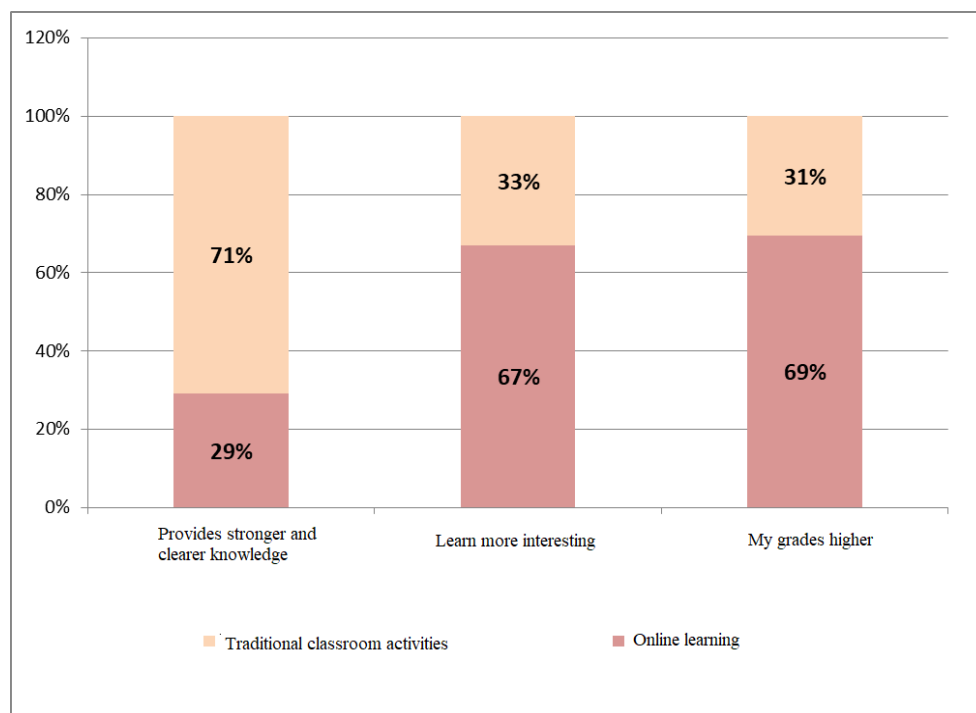


Figure 2 Comparative analysis of the capabilities of educational formats

An exception to the general distribution was the answers of full-time and distance students. They decided, that the solidity and clarity of knowledge, gained as a result of classroom studies and online learning, are about the same.

Identifying the problems and benefits of online learning. 27% of respondents in the 2018-2019 academic year called the inability to consult with a teacher as a problem of the online format (Fig. 3). This part coincided with the number

of students, who called feedback the most important component of online courses. 18% found it difficult to

focus on online tasks.

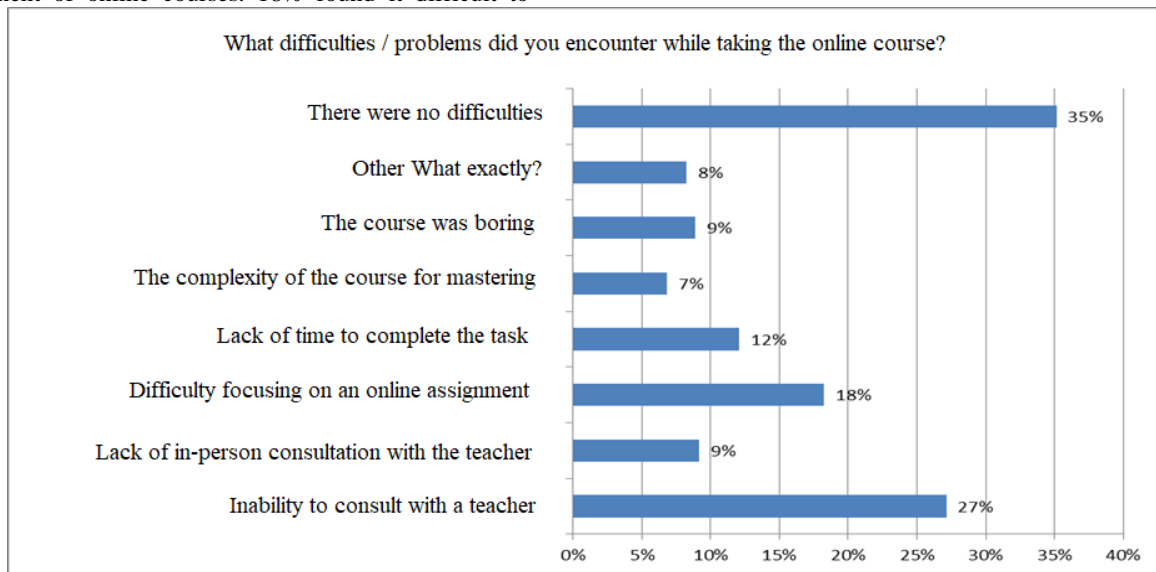


Figure 3 Problems associated with online learning

The results of the second stage of monitoring (2019-2020 academic year).

943 respondents of 2-4 undergraduate courses and 1-2 full-time graduate courses of technical faculties took part in the survey.

Identification of students' preferences in the choice of learning formats. Compared with the previous monitoring surveying, the part of respondents, who prefer online formats, compared to traditional classroom lessons, did not

change and amounted to 65%. 11% prefer to work in classrooms.

The tendency, identified at the previous stage of monitoring, was confirmed: senior students of both undergraduate and graduate programs prefer a hybrid format than other formats. Of the students, who prefer classroom studies, the largest part belongs to second-year undergraduate students (Fig. 4).

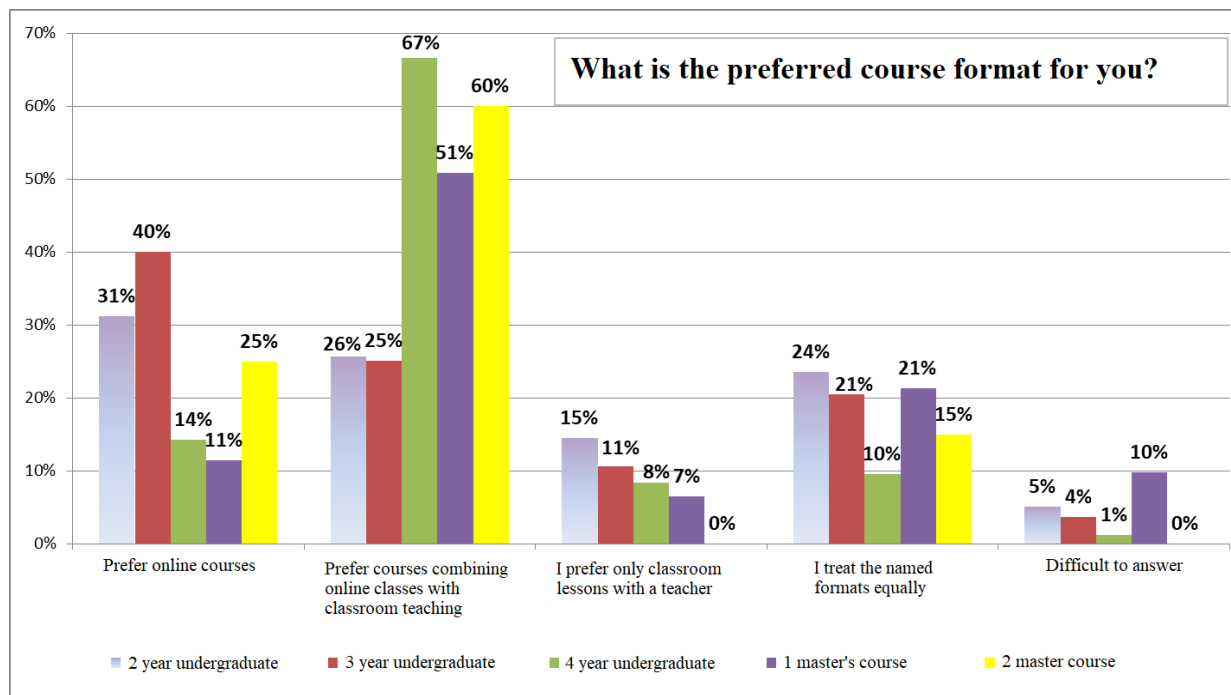


Figure 4 Preferences of students of various courses in the choice of learning formats

When answering the question about replacing or combining formats within the framework of the curriculum of the semester, respondents of the 2019-2020 academic year expressed a clear preference for online/hybrid formats over the classroom. The part of students, who want to

replace classroom studies in the framework of 2 - 3 or more disciplines with studies, containing online forms, is higher than a third, regardless of the course and level of study (Fig. 5).

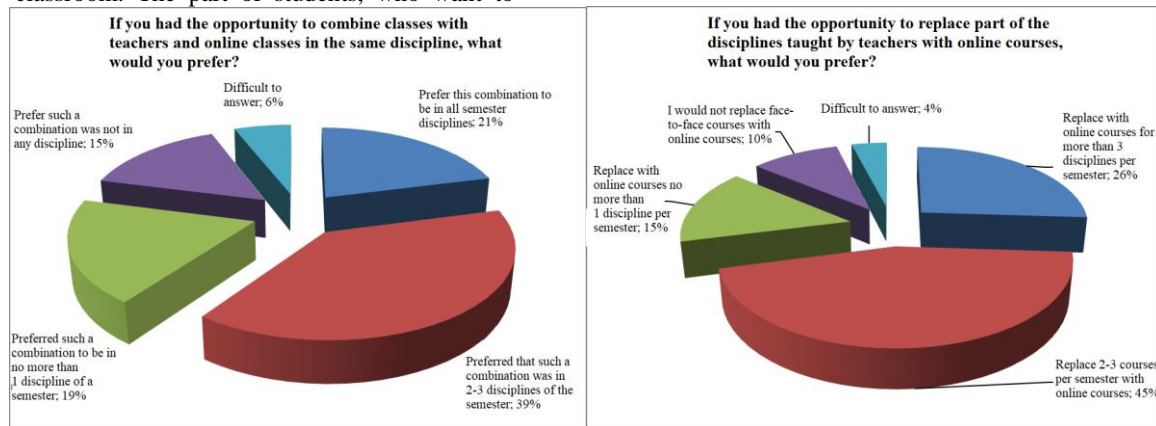


Figure 5 Students' opinion on the need to replace/combine disciplines with online formats

Assessment of students' satisfaction with various aspects of online courses and the results of their taking them. Before going to the description of the satisfaction and performance assessments, given by students after learning specific online courses, it is necessary to note a significant change in the nature of the sample of the second monitoring stage.

The part of respondents, whose online learning experience is first, is falling. In the 2019-2020 academic year it amounted to 44% of respondents, which is 17% less than at the previous monitoring stage. At the same time, the part of respondents, who have already had experience of online education increased by 18% and amounted to 56%. At the same time, the largest increase was achieved by the percentage of students, who received online education in the framework of the main educational programs, implemented at the university.

Respondents, who have already had the experience of online education note, that online courses were chosen not only on the basis of interest in the content of the course (32%) or a desire to more thoroughly understand the subject/topic (23%), but also because of the inability to study the discipline in a traditional classroom format (26%). This answer takes second place among specified reasons.

Compared with the previous surveying, the nature of the answers to the question about educational platforms, on which online courses were posted was also significantly changed. Even in the last academic year, the majority of respondents found it difficult to name such platforms. The distribution of answers directly indicates a growing awareness of students about digital education and expanding the experience of its use (Fig. 6).

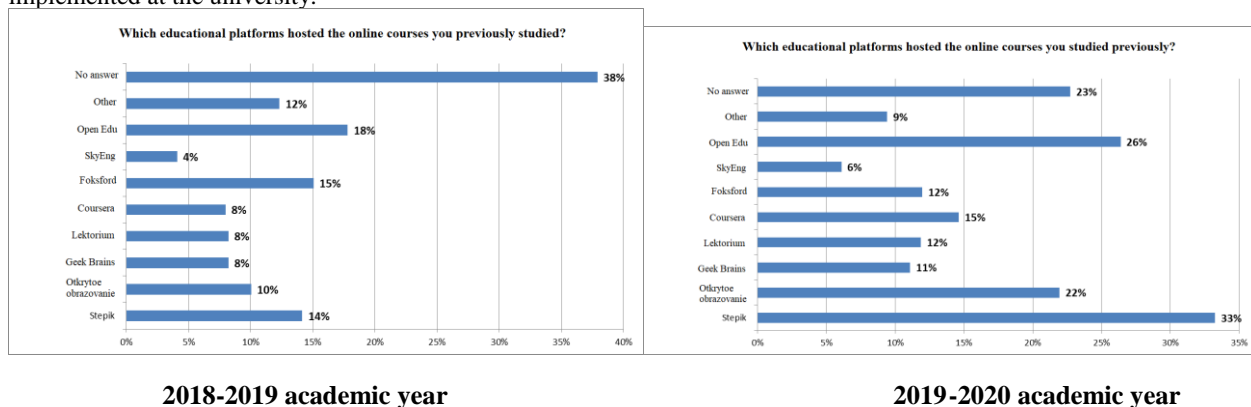


Figure 6 Educational platforms known to students

Changes in the nature of the sample made it necessary to pay special research attention to the differences in the responses of "experienced" and "inexperienced" respondents and to distinguish the corresponding target audiences for this. The "experienced" category included

mainly 4th-year undergraduate students, who had the experience of online learning in the previous year. A group of "inexperienced" were second-year undergraduate and first-year graduate students.

Respondents 2019-2020 academic year still mostly satisfied with the taken online courses. The majority of respondents at this stage of monitoring also rated the level of tests and tasks as optimal. At the same time, assessments of the amount of learning materials, involved in mastering the courses, were not the same. Satisfaction with the amount of learning materials was mostly demonstrated by "experienced" students of online courses. While, about a third of first-year graduate students, i.e. making up a group of "inexperienced" respondents, reported that there were not enough learning materials.

Answering the projective question "If you had to prepare an online learning course, what would you pay special attention to?", Respondents in the 2019-2020 academic year for the mostly demonstrated the same hierarchy as those, surveyed in the 2018-2019 academic year. However, differences in responses were demonstrated by both "experienced" and "inexperienced" respondents. "Experienced" among the most important characteristics of the online course put the use of practical examples in the course in second place after the clarity and consistency

of presentation of the material and did not put course entertaining into the list of significant. "Inexperienced" called feedback as important characteristics.

Assessment of the results of mastering online courses in the 2019-2020 academic year also became differentiated. On average, students called the level of mastered knowledge medium. However, about 30% of "experienced" respondents rated the level of gained knowledge as high. The difference in the answers of "experienced" and "inexperienced" respondents to a question, associated with comparing the capabilities of formats is of interest. If the opinion, that digital learning is more interesting and provides higher academic performance in these groups is the same, then the opinions about which formats give more solid and clear knowledge of the subject are clearly different. Figure 7 shows the answers of respondents, who studied in the same discipline, but at different courses. At the same time, fourth-year undergraduate students have already had experience of digital learning a year earlier, and first-year graduate students in the vast majority have not.

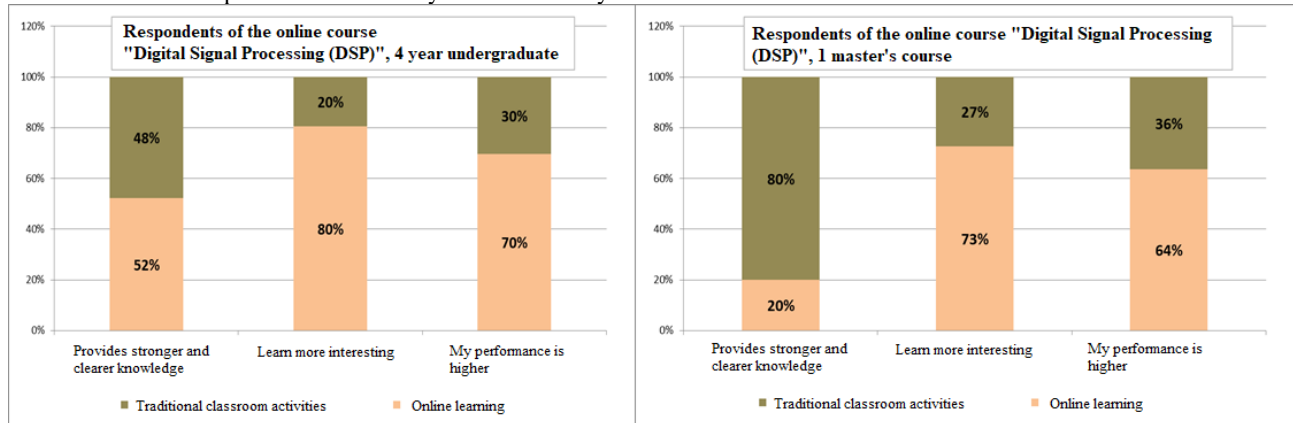


Figure 7 Comparative analysis of the capabilities of educational formats

In addition to the presented distribution, some answers to open questions were noteworthy. For example, the following answer of a fourth-year undergraduate student of one of the technical faculties: "I believe that mastering the course without feedback from the teacher is suitable for people, who do not plan to further engage in this area or people, who already have some technical education, to form a big picture of subject"

Identify the problems and benefits of online learning. The most acute problem of online learning, as in the previous surveying, respondents of 2019-2020 academic year called the inability to consult with the teacher. In second place was the problem of lack of time to complete tasks. In connection with the latter, would like to note, that these answers were given against the background of the fact, that students (as they themselves noted) spent on online learning only 1/5 of the time, spent on the learning process weekly.

As the benefits of online learning, respondents of both the first and second stages of monitoring called the

opportunity to take the course at a convenient time and convenient place and to revise learning materials.

The results of the conducted studies reveal a number of paradoxes of digital learning in universities and, thus, open the following discussion topics:

- against the background of a clear preference for online learning formats over classroom ones, regardless of the presence or absence of relevant educational experience, the older the students become, the more they tend to hybrid (rather than net online) formats;
- on the one hand, among the problems of online learning, students put in the first place the impossibility of consulting with a teacher, and on the other, a weak interest (or even its lack) in the wider possibilities of ICT in the field of feedback is revealed among students, which can be organized in a digital format both individually and in group mode, without and/or with the participation of a teacher;
- online learning attracts students with its autonomy, independence from the educational chronotope, but at the same time, respondents put the lack of time to complete

tasks in second place among the problems arising from this learning mode.

4. CONCLUSION

In the conditions of the ever-increasing competitive struggle of universities “for a student”, and given the natural choice of a “digital” lifestyle by young people, the transition of higher education to a “digital” seems inevitable. The results of the studies, presented in the article, confirm the interest of young people in online education and their willingness to independently find useful courses in this format. Moreover, in the growth of online educational experience, regardless of whether it was forced or free, students tend to consider the results of such learning more confident, and study more interesting. If during the first experiment in an online course they are interested in its entertaining and visibility, and the solidity and clarity of the gained knowledge are attributed to traditional forms of education, then over time the attitude changes and the idea of an online course as an entertaining and frivolous game transforms into its perception as an ordinary academic discipline. The same requirements, as for traditional courses, are beginning to be imposed on it, for example, the need to fill learning materials with practical examples.

At the same time, whether there is a transition of higher education to the principles of a smart paradigm is being carried out at the present stage of the digitalization of higher education remains unclear. Firstly, there is no sufficient data on a significant increase in the effectiveness of educational activities. It is only possible to record the growth of students' satisfaction with their academic performance, perhaps due to the ability to answer the control tests several times. Secondly, there is a problem of self-organization of the system. Its main participants - students indicate difficulties in the skills of independent time allocation and organization of knowledge development forms without the participation of a teacher. Finally, the degree of readiness of students, who have completed online learning, to independently produce knowledge and solve non-standard problems is completely unclear. Rather, on the contrary, the more difficult the mastered professional discipline becomes, the more students need the help of a teacher.

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