THE ROLE OF ELECTRONIC EDUCATIONAL RESOURCES TO INCREASE EFFICIENCY OF EDUCATIONAL ACTIVITY OF STUDENTS IN MATHEMATICAL DISCIPLINES

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ABSTRACT
The urgency of the problem under investigation due to the need to find new tools and techniques to improve the efficiency of educational activity of students. Electronic educational resources help to strengthen and expand the range of students' independent work, as well as improve the quality of their educational activities. The article studies the effectiveness of a combination of distance learning technologies, and traditional forms of education, in addition revealed the dignity of the use of electronic educational resources in the learning activities of students. The effectiveness of the combination of e-learning and traditional forms of learning grounded on the analysis of the semester students' progress and results of the examination on the subject "Mathematical analysis" application $\chi2$ criterion, calculating the Yule statistical factor. Electronic educational resources to develop students' ability to self-rule their own teaching and learning activities for high school teachers article materials may serve as a basis for a decision in favor of the use of electronic educational resources in teaching.

Keywords: *activation of independent work of students, electronic educational resources, mathematical analysis, the effectiveness of training activities, the criterion x2, Yule coefficient of association.*

INTRODUCTION

Currently, one of the main tasks of higher education is to prepare specialist, striving for continuous self-education and self-development. The solution to this problem lies not only in the transmission from teacher to students ready knowledge and skills, but also in the development of their preparedness to continuous learning, skills for independent search and use the information obtained. Therefore, students' independent work is a necessary foundation of the educational process.

In the study of mathematical disciplines most of the independent work is given to the solution of problems for each topic to consolidate the acquired knowledge and skills. It is clear that systematic self-study student is able to have an impact on the quality of its training activities .

Teaching experience shows that the independent work of students with textbooks is difficult because of the dryness of presentation of language, lack of control of mastering the knowledge and inability to work with literature. It is therefore necessary to find other forms of further education designed to bring students' independent work to a new level of development.

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One of such forms of training is e-learning. Electronic educational resources (ERR) are the backbone of e-learning. Electronic educational resources - an educational resource designed and implemented based on the computer technology.

Improving the quality and efficiency of educational activity of students is the aim of the introduction of e-learning. It determined the purpose of the study: how e-learning is able to activate the students' independent work, and, as a consequence, increase the effectiveness of their learning activities.

The problem of the use of electronic educational systems close to both domestic and foreign authors. In the works of A.V. Osin, T.V. Dorofeeva, L.M. Osadchaya, G.A. Bordovskikh, I.B. Gotskya, V. L. Vorontsova O. V. Druzhinina, O. N. Masina [1,2,3,4,5,6] notes the role of electronic educational resources in the educational process. There is a study on the positive experience of the use of electronic educational resources in order to develop the students' persistence in learning activities [7]. The scientific works of foreign colleagues can become familiar with new technical opportunities offered at e-learning, such as remote laboratories and remote experiments [8,9]. The need to strengthen distance learning in small rural US schools has been investigated in the works of De La Varre C, Keane, J., Irvin, M.J. [10]. There are a number of studies with a comparative analysis of the effectiveness of two types of learning (traditional and virtual) in high school [11,12]. In contrast to the foreign colleagues, in our study, a comparative analysis is performed between the traditional education and a combination of traditional and e-learning. Moreover, mathematical basis for the differences obtained in this study are used other statistical criteria and values. In our study analyzes the semester students' progress and the results of the examination on the subject "Mathematical Analysis". With the Yule coefficient Association installed a noticeable link between academic performance and type of training. The results obtained using $\chi 2$ criterion show significant differences of student performance after forming experiment by 95% .

THEORY

Currently, one of the most common forms of e-learning is a learning management system LMS Moodle. This is a freeware web application that allows each teacher to create their own e-learning courses on subjects and manage through the learning process. The peculiarity of applying the ESM is that due to the additional opportunities offered by it allows you to enhance and expand the range of students' independent work.

According to the research aims to study the increase of efficiency of educational activity at students with e-learning, at the Institute of Economics and Finance K(P)FU conducted formative experiment. The experimental base totaled 152 students (76 students in the experimental and control group), the first course of general economic department studying on a contract basis.

In the traditional form of "a lecture and practical session" learning activity carried out in the control groups. Traditional forms of education combined with e-learning in the experimental groups. In the first semester in the first year students of the department of general economic study discipline "Mathematical Analysis."

Titled "Mathematical analysis" electronic course has been created in this connection. This electronic course is divided into training modules, provides a complete interactive multimedia product aimed at acquiring specific educational topics. Electronic course contains in each module all the necessary training, support, control materials and methodical instructions.

In the study of discipline "Mathematical analysis" according to the curriculum, students are allocated 144 hours. Of these, 36 hours of lectures, 36 hours practical classes and 72 hours of independent work. Lectures and practical classes are held once a week. After each traversed theme, the students in the

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control group was given the job on their own and decide to give them a lecture to read and do certain exercises in a notebook. The students of the experimental group, in addition to the above, it was necessary to solve control tasks and take tests on the topic in the electronic educational resources. Students could once again browse the lectures materials, acquainted with analyzed examples, discuss on the forum solving tasks, ask a questions to the teacher on the educational resource.

In the control groups checking the students assimilation of the material was carried out by the form of surveys, solving examples at the blackboard and rare verification and tests. The experimental groups were evaluated and taken into account in the current ranking of academic performance results of the work carried out on the ESR. The current rating put down marks for the most complex tests, the remaining work was taken into account only, and if the job was not decided for a certain period, the rating stamped score zero. To encourage students to actively use e-learning home control tasks and assignments verification class works were similar. Through chats and forums conducted monitoring frequency and length of stay to students online, the number of actions made by them, online monitoring homework.

During the semester, students can gain from 0 to 60 points on a given academic discipline, of which 44 points are reserved to control classroom and independent work. Throughout the study, 16 verification and examinations works were carried out. In our study we shall consider only the results. A ordinal scale with four gradations is used to measure performance: low (0 to 11 points), medium (12 to 22 points), above average (from 22 to 33 points), and high performance levels (from 34 to 44 points). To justify incidental or consequential performance differences in the control and experimental group used statistical criterion x2. To establish the connection between the academic performance of students and the kind of learning rate was calculated Yule criterion .

RESULTS

During the year, we conducted formative experiment, after which a repeated measurement of the studied trait. All data obtained before and after the experiment in the control and experimental groups are shown in Table 1.

Table 1

THE LEVEL OF ACHIEVEMENT OF CONTROL AND EXPERIMENTAL STUDENTS GROUPS

BEFORE AND AFTER THE EXPERIMENT

The level of students' progress	The control group befor the experiment	The experimental group before the experiment	The control group after the experiment	The experimental group after the experiment
low	10	12	14	20
average	25	23	31	41
above average	29	30	26	15
high	12	11	5	0
Sum	M=76	N=76	M=76	N=76

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Visual analysis of comparative control and experimental groups before and after the experiment can be carried out using the graphs, bar graphs, diagrams, percentages. According to Table 1, it was revealed that before the experiment performance of the experimental group was assessed as follows: "low" -14.47% of the students, "average" - 39.47% "above average" - 30.26% , "above average" - 15.8% people.

In the control groups, respectively: "low" - 15.79%, "average" - 38.16%, "above average" - 32.89%, and "above average" - 13.16% of the total number of students.

When comparing data re-educational assessment on the results of the formative experiment revealed a positive trend on the achievement of students in the experimental group, as shown in table 2. In the experimental groups, the number of students with a "low" achievers decreased by 14.47% and amounted to 0%, with the "average" academic performance has decreased by 19.73% and amounted to 19.74%, with achievers "above average" increased by 23.69 % and amounted to 53.95%, with a "high" level of performance has increased by 10.52% and amounted to 26.32%, respectively, of the total number of people. In control groups, the number of students whose performance level was assessed as "low" decreased by 9.21% and amounted to 6.58%, with the "average" academic performance decreased by 3.95% and amounted to 34.21%, with achievers "above average "increased by 7.9% and amounted to 40.79%, with a" high "level of performance has increased by 5.26% and amounted to 18.42%, respectively.

In general, the total number of students with "high" and "above average" academic performance was 80.27% in the experimental group and in the control group - 60.21%. Visual analysis does not allow to draw a conclusion about the significance of differences in rates of the control and experimental groups. In turn, the statistical methods of data processing make it possible to quantify the educational phenomenon and conclude incidental or consequential of these differences after the pedagogical experiment. Checking the statistical significance is based on the use of χ2 criterion at a significance level α = 0,05 .

Empirical (observed) value of χ2 criterion for each case is calculated as follows:

$$\chi^2_{эмп} = N \cdot M \cdot \sum_{i=1}^{K} \frac{\left(\frac{n_i}{N} - \frac{m_i}{M}\right)^2}{n_i + m_i} \qquad (1)$$

Where ni - the number of students of the experimental group, having the i-th feature, mi - the number of students in the control group, having i - th characteristic. N and M - the total number of students of experimental and control group in the study .

In this example, we choose a significance level α = 0,05, that is, the possibility of error is 5%. Since the number of levels K = 4 (marked with four levels of achievement - "low", "medium", "above average" and "high"), therefore, the number of degrees of freedom of S = K - 1 = 3. From the statistical tables to get α = 0.05 and S = 3 critical χ2 crit.=7,8.

According to the formula (1) calculate all possible pairwise comparisons of the data of the experimental and control groups. So empirical value of observed criterion before the experiment of the control and experimental groups according to the formula (1) is as follows.

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$$\chi^2_{эмп} = 76 \cdot 76 \cdot \left(\frac{\left(\frac{12}{76} - \frac{10}{76}\right)^2}{12+10} + \frac{\left(\frac{23}{76} - \frac{25}{76}\right)^2}{23+25} + \frac{\left(\frac{30}{76} - \frac{29}{76}\right)^2}{30+29} + \frac{\left(\frac{11}{76} - \frac{12}{76}\right)^2}{11+12} \right) = 0{,}312$$

Comparing the empirical and the observed values of criterion χ2, we find that the χ2 emp/ < χ2 crit as 0.312 <7.8. Thus, students progress before the forming experiment is about the same.

We calculate the value of empirical criteria for the control and the experimental group after the conduct of the experiment. χ2 emp > χ2 crit, as 9,424 > 7,8. The reliability of differences of student performance after forming experiment is 95%. Thus, the researcher applied a pedagogical effect on the experimental group of students improved their performance on a subject as compared to academic performance of control groups of students .

Similarly, we can calculate the value of empirical criterion after the experiment to control and before it is held for the experimental group. In this case, χ2 emp = 3,832, χ2 emp < χ2 crit,, pedagogical influence was applied to a group of students, and therefore achievement of all students is about the same. The empirical value of the criterion to the experiment for the control and after to the experimental groups will χ2 emp = 23,667. χ2 emp > χ2 crit, так как 23,667 > 7,8, that is achievement of students of experimental and control groups are different.

To complete the study set the closeness of the relationship between student performance and the type of training. After a performance analysis for all 16 performed works, 2x2 contingency table was created. (Table 2). The first line of n11 - is the number of students of the experimental group, whose performance improved during the semester, n12 - those students who have a positive trend in performance is not revealed. The second line n21 - number of students in the control group with the positive dynamics in progress, n22 - without dynamics. For Table 2 Yule Association coefficient Ka was calculated as follows:

$$K_a = \frac{n_{11} \cdot n_{22} - n_{12} \cdot n_{21}}{n_{11} \cdot n_{22} + n_{12} \cdot n_{21}} \qquad (2)$$

Table 2

THE RATIO OF THE NUMBER OF STUDENTS WITH POSITIVE PROGRESS DYNAMICS

AND WITHOUT DYNAMICS

Event	The resulting event		Sum
	There are a dymamic	There are not a dymamic	
Traditional and electronic learning	32	44	76
Traditional learning	12	64	76
Sum	44	108	152

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Yule association coefficient and in this case is

$$K_a = \frac{32 \cdot 64 - 44 \cdot 12}{32 \cdot 64 + 44 \cdot 12} = \frac{1520}{2576} \approx 0{,}6$$

On a Cheddok scale get that link of the selected form of student achievement of learning and the dynamics of the discipline "Mathematical analysis" remarkable.

At the same time the observed value $\chi 2$: $\chi 2emp = N \times K2a = 152 \cdot 0{,}36 = 95{,}76$. From the statistical tables find the critical importance $\chi 2crit(\alpha, 1) = \chi 2crit(0{,}05, 1) = 3{,}8$. Since $\chi 2\ emp > \chi 2\ crit$, the value of the coefficient of association Ka is reliable and there is a relationship between the form of teaching and student performance.

CONCLUSION

In high school, great emphasis is placed on independent work, but freshmen until have not the skills and self-management of their time. Only with a systematic supervision of the teacher organization of independent work of first-year students is effective. Electronic learning capabilities allow to realize it. Purposeful character of tasks organized system of control and self-knowledge, the possibility of building individual educational trajectories of students, student orientation to the achievement of the final positive results allow to strengthen the independent work of students and improve the quality and effectiveness of learning activities. Indeed, in the experimental group with a total number of students "high" and "above average" academic performance was 80.27%, and in control group - 60.21%. Thus, the qualitative indicator of progress in experimental group up to 20.06%.

As a result of the winter exam session on the subject "Mathematical analysis" in the control groups of 10 students were in the exam evaluation "excellent" and 25 students - evaluation "good", that is 46% of the total. In the experimental groups, respectively, 15 people were in the exam evaluation "excellent" and 34 - "good", that is 64.5% of the total. Thus, the qualitative indicator of mastering the material of the course "Mathematical Analysis" in experimental group up to 18.5%.

Performance level before the start of the experiment in the experimental and control groups is the same, but differ with reliability of 0.95% after the end of the experiment. Therefore, it can be concluded that the effect of the changes on the performance of the subject matter for the students of the experimental group was due to the use of experimental methods of teaching .

The calculated association coefficient Ka has established a significant link between the optimal chosen combination of traditional forms of learning and distance learning technologies, and academic performance of students on the subject "Mathematical Analysis."

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