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EXPERIENCE AND RESULTS OF DISTANT AND BLENDED LEARNING IN GENERAL TECHNICAL DISCIPLINES

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Abstract

The article is devoted to the practice of usage mixed and distance learning in general technical disciplines. The expediency of using mixed learning in the process of general technical training is shown and also the relevance of lecturers' consolidated approach to the choice of content and complex of forms, means and methods of blended learning is demonstrated. A review of scientific and methodological literature of blended learning technology is carried out. The main point was determined in the course of the study, furthermore the choice was substantiated, and the essence of the implementation of the blended learning rotational model in general technical disciplines was revealed. The experience of transition from blended learning to distance forms of educational process organization is shown. The main means and level monitoring methods of general technical training are investigated. Also, the transition results from blended learning to distance learning of general technical disciplines are shown in the example of the field of study "Agroengineering". The analysis of pedagogical results showed the ineffectiveness of full distance learning in general technical disciplines.

Keywords: Blended learning, distance learning, learning monitoring, general technical disciplines

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1. Introduction

Nowadays, the usage of blended and distance learning technologies in the educational process is being actively introduced and discussed. There are several reasons for this. On the one hand, this happens due to the state policy of actively introducing information technologies into education and informatization of all spheres of human life in accordance with the order of the Ministry of Education of the Russian Federation dated 12/02/2019 No. 649 "The approval of the target model of the digital educational environment" (Official Internet portal of legal information, 2019) and the decree of the President of the Russian Federation dated 09/05/2017 No. 203 "On the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030" (Presidential Executive Office, 2017). On the other hand, this is due to the transition to a two-tier educational system, which in turn significantly reduced the classroom hours in general technical disciplines. For example, in such disciplines as "Materials Science", "Theoretical Mechanics" and "Resistance of Materials" the lecture hours and hours allocated for practical and laboratory studies have been reduced by almost half. The limitation of time resources, which entailed the redistribution of the volumes of independent and classroom load, as well as the key role of students' general technical training in the formation of the basic, fundamental foundations of engineering.

The self-isolation regime announced in connection with the spread of coronavirus infection has greatly accelerated the process of introducing information and communication technologies into the education system.

2. Problem Statement

The problem of the transition from traditional methods of organizing the educational process to blended, and especially distance learning, is quite acute and it is connected not so much with organizational and technical capabilities, but with the pedagogical aspect of the application of such training (Bespalko, 2018).

Some authors note in their works a significant lag in the development and application of the pedagogical foundations of e-learning from the introduction of e-learning elements into educational practice (Yanchenko, 2016).

The technology of blended and distance learning, that provides lectures with new opportunities for the usage of information and communication technologies for solving various pedagogical problems, raises the question of choosing the most optimal from a pedagogical point of view, forms, means and methods of teaching (Vainshtein et al., 2019).

The key role of students' general technical training in the formation of universal polytechnic knowledge and skills (Lazar et al., 2020) actualizes the issue of choosing the technology for implementing blended and distance learning. The close interdisciplinary relationship of general technical disciplines requires a lecturer's consolidated approach in educational content selection, as well as a set of forms, means and methods for implementing blended and distance learning.

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3. Research Questions

During the research, the following questions were formulated:

- What are the criteria for choosing a general technical blended learning model?
- What forms, means and methods of implementing blended and distance learning are more optimal for teaching general technical disciplines?
- How has the usage of blended and distance learning influenced student achievement in general technical subjects?

4. Purpose of the Study

The aim of the study is to review scientific reseach in the field of implementation and justification choice of a set of forms, means and methods of organizing blended and distance learning, also to evaluate the effectiveness of the usage of blended and distance learning in general technical disciplines using the example of the field of study 35.03.06 "Agroengineering".

5. Research Methods

In this work, we used theoretical and empirical methods of scientific research. The theoretical method was used in the analysis of psychological-pedagogical and scientific-methodical literature of the research topic, analysis of regulatory documents, study and generalization of the pedagogical experience of blended and distance learning usage. The empirical method was used to analyze the results of students' educational activities in the process of blended and distance learning in general technical disciplines such as oral examination, testing, independent work and course design.

5.1. The essence and rationale for the choice of a blended learning model for general technical disciplines

Currently, in the scientific and methodological literature, issues of blended learning are widely discussed, but there is still no consensus on the definition of this concept. In Russian literature, there are different definitions for blended learning, such as hybrid, combined, mixed and integrated. Despite the discrepancies in the name and interpretation of the concept, most authors define blended learning as a combination of traditional (full-time) and e-learning (distance). Summarizing the accumulated experience, we defined the main essence of blended learning in general technical disciplines as a purposeful process of organizing educational and cognitive students activities, which is based on the integration of traditional and electronic forms of general technical training with using distance educational technologies and the priority of students' independent activity in solving general technical problems.

Nowadays, in foreign and domestic practice, there are several main models of blended learning. These models are similar to each other, but in the domestic models of blended learning, the specifics of russian education can be traced as it is shown a Table 1.

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Table 1. Models of blended learning in foreign and domestic practice

Blended Learning Model Name	Features of the blended learning model
Foreign blended learning models	
«Face-to-Face Driver» (full-time education)	The main training takes place in the traditional way, with the direct lecturer's participation, and e-learning is used as needed, as an auxiliary tool.
«Rotation Model»	Taking into account the specifics of the educational content, the time of traditional (contact) training and independent, using distance information technologies is distributed
«Flex Model»	The main curriculum is studied in the format of e-learning, with the remote support of the teacher and, as necessary, face-to-face consultations
«Self-Blend Model»	Students are given the opportunity to choose online courses in addition to the main curriculum
«Online Driver Model»	The main curriculum is implemented as online training, with the remote teacher's contact and the possibility of full-time testing and episodic consultations with the teacher
Domestic blended learning models	
"Rotation"	The curriculum is implemented using (alternating) various forms of training organization (full-time, distance, independent work, group work, research work, etc.)
«Flex Model»	The main curriculum is implemented in the format of e-learning, with distance and full-time teacher support, and the development of the discipline is regulated by individual routes, taking into account the characteristics of the student
"Own choice"	This model allows the student to independently build an individual educational route, choosing additional disciplines for study, which can be studied both offline and online.
Combined model	The model assumes a combination of existing blended learning models.

We selected a blended learning model for general technical disciplines, paying attention to such criteria as the level of students initial general technical training, types of educational activities performed by students, the degree of individualization of the educational process and the students readiness for independent educational activities, work experience of students and lecturers in the electronic educational environment and finally technical equipment (the availability of computers, laptops, tablets and a stable Internet).

Having considered all the listed criteria, we have identified the key factors that influenced the choice of a blended learning model for general technical disciplines: difficulty in mastering theoretical material; the large workload of solving general technical problems; low initial training of students and, as a result, their unpreparedness for independent (remote) mastering of the curriculum of disciplines; insufficient experience of the teaching staff in providing distance learning; low students equipping level with personal computers. Considering all these factors, the most acceptable model is the rotational one, where the teaching material is rationally distributed between traditional and distance learning.

Moreover, the rotational model "Inverted class" is of our particular interest. The main characteristic of the chosen model is that a face-to-face lesson, it can be either a lecture or a practical or laboratory lesson, is preceded by an independent study of educational materials using online resources, which is subsequently discussed and consolidated with lecturer during the lesson.

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5.2. Implementation of the blended learning model for general technical disciplines

Federal State Budgetary Educational Institution of Higher Education "Krasnoyarsk State Agrarian University" (FSBEI HE Krasnoyarsk SAU) creates all necessary conditions for the effective organization of blended learning, including development of e-learning provisions such as "Regulation on the organization of the educational process using e-learning and distance learning technologies" (FSBEI HE Krasnoyarsk SAU, 2015) and "Regulations on the functioning of the electronic information and educational environment" (FSBEI HE Krasnoyarsk SAU, 2020) which are regulated and stimulated the usage of blended learning in the educational process.

The lecturers of the department of general technical disciplines of FSBEI HE Krasnoyarsk SAU developed a general strategy for the implementation of blended learning in general technical disciplines (Noskova, 2018; Romanchenko, 2020). In this case the electronic courses of general technical disciplines in Learning Management System "Moodle" is the basical part of learning. The electronic course of the discipline has a certain structure, which includes an introductory part; theoretical material (interactive and video lectures, a list of references and reference materials, hyperlinks), tasks for independent work, a fund of assessment tools and remote communication. The priority direction of training is the orientation of teaching methods to the active independent work of students, for example performance of individual calculation and graphic tasks, research papers and course projects, participation in conferences and so forth. Students pre-study information in Moodle LMS in accordance with the rotational model. The teacher has the opportunity to track the students' activity during studies. All the necessary information and statistics for each student is available for viewing by the teacher online. An important point of blended learning is the systematic assistance to students in their educational and cognitive activities through the interactive communication organization between all participants of the educational process.

5.3. Organization of distance learning in general technical disciplines

The learning experience during the COVID-19 pandemic has shown the effectiveness of distance learning in general technical disciplines. The first semester students studied face-to-face according to a mixed model, and in the second semester they were forced to switch to distance learning.

And now came the great question: how to ensure the maximum efficiency of the educational process in the context of full distance learning? Conducting lectures in various forms (face-to-face, distance, video lectures) does not cause difficulties, although, the organization of practical and laboratory classes is very difficult.

Practical training in general technical disciplines is, as a rule, the solution of applied problems. The lecturers of the department have developed teaching aids and guidelines for solving general technical problems in all disciplines. Videos have been created to solve complex problems. However, the level of mastering the educational material and completing assignments turned out to be low. In part, this issue was resolved by the choice of effective communication tools that allow to quickly resolve emerging issues (forum, chat, e-mail, Skype, Zoom and social networks).

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It is not always possible to carry out laboratory work in a remote format, as laboratory equipment is very often required. Currently, virtual laboratory work is actively discussed in scientific and methodological literature.

However, the developed specialized software systems (virtual laboratories) require significant financial investments and not all educational institutions have the opportunity to purchase them. For laboratory work in such disciplines as "Theoretical Mechanics", "Resistance of Materials", "Theory of Machines and Mechanisms" and "Machine Parts" the lecturers of the department prepared tasks for conducting a computational experiment using applied programs which are available to students.

5.4. General technical training monitoring

The assessment of students' progress in general technical disciplines was carried out with the help of tests, presentations of practical and laboratory work, oral exams and presentations of a course paper.

The estimation of the educational material assimilation according to the test results was carried out on two levels of assimilation: the level of memorization and the level of understanding and application.

For such assessment, tests have been developed for all discipline educational modules, focused on different levels of mastering the educational material.

Figure 1 shows an example of two test tasks with different levels of material assimilation, in which student should determine the degree of mobility of a flat mechanism. The first test task (Figure 1, a) refers to the first level and is used to test knowledge of the formula, the second test task (see Figure 1, b) refers to the level of understanding and is used to test the ability to apply knowledge of the formula in practice. The first test task (Figure 1, a) refers to the first level and is used to control knowledge of the formula, and the second test task (Figure 1, b) refers to the level of understanding and is used to control the ability to apply knowledge of the formula in practice.

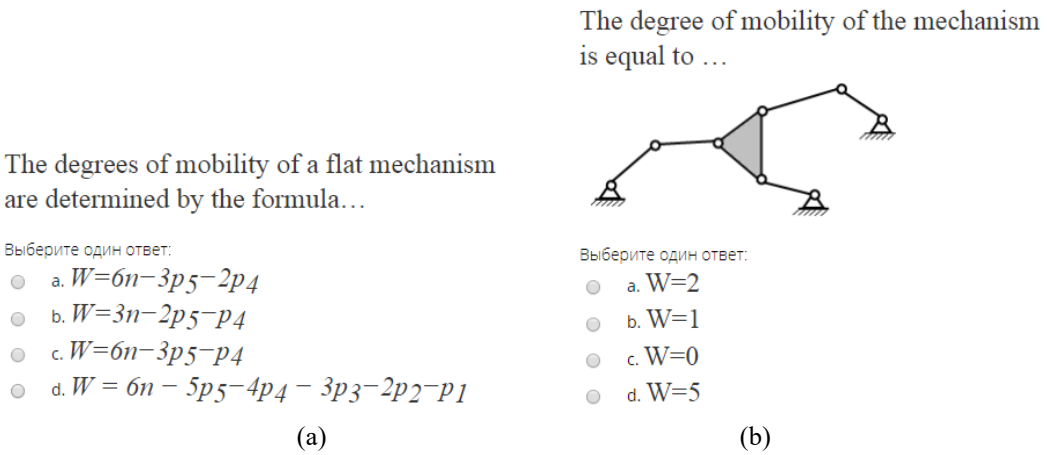

Figure 1. Sample test questions

The organization of such monitoring for each educational module of the discipline allows to identificate students' problems in understanding the educational material. The purpose of such monitoring is to determine the structure of knowledge and skills and timely adjust student's educational activity (Zyryanova & Polinovsky, 2020).

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In the spring semester, control events were held in a traditional format: examinations and presentations of practical and laboratory work, full-time coursework and remote testing in Moodle LMS. In the fall semester, all control activities were carried out remotely in Zoom in the form of an interview and in Moodle LMS in the form of tests.

To assess the dynamics of students' progress in general technical disciplines, four levels are allocated: unsatisfactory, low, medium and high. The level of a student's preparation was determined by the average score for all control activities of the studied general technical disciplines on a 5-point scale: excellent - from 4.5 to 5 points; good - from 3.6 to 4.4 points; satisfactory - from 3 to 3.5 points; unsatisfactory - below 3 points. The test results were also evaluated on a 5-point scale. The high level corresponded to 90–100% of correct answers, the medium level - 72–89% and the low level - 60–71%. The overall students' progress in the field of study "Agroengineering" for the 2019-2020 academic year as a result of blended learning in general technical disciplines is shown in Figure 2 (Bezyzvestnykh & Smolyaninova, 2017).

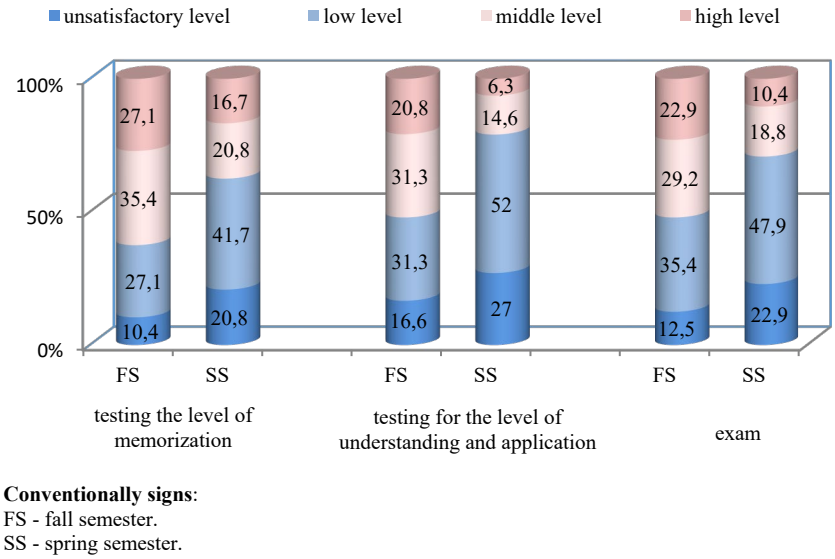

Figure 2. Results of general technical training of students for the 2019–2020 academic year

The Figure 2 shows the level of mastering the material for three forms of knowledge control: testing the level of memorization, testing for the level of understanding and application and exam. When full-time and distance learning are conducted in the spring semester, the level of mastering the material in all forms of control is significantly higher than in the autumn semester, when only distance technologies were used.

6. Findings

A generalized analysis of the students' progress in the field of study "Agroengineering" in general technical disciplines showed a negative dynamic in the quality of general technical training as a result of the transition to distance learning.

The number of students with a high level of understanding and application of general technical knowledge and skills has significantly decreased (from 20.8% to 6.3%) and the number of students with an

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unsatisfactory level has doubled. Testing showed lower results in determining the level of understanding and application of knowledge and skills among students than the level of memorization.

This means that students just memorize theoretical material without any comprehension and understanding, and, as a consequence, they are unable to apply this knowledge in practice when they need to solve general technical problems.

7. Conclusion

The analysis of the results showed the ineffectiveness of distance learning in general technical disciplines. The usage of distance learning in fundamental disciplines, which include general technical disciplines, is unacceptable and harmful, moreover, it critically affects the further professional students development in engineering fields of study.

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