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INDIVIDUAL LEARNING OF STUDENTS WITH DISABILITIES BY MEANS OF INFORMATION TECHNOLOGIES

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Abstract

Nowadays one of the urgent problems of higher education is its accessibility for students with disabilities. It is the question of logistics as well as of educational resources. In order to solve this problem, the paper suggests using electronic courses adapted for this category of students in the teaching process. The approach of individual learning defined by the authors allows revealing the possibilities of electronic courses at each stage of teaching process (preliminary stage, educational stage and final stage). The task of university teacher is to adapt the resources of electronic courses taking into account individual and psychophysical characteristics of the health of students. Assessment of the effectiveness of individual learning of students with disabilities by means of information technology was carried out through the formation of educational and cognitive competence on the basis of natural science disciplines. As a result, the experimental work given in the article proves the effectiveness of the proposed methodology.

Keywords: Students with disabilities, individual learning, information technology, e-learning.

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1. Introduction

In 2016 a large-scale campaign was launched to ensure the accessibility of buildings of educational institutions and their educational services for disabled people. The Order of the Ministry of Education and Science of the Russian Federation № 1309 from 09.11.2015 approved the Procedure for ensuring the availability of facilities and services for people with disabilities in the sphere of education, as well as providing them with the necessary assistance. Higher educational institutions are not yet sufficiently targeted at students with disabilities but it is worth noting that more and more universities are paying attention to the problem of access for this category of students to education (Bayramov et al., 2018; Naumova et al., 2019). Therefore, nowadays more students with health problems enter the higher education system.

2. Problem Statement

One of the most effective ways to increase social status and protection of a young person is to obtain education of high quality. Disability should not impede an opportunity to get complete education (Smolin, 2017; Zinov'yeva, 2016). The study of Zaitsev and Martynova (2002) is devoted to the problem of accessibility of higher education for disabled people; it reveals the socio-pedagogical side of the problem. The academic staff needs certain knowledge and skills to work effectively with this category of students (Zinov'yeva & Bersenev, 2012). Many methodological recommendations consider theoretical and methodological approaches to the trajectory of teaching in the conditions university provides with. Besides, they dwell upon the theoretical, methodical and practical issues of the organization of the educational process and a system of complex psychological and pedagogical support for students with disabilities and students with HIA in the process of studying at the university (Aismontas et al., 2017; Asmakovets & Koziej, 2018; Bessarabova, 2012; Fedorova, 2011; Fomina, 2018; Zaitsev & Martynova, 2002).

3. Research Questions

The paper discusses theoretical and methodological issues of organizing the learning process of students with disabilities. The problem of accessibility of education for this category of students can be solved with the help of an individual educational trajectory by means of information technologies in the framework of e-learning.

4. Purpose of the Study

The purpose of this study is to verify and justify the effectiveness of the use of information technology in condition of person-centered approach in the process of teaching students with disabilities.

5. Research Methods

The learning of students with disabilities has a number of characteristics and should be organized in relation to their needs (Samokhin et al., 2016). According to the Federal Law "On the Social Protection of People with Disabilities in the Russian Federation" the state guarantees the necessary conditions for

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disabled persons to receive education and professional training. These conditions are understood not only as benefits at admission to university and material conditions of learning, but also unhindered access of students to educational information. Therefore, it is essential to specifically develop and implement adaptive educational programs and methodological support for people with disabilities in the educational process. To achieve these aims it is necessary to use the means of information technology and to create unified electronic educational resources.

The system of learning with the help of information and electronic technologies is called *e-learning*. E-learning includes:

- independent work with electronic materials using a personal computer and other technical means;
- getting consultations, advice, assessments from the teacher, the possibility of remote interaction;
- creation of a distributed community of users (social networks) who have a common virtual learning activity;
- round-the-clock delivery of electronic training materials;
- standards and specifications for electronic learning materials and technologies and distance learning tools;
- development and popularization of innovative pedagogical technologies and their transfer to teachers;
- opportunity to develop web-based training resources;
- opportunity to acquire modern knowledge at any accessible site of the world at any time and in any place;
- access for people with disabilities to higher education.

Electronic learning includes electronic textbooks, educational services and technologies (Gil'mutdinov et al., 2008; Satunina, 2006; Shestak & Podzolkova, 2015).

To organize education of high quality it is essential to improve technical and methodological support of the educational process. We would like to draw your attention to the use of electronic courses for teaching (Kokova & Solov'eva, 2015, Solov'eva, 2011). Electronic courses allow students with disabilities to receive necessary information, communicate with teachers, build their own educational strategy of studying a particular discipline, pass an intermediate certification in a convenient form and at a convenient time. Thus, e-learning courses serve as an alternative to traditional teaching when students participate in the educational process not being physically in the educational institution.

For the creation of e-learning system for students with disabilities it is necessary to organize an unified informational and educational environment that allows students to get help in planning an individual educational trajectory. It contributes to the goal determination according to the knowledge, skills and abilities, formation of control and self-control to do independent work, the ability to use educational and methodological support.

It is essential to divide the process of teaching natural science disciplines to students with disabilities in the e-learning system into stages. In our opinion three stages should be distinguished (Figure 01):

1. The preliminary stage.
2. The educational stage.
3. The final stage.

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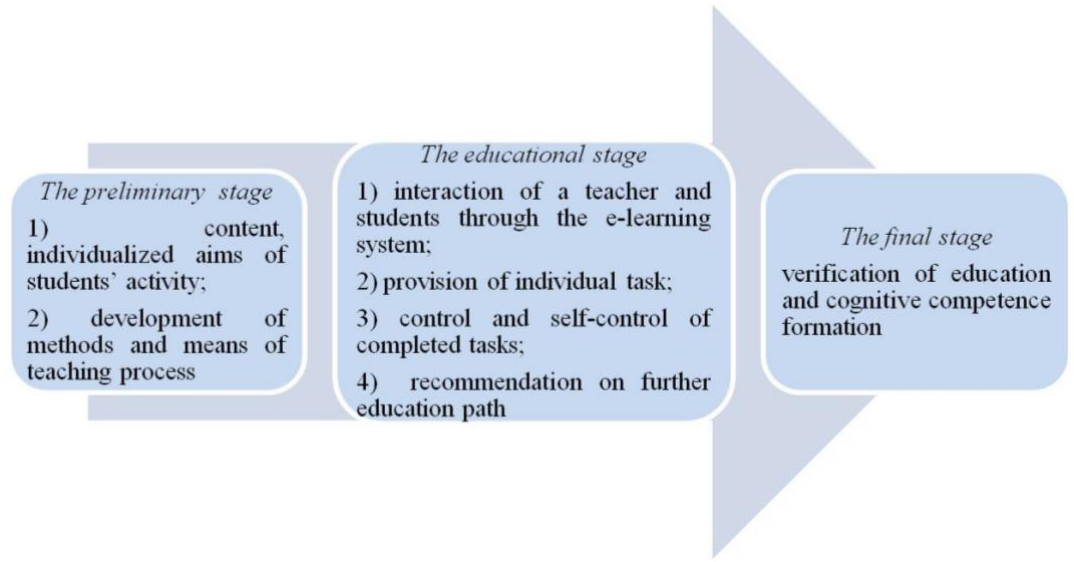

Figure 01. Stages of teaching students with disabilities

Let us consider the stages of creating methodology of individual learning for students with disabilities in e-learning system.

At the preliminary stage the functional capacity of health is assessed. At this stage student with disabilities go through interviews, conversations and tests. This data helps to collect information related to problems in learning process, accommodation, and way to get to the university. Analyzing the information received, specialists state the requirements for the electronic educational resource and educational programs for students with limited health opportunities and select methods and means of instruction. At this stage the teachers of the courses develop recommendations on the organization of the individual process and technology of teaching and also compile methodological recommendations on work in the e-learning system. These recommendations include:

1) information about work in the e-learning system;
2) information about the university teacher;
3) structure of the study course;
4) aims of the course;
5) procedure of studying course material;
6) procedure of sending independent works and test tasks;
7) hours of phone and online consultations;
8) other instructions.

In the process of creating individual learning strategy the professor should pay special attention to poorly mastered topics (for example, to include material for revision if it is necessary).

The use of electronic educational technologies in teaching people with disabilities implies the individualization of the content, methods, pace of the student's learning activity, teacher's ability to follow student's thoughts and actions in solving specific problems, and, if necessary, making the urgent changes to the performance of the student and the teacher.

At the educational stage we deal with the implementation of methodology of forming individual education for students with disabilities in the e-learning system. The electronic course contains educational

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material for learning divided into sections. Each section gives an idea of a particular subject of discipline and contributes to the individualization of the learning process. The roadmap (a plan of the course) for learning is one of the most important types of handouts for students studying remotely. Students turn to it to obtain accurate and clear information about the sequence of the study of the material. Reasonable presentation of theoretical material, clear formulations of definitions, examples of solving tasks are also of great importance. Each section incorporates a large amount of tests to check the level of knowledge of theoretical material as well as the skills of calculation and solving the thematic tasks. The system allows to the teacher to insert new questions and adjust existing ones. In addition, e-learning system enables the teacher to distribute individual tasks according to the methods of information perception of students: for people with visual, auditory or haptic perceptions. The students can work in self-test mode using the clues as well as in the control mode with the system of assessment. The test results show the extent to which the student has mastered various program topics. Due to the unlimited time the student can study a particular topic until it is fully understood.

Individualization of studying the courses with the help of electronic recourse is fully realized due to the variety of used means, methods and forms. E-learning system ensures design and implementation of independent work which is based on the individual characteristics of students with disabilities. The system of monitoring the process of interaction of students with the educational materials, which are included in the learning resource, will make it possible to increase the effectiveness of studying the discipline.

At the final stage of education self-check and control of the acquired and mastered knowledge and skills during the leaning period are important. The electronic system allows checking and assessing. In addition, the analysis of learning outcomes will help to develop recommendations for the learner in terms of further self-education.

6. Findings

The presented stages provide an opportunity to check the effectiveness of individual learning of students with disabilities by means of information technology. The study was conducted in Khakassia Technical Institute (a branch of SibFU) during the period from 2016 till 2018. At that time the school had about 30 students with disabilities on an average.

Within the study we put forward a following hypothesis: e-learning in condition of person-centered approach ensures the development of the necessary competencies through the teaching material of natural science courses both for students with disabilities and healthy students.

The hypothesis was tested with the help of the folded F-test. The choice of the criterion (φ^*) is due to the high reliability of the results obtained in the conditions of a small sample.

In order to provide evidence-based and scientifically objective verification of the correctness of the proposed hypothesis, experimental work has been carried out to adapt the developed electronic courses for students with disabilities. The purpose of the experimental work is an empirical confirmation (or disproof) of the hypothesis.

The pedagogical literature (Khutorskoy, 2017) singles out seven groups of educational competencies, one of which is a group of educational and cognitive competences. This competence is understood as the complex of the skills of the learner in the sphere of cognitive activity which includes

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elements of a logical, methodological, general educational culture. The structure of educational and cognitive competence includes knowledge and skills related to a range of real objects.

We singled out the following components ("circle of real objects") of natural science disciplines: 1. Informatics (number systems, representation and reading of data in different types of information models, information coding, methods for measuring the amount of information, data visualization, logic algebra, algorithmization and programming, databases, spreadsheets, computer networks); 2. Mathematics (complex numbers, determinants, matrices, vectors, systems of linear equations, line on the plane and in space, differential calculus of a function of a variable, integral calculus of a function of a variable, multiple integrals, several variables, series, field theory); 3. Physics (kinematics and dynamics of translational and rotational motion, oscillations and waves, electric and magnetic fields, wave and quantum optics).

The level of the development of the educational and cognitive competence on the basis of the study of natural science disciplines was verified with the help of "indicators" (Khutorskoy, 2017) – control-evaluation assignments (test tasks of a theoretical and practical orientation, individual calculation and graphic tasks, laboratory work, etc.).

In the experimental work two groups were selected: the experimental group (EG) of students with disabilities in an amount of 10 people and the control group (CG) of healthy students in an amount of 15 people. We chose two groups approximately of one level of knowledge for the experiment to be reliable. The criteria for the selection of groups were the results of unified state exam and entrance tests.

The performed calculations by means of F-test enabled to check the significance of differences in the level of knowledge (the "studied effect") between healthy students and students with disabilities in the electronic learning system by the end of the experimental work.

F-test is designed to compare two series of sample values according to the frequency of occurrence of the effect we are interested in. F-test measures the reliability of the differences between the percentage shares of the two samples in which this effect is fixed. The percentage shares are converted to the values of the central angle, the larger the percentage value corresponds to the larger value of the angle φ*. The larger the value of φ* the more likely that the differences are reliable.

Let us formulate the hypotheses:

H_0: The proportion of people in the group of students with disabilities who has the studied effect is not less than in the group of healthy students.

H_1: The proportion of people in the group of students with disabilities who has the studied effect is less than in the group of healthy students.

Then we draw up the so-called four-cell or four-field table which is actually a table of empirical frequencies for two values of the criterion: "there is an effect" – "there is no effect" (Table 01).

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Table 01. A four-cell table for calculating the criterion for comparing two groups of testees by percentage of those who passed the exam

	"There is an effect": the indicator – average, high levels		**"There is no effect": indicator – low level**		**Sum**
	Number of students	**% share**	**Number of students**	**% share**	**PPL**
Sample 1 (Experimental Group)	3	30.0	7	70.0	10
Sample 2 (Control Group)	5	33.3	10	66.7	15

We compare the percentage shares of the column "There is an effect" and determine the values of φ_1 and φ_2 in accordance with the Urbach's table of values φ which correspond to the percentage of each sample and calculate the empirical value of φ* by the formula (1)

$$\varphi^* = (\varphi_1 - \varphi_2) \cdot \sqrt{\frac{n_1 \cdot n_2}{n_1 + n_2}}, \quad (1)$$

where φ_1 – the angle corresponding to the higher percentage; φ_2 – the angle corresponding to the lower percentage; n_1 – number of subjects in sample 1; n_2 – number of subjects in sample 2.

We construct the "axis of significance" and compare the value φ^*_{emp} with the critical values φ^*_{chrit} (Figure 02).

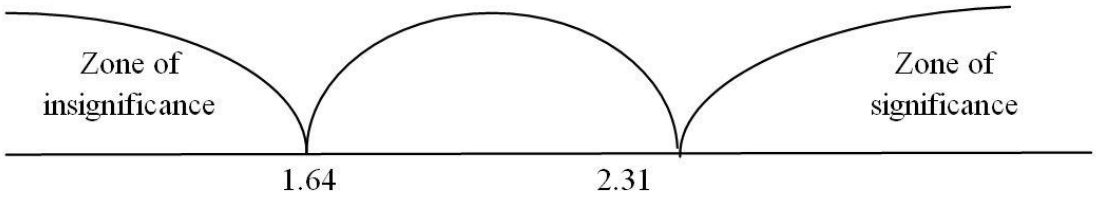

Figure 02. Axis of significance

If $\varphi^*_{emp} < \varphi^*_{chrit}$ than φ^*_{emp} gets into the zone of "insignificance of differences" and there are no grounds for rejection of hypothesis $\mathbf{H_0}$ at the significance level of 5% so $\mathbf{H_0}$ gets accepted. In other words, we can affirm with an error of 5% that there are no significant differences in the percentage shares of people with "effect" in samples.

If $\varphi^*_{emp} > \varphi^*_{chrit}$ or equal to the critical value than φ^*_{emp} gets into the zone of "significance of differences" and $\mathbf{H_0}$ gets rejected at significance level of 1% and $\mathbf{H_1}$ gets accepted, so it is possible to claim the significant difference in the shares of individuals with the manifestation of "effect" in the samples, namely percentage of individuals with "effect" in the first sample are larger than in the second sample.

If φ^*_{emp} gets into the zone of "uncertainty" we can claim a proved difference in the shares of people with "effect" in the samples at the significance level of 5% but this cannot be confirmed at level of 1%.

$\varphi^*_{emp} = 0.174$.

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The empirical value that we have got is in the zone of "insignificance of differences", therefore there are no grounds to reject the hypothesis $\mathbf{H_0}$ at the significance level of 5%. Consequently, the hypothesis $\mathbf{H_0}$ gets accepted.

7. Conclusion

Accordingly, we have obtained that in the experimental group of students with disabilities and in the control group of healthy students the shares of those who successfully passed the exam do not have significant differences.

Thus, the analysis of the obtained data confirms the effectiveness of the use of information technologies in the process of teaching students with disabilities. E-learning makes it possible to develop an individual approach to work with each student that positively impacts the learning results.

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