

# Students' Individual Work on Studying the Discipline «Mathematics Teaching Methodology» by Using Distance Technologies

## Trabajo Individual de los Estudiantes en el Estudio de la Disciplina «Metodología de la Enseñanza de las Matemáticas» utilizando las Tecnologías de la Distancia

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#### ABSTRACT:

The urgency of the problem set in the article is stipulated by the fact that over the recent years the role of information technologies in organizing students' individual work has strengthened. In this context, it is necessary to provide the educational process with electronic educational resources. The aim of the article is to organize individual work of students and to estimate its efficiency when mastering the discipline "Mathematics Teaching Methodology" by using distance technologies. The leading methods in researching this problem include the method of design aimed at selecting and structuring the content of the electronic

#### RESUMEN:

La urgencia del problema planteado en el artículo está estipulada por el hecho de que en los últimos años el papel de las tecnologías de la información en la organización del trabajo individual de los estudiantes se ha fortalecido. En este contexto, es necesario dotar al proceso educativo de recursos educativos electrónicos. El objetivo del artículo es organizar el trabajo individual de los estudiantes y estimar su eficiencia al dominar la disciplina "Metodología de la Enseñanza de las Matemáticas" mediante el uso de tecnologías a distancia. Los principales métodos de investigación de este problema incluyen el método de diseño destinado a

resource, as well as testing according to the estimation of the performed work efficiency. The developed resources include all required components for organizing and carrying out the students' individual work: study, control, and correction. The experiment made by teachers of the Elabuga Institute of the Kazan (Volga Region) Federal University and related to implementing the developed electronic resources in the educational process showed the importance and efficiency of applying distance technologies in organizing individual work of students.

**Keywords:** distance technologies, electronic educational resource, students' individual work, Mathematics teaching methodology.

seleccionar y estructurar el contenido del recurso electrónico, así como las pruebas de acuerdo con la estimación de la eficiencia del trabajo realizado. Los recursos desarrollados incluyen todos los componentes necesarios para organizar y llevar a cabo el trabajo individual de los estudiantes: estudio, control y corrección. El experimento realizado por profesores del Instituto Elabuga de la Universidad Federal de Kazan (Volga) y relacionado con la implementación de los recursos electrónicos desarrollados en el proceso educativo mostró la importancia y eficiencia de aplicar las tecnologías a distancia en la organización del trabajo individual de los estudiantes.

**Palabras clave:** tecnologías de la distancia, recursos educativos electrónicos, trabajo individual de los estudiantes, metodología de la enseñanza de las matemáticas.

## 1. Introduction

Training future teachers in the system of higher education must be based on the personality's creative development, ability to continuous self-improvement and self-development. At the present time the school needs highly qualified specialists who can transfer from one type of pedagogical activity to another. The modern teachers are required to have not only deep but above all systemized knowledge and skills. Distance technologies make a considerable contribution to organizing the educational process, because they provide access to higher levels of education.

## 2. Literature Review

The problem of using distance educational technologies is actively discussed in Russian and foreign research and methodic literature (Andreev, 2003; Polat, 2006; Khutorskoy, 2001; Burns; Stephens, 2007). These works consider peculiarities of using electronic educational resources (EER).

Other researches consider the problems of developing distance courses (Mironov 2015; Lyubimova 2015), implementing distance technologies in the educational process (Eremeeva, 2013), using distance technologies in organizing students' individual work (Anisimova, 2013; Muravyova, 2013), and diagnosing students (Sukhovienko, 2013).

Researches on teaching Mathematics and training Mathematics teachers have been remaining one of the actual problems over several decades. Herewith, the number of such researches has been increasing these years (Lerman, 2013).

Based on professional recommendations on integrating the science, technology, engineering and Mathematics in training of Mathematics teachers, the Delaware University developed the course of future Mathematics teachers using such Mathematical software as GeoGebra, Cabri3D and Mathematica (Flores, 2014).

The role of distance technologies when learning Mathematical disciplines in the higher educational establishment is increased because they act as an efficient didactic resource that allows to form individual educational trajectory of students. Such trajectory emerges as a result of selecting the personally important content of education, its complexity, type of tasks, their quality content, speed of learning, etc. (Ganeeva, 2014).

Herewith, to a great degree, the efficiency of training depends on peculiarities of organizing individual work by using EER as a tool that provides self-development and self-actualization of the trainee, which adds a special urgency to the set problem.

The work (Ualiyeva et al., 2016) considers theoretical basics of organizing competence-based individual work of students who study at the Department of Pedagogics and Methodology of Primary School, and defines the impact of self-education and self-development

on the development of professional competence.

Other researchers describe in detail the problems teachers face when estimating students' individual work (Huba & Ľapák, 2011).

The general goal of creating electronic educational courses is to improve the efficiency of mastering knowledge and quality of training specialists. In the system of full-time education electronic educational courses can be used as additional training resources that allow to methodically properly organize the students' individual work controlled by the teacher (Ganeev and Ganeeva).

The goal of the research is to provide results on organizing individual work of students of the Department of Mathematics and Natural Sciences according to area 44.03.05. Pedagogical Education (with two specializations) "Mathematics and Physics" of the Elabuga Institute of Kazan (Volga Region) Federal University (EI KFU). The discipline "Mathematics Teaching Methodology" studied in terms 5-7 is considered as an example.

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## 3. Methods

### 3.1. Participants and Procedures

During the research the following research methods were used: analysis of scientific literature on psychological and pedagogic, philosophical, mathematical, methodic and special aspects related to the area of research, analysis of documents and literature resources (decrees, concepts, programs); interviews, pedagogic observations, questioning of students and teachers, pedagogic experiment with the further mathematical processing of results, and designing of EER.

Pilot research was made on the basis of the Elabuga Institute of Kazan Federal University, the Department of Physics and Mathematics.

The main goal of the pedagogic experiment was to check out the presumptions of the hypothesis:

- Individual work of students in the higher educational establishment can be intensified and set on a qualitatively new level by implementing distance technologies,
- Organization of training by using distance technologies when studying the course "Mathematics Teaching Methodology" forms students' positive motivation to study, and improves students' activity and interest in the subject, and
- It is necessary to develop EER for efficient organization of training.

Stages of the research:

- During the first stage – preparation – the current state of the problem under analysis was analyzed in the pedagogic theory and practice; the methodology of studying elementary Mathematics by using information technologies was developed,
- During the second stage – basic – individual work of students was analyzed, its efficiency when mastering the discipline "Mathematics Teaching Methodology" by using distance technologies was estimated, pilot testing on checking out the efficiency of this model was carried out, and
- During the third stage – final – the research results were systemized, understood and generalized, theoretical conclusions were clarified, and the obtained results of the research were processed and documented.

The efficiency of computer-aided training resources to teach mathematical disciplines in a higher educational establishment (through the example of the course "Mathematics Teaching Methodology") was defined during the forming experiment.

The direct object of the forming experiment included changes of the size, character, and quality of knowledge, abilities and skills of students that took place under the pedagogic impact of applying EER developed in LMS Moodle. During the preparatory and stating stages of the pedagogical experiment, tasks on studying the state of the research problem and objective

opportunities of applying LMS Moodle for organizing individual work were studied.

We will shortly describe the main stages of the experiment.

### **Preparatory stage**

Tasks include:

- Analysis of psychological and pedagogic aspects of the research problem,
- Compiling the research bibliography,
- Selecting and stipulating goals of the research, and
- Studying the experience of teachers' work on the problem related to implementing distance technologies.

Methods: analytical, including:

- Analysis of references, psychological and pedagogic literature on the research issues,
- Studying and understanding modern forms and methods used in the pedagogic activity by teachers of the higher educational establishment,
- Studying the experience of students with EER for some disciplines of the higher educational establishment or using them during self-education,
- Studying the students' opinion on using distance technologies in education,
- Studying the experience of teachers on organizing students' individual work by using distance technologies and applying LMS Moodle during training,
- Studying the experience of informing students of the Department of Mathematics and Natural Sciences with the LMS Moodle system, and
- Studying the global experience of applying LMS Moodle for the applied, scientific and pedagogic purposes.

In order to study the students' opinion on implementing distance educational technologies in the higher educational establishment, the questioning of students of the Department of Mathematics and Natural Sciences was carried out. This questioning was carried out before the forming stage of the experiment. It aimed at answering the question "Is it worth using EER for organizing the students' individual work?"

### **Stating stage**

Task: to define characteristics of practical use of the EER created within the LMS Moodle system as a resource of distance technologies in education, including:

- Defining the nature of the interrelation between the students' knowledge about the LMS Moodle system and its practical use,
- Defining ways, methods and character of applying to the EER created in the LMS Moodle system when training, and
- Defining ways, methods and character of applying to the EER created in the LMS Moodle system during the students' individual work on the discipline.

Methods: questioning, interview, observation, studying students' and teachers' work.

## **3.2. Research of Factor and Data Collection**

### **Forming stage**

During 2015-2106 we were carrying out the experimental research with students of the Department of Mathematics and Natural Sciences. Bachelor students of the 4th course studying the pedagogic area of Mathematics and Natural Sciences made up the control group, and bachelor students of the 3rd course studying the pedagogic area of Mathematics and

Natural Sciences of the Elabuga Institute of the Kazan (Volga Region) Federal University made up the experimental group.

In order to check out the veracity of the hypothesis, we took control measures in the experimental and control groups on checking the acquired knowledge and practical skills in the area "Mathematics Teaching Methodology".

In order to check out the knowledge formed at the classes during the experiment, the test was carried out.

After students had studied the EER "Mathematics Teaching Methodology", students of the experimental group who had studied by using information technologies, and the control group studying according to the traditional methodology were tested. The test was carried out in the experimental group consisting of 16 students, and in the control group consisting of 11 students. The students were offered to answer 50 questions.

The students who obtained the summary point of not less than 25 were considered as those who successfully passed the theoretical material in the form of a test in the experimental group. To measure the degree of mastering the material based on the obtained data, the informational Mann-Whitney test statistics was used (Mayer, 1997).

We will accept the presumption that there are no differences between the groups as a zero hypothesis.

**Table 1.** Results of Final Testing in the Experimental and Control Groups (the maximum possible number of points - 50)

Experimental group				Control group		
Ser No.	Results of testing	Ranges	Average value	Results of testing	Ranges	Average value
1	40	3	3.0	32	7, 8, 9	8.0
2	35	6	6.0	17	19	19.0
3	32	7, 8, 9	8.0	28	11, 12	11.5
4	15	20, 21	20.5	2	27	27.0
5	26	13	13.0	22	15	15.0
6	39	4	4	15	20, 21	20.5
7	37	5	5.0	32	7, 8, 9	8.0
8	18	18	18.0	20	17	17.0
9	23	14	14.0	14	22	22.0
10	21	16	16.0	8	24, 25	24.5
11	42	1	1.0	10	23	23.0
12	31	10	10.0			

13	28	11, 12	11.5			
14	8	24, 25	24.5			
15	5	26	26			
16	41	2	2			
Total	<b>441</b>		$R1=182.5$	<b>200</b>		$R2=195.5$

Processing of experimental data gives the following results of ranges of the experimental and control groups:  $R1=182.5$ ;  $R2=195.5$  (Table 1).

In order to calculate statistics, we will use the following formulas:

$$U_1 = n_1 \cdot n_2 + \frac{n_1(n_1 + 1)}{2} - R_1; \quad U_2 = n_1 \cdot n_2 + \frac{n_2(n_2 + 1)}{2} - R_2;$$

$$U_1 = 16 \cdot 11 + 136 - 182.5 = 129.5; \quad U_2 = 16 \cdot 11 + 66 - 195.5 = 46.5.$$

The least values  $U_1$  and  $U_2$  are taken as the checking statistics of Mann-Whitney U-test.

In our case the statistics is  $U = 46.5$ . The zero hypothesis is rejected if the numerical value  $U$  is less than the critical value that under  $n_1 = 16$  and  $n_2 = 11$  on the level of the value  $\alpha = 0,05$  acquires the value  $U_{krit} = 47$ . Since  $U < U_{krit}$ , ( $46.5 < 47$ ), the zero hypothesis must be disproved. Consequently, judging from the test quality, the difference between the experimental and control groups is statistically valuable on the level of 0.05 or with the probability of 0.95.

Judging from the results, it is possible to make the conclusion that the experimental group coped with the test better than the control group, i.e. the theoretical knowledge of the experimental group is higher.

## 4. Results of Students' Interviews

### Results

- It was revealed that abroad there was not only numerous educational, reference and special periodical literature about the LMS Moodle system, but there were also examples of the developed didactic literature. The situation in Russia is quite different: there are few references and educational literature about the system itself; little attention is paid to it in special periodicals,
- It was determined that teachers of Computer Science sufficiently informed students of the Department of Mathematics and Natural Sciences with the LMS Moodle system. However, when teaching other disciplines, teachers use it in practice not much, in particular when organizing individual work, and
- The interrelations between the students' knowledge obtained during the classes with the use of the EER created in the LMS Moodle system and applying it in practice by using the system were determined. Besides, difficulties arising when working with EER were revealed. Ways and methods of using the EER created in the LMS Moodle system in the educational process of the higher educational establishment were set.

## 5. Discussion And Conclusion

The previous researches carried out by (Mironov 2015; Lyubimova 2015, Ereemeeva 2013 et al.) are basically devoted to the main review of applying distance technologies and contain some recommendations on applying them in various areas of knowledge. Our research aims at showing the efficiency of applying distance technologies for organizing individual work of students when mastering the specific discipline "Mathematics Teaching Methodology".

When developing the electronic educational resource, the analogous experience of teachers of the Faculty of Higher Mathematics and Informatics of the Surgut State Pedagogical University (SurSPU BE HE) on organizing individual work of students of area 44.03.01 Pedagogic Education (Mathematics) was used.

EER in the educational process of the higher educational establishment are efficiently used due to the conditions created by the Kazan Federal University.

The authors of this article have the experience of creating EER implemented in the educational process of the higher educational establishment:

- 1) Elementary Mathematics (Elements of Numbers Theory and Combinatorics) / Ganeeva A.R.
- 2) Elementary Mathematics (Trigonometry) / Ganeeva A.R.
- 3) Updating the content of the Physical and Mathematical education in the context of moving to the system and activity approach / Anisimova T.I., Gilmullin M.F., Sabirova F.M., Krasnova L.A.
- 4) New approaches and principles of teaching Mathematics (activity approach) / Anisimova T.I., Gilmullin M.F.
- 5) Content and organizing Mathematics teaching on the profiled and pre-profiled levels / Anisimova T.I., Gilmullin M.F.
- 6) Professional and pedagogic competences of the teacher of Natural and Mathematical sciences in the context of implementing FSES / Anisimova T.I., Sabirova F.M.

The results of organizing students' individual work on developing the EER "Mathematics Teaching Methodology" and implementing them in the educational process persuasively say about the positive impact of applying information technologies during classes and doing home assignments.

Certainly, high results of the experimental group were achieved due to using the EER created in the LMS Moodle framework. The EER enrich the theoretical material of the subject that goes beyond the academic program and thereby extends the opportunities of organizing students' individual work.

Thus, the results of the pilot testing prove the consistency of our hypothesis.

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## **6. Implication**

When using distance technologies, the teacher of a higher educational establishment is a coordinator, i.e. he or she directs students to successfully master knowledge during the individual work. The applied technologies enable the teacher to choose an individual route for every student, i.e. training has a student-centered nature.

We recommend to offer for electronic training the themes that can be learnt by the student individually, and to devote the released class hours to the research work of students.

Thus, the implementation of distance educational technologies is strengthened every year because it allows to organize the educational process on the differentiated basis. The adjusted structure of electronic training and research made by the teachers of the Elabuga Institute of the Kazan (Volga Region) Federal University on implementing EER in the educational process shows the importance and efficiency of applying electronic education and distance educational technologies.

## **Conflicts of interests**

The authors confirm that the above data does not contain a conflict of interests.

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