

Effectiveness criteria and experimental results of designing students' creative activities in primary class mother tongue education

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Abstract. The smaller the gap between the goal set in the educational process and the achieved result, the more effective the education is. Mathematical statistical methods make it possible to evaluate the objective laws of the pedagogical phenomenon and process. Before applying mathematical methods in data processing, it is necessary to logically analyze the concept of the effectiveness of education. Analysis shows that it is not possible to look at the question of the effectiveness of this or that method in general, but it is possible to speak only about its effectiveness according to some parameters.

1 Introduction

Mathematical statistical methods make it possible to evaluate the objective laws of the pedagogical phenomenon and process. Before applying mathematical methods in data processing, it is necessary to logically analyze the concept of effectiveness of education. Simple analysis shows that it is not possible to look at the question of the effectiveness of this or that method in general, but it is possible to speak only about its effectiveness according to some parameters[1].

The effectiveness of creative education can be checked according to many parameters. In our work, efficiency was studied according to the following methodical criteria:

- 1) students' learning material level;
- 2) the quality of students' mastery of educational material;
- 3) the time spent by students on mastering the learning material [7].

We used the following as indicators of the efficiency criterion for the level of students' mastery of the educational material:

1. Arithmetic mean value of the grade of mastery in the classes for the purpose of comparing the mastery of the experimental and control classes

$$X = (\sum x_i \cdot m_j) / N \text{ from}$$

here x_i - is the value of the estimate, and u 1,2,3,4,5 can take values; m_j - the number of repetitions of matching values; N - number of students participating in the experiment.

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2. The ratio of the average arithmetic values of the grades of experimental and control classes evaluating the effectiveness of designing students' creative activities in mother tongue education - efficiency coefficient $\eta = x^* \tau / X^* H$ from

Here: x^*_m - the arithmetic mean value of mastery grades in the experimental class; x^*_n - the arithmetic mean of the mastery grades in the control class.

The grade of the students, i.e. the level of mastery, was determined through special test tasks and exercises corresponding to the level of knowledge and skills formed in them.

Since our research was conducted in 3 options, the above formula for determining the efficiency coefficient was made into the following form:

$$\eta_1 = \frac{X_{T_1}^*}{X_H^*} \quad \eta_2 = \frac{X_{T_2}^*}{X_H^*} \quad \eta_3 = \frac{X_{T_1}^*}{X_{T_2}^*}$$

In this: $X_{T_1}^*$ - the average grade of students in the experimental class organized on the basis of the work of experienced teachers; $X_{T_2}^*$ - the average grade of students in the experimental class trained on the basis of the work of teachers with up to 5 years of work experience; X_H^* - the average grade of students in the control class taught on the basis of traditional methods; η_1 - effectiveness of classes organized on the basis of the activities of experienced teachers compared to classes conducted on the basis of traditional methods; η_2 - the effectiveness of lessons organized based on the work of teachers with up to 5 years of work experience compared to lessons conducted based on traditional methods; η_3 - effectiveness compared to lessons organized on the basis of the work of teachers with experience and work experience of up to 5 years[4].

2 Materials and methods

In order to assess the reliability of the obtained results, a confidence interval for the theoretical value of the mathematical expectation of a random variable was also determined in the pedagogical experiment. This intermediate quantity in our experiment is x^* , which represents the arithmetic mean of the mastery grades.

Δ the confidence interval is determined from the following formula:

$$\Delta = t_{g,m} \frac{\tau^*}{\sqrt{N-1}}$$

here $t_{g,m}$ - degrees of freedom ($M=N-1$) value and the probability that the value of the "X" parameter does not belong to the confidence interval is the percentage of the probability of the true value and the coefficient that depends on the quantity g determined by the table; τ^* - is the mean squared deviation, $\tau^* = \sqrt{D^*}$ D^* - the empirical value of the variance; N - number of students participating in the experiment.

We also examined the effectiveness of acquisition over time in experimental classes. We used the following formulas:

$$\eta_{\text{вакм1}} = \frac{T_{T_1}}{T_H} \quad \eta_{\text{вакм2}} = \frac{T_{T_2}}{T_H} \quad \eta_{\text{вакм3}} = \frac{T_{T_1}}{T_{T_2}}$$

In this T_{T_1} - the average time spent by students in the experimental class, trained on the basis of designing creative activities of students in mother tongue education; T_{T_2} - the average

time spent by the students in the experimental class, who were trained on the basis of creative tasks related to the design of creative activities of students in mother tongue education; T_H is the average time spent by students in the control class trained on the basis of traditional methods to complete the specified tasks; η_{time1} – efficiency achieved by students trained on the basis of the traditional methodology established on the basis of the activities of experienced teachers, in the process of completing the assigned tasks; η_{time2} – The time efficiency of students trained based on the work of teachers with up to 5 years of work experience compared to students trained based on traditional methods in the process of completing tasks; η_{time3} – the effectiveness achieved by the students in the process of completing the assigned tasks based on the work of experienced teachers with up to 5 years of work experience.

In the control class, the teacher, after explaining the new topic, emphasized that exercises should be performed to strengthen the learned material, and distributed separate sheets for completing tasks, explaining that all today's exercises should be performed independently [6]. Then, the condition of exercise 1 was explained, and each paragraph of the exercise was re-read by the teacher 2 times. Students wrote on paper whether each item was true or false [8].

After the content of exercise 2 was explained, its condition was shown on the screen through a projector. Students wrote a sequence of program line numbers on paper [7].

After the 3rd exercise condition was explained, these exercise items were also shown on the screen via a projector. Students recorded on their paper whether each case was an error or not [7].

The conditions of the 4th exercise were also explained, and the clauses were shown on the screen through a projector [3]. Students count the number of times the repetition body is repeated in each clause and write it on their paper.

When the results were compared, it was found that the students of the control class spent less time on the 1st exercise than the students of the experimental classes and spent more time on the remaining exercises. However, the level of correct completion of the tasks was found to be lower in the control class for each task.

When the results of the students of the 1st and 2nd experimental class were analyzed, it was found that the time spent by the students of the 1st experimental class to complete each task was less than the students of the 2nd experimental class, and the level of correct completion was higher. Of course, there is no reason to conclude that one method is more effective than the other based on whether the "5" grades in the 1st grade are more or less than the "5" grades in the 2nd grade. To substantiate this scientifically, it is necessary to use mathematical statistical methods and achieve the reliability of the results.

In this sense, the results were statistically processed. The processing of the statistical parameters obtained from the experiment was expressed in the tables. The results of the analysis of grades in this lesson are in table 1, reliability probability $\alpha=0,95$ The calculation of the confidence interval for the empirical mean value of the control estimates is given in Table 1.

Table 1. The calculation of the confidence interval for the empirical mean value of the control estimates

	Experimental class	Control class
Grade value	5 4 3 2	5 4 3 2
Number of matching grades	62 24 4 0	12 20 41 17
The average of grades arithmetic value	$X_{T1}^* = 4.64$	$X_H^* = 3.3$
Efficiency coefficient	$\square_1 = X_{T1}^* / X_H^* = 1.41$	$\square_3 = X_{T1}^* / X_{T2}^* = 1.07$

X's credibility probability interval	$4.59 < X^*_{T1} < 4.70$	$3.26 < X^*_{H} < 3.34$
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Table 2. The result of the analysis of the control work of the students of the 4th grade experimental and control class on the topic "Repetition"

N		90		
x_i	5	4	3	2
m_j	62	24	4	0
$x_i m_j$	310	96	12	0
$\sum x_i m_j$		418		
$x^* = \sum x_i m_j / N$		4.644444		
$x_i - x^*$	0.355556	-0.644444	-1.644444	-2.644444
$(x_i - x^*)^2$	0.12642	0.415309	2.704198	6.993086
$\sum (x_i - x^*)^2$		10.23901		
$D^* = \sum (x_i - x^*)^2 / N - 1$		0.115045		
$\tau^* = \sqrt{D^*}$		0.339183		
$\gamma^* = (\tau^* / x^*) \cdot 100\%$		7.302982		
$\Delta = t_{g,m} \tau^* / \sqrt{N - 1}$		0.059143		
$X^* - \Delta$		4.585301		
$X^* + \Delta$		4.703588		

Table 3. "Determining the confidence interval for the theoretical value of the mathematical expectation of a random variable in the experiment-test conducted in the experimental class on the topic "Repetition"

N		90		
x_i	5	4	3	2
m_j	12	20	41	17
$x_i m_j$	60	80	123	34
$\sum x_i m_j$		297		
$x^* = \sum x_i m_j / N$		3.3		
$x_i - x^*$	1.7	0.7	-0.3	-1.3
$(x_i - x^*)^2$	2.89	0.49	0.09	1.69
$\sum (x_i - x^*)^2$		5.16		
$D^* = \sum (x_i - x^*)^2 / N - 1$		0.057978		
$\tau^* = \sqrt{D^*}$		0.240785		
$\gamma^* = (\tau^* / x^*) \cdot 100\%$		7.296522		
$\Delta = t_{g,m} \tau^* / \sqrt{N - 1}$		0.041986		
$X^* - \Delta$		3.258014		
$X^* + \Delta$		3.341986		

The results showed that the students of the experimental class achieved 1.32 times higher mastery than the students of the control class and 1.41 times of the students of the experimental class compared to the students of the control class.

The range of the arithmetic mean value of the scores $\alpha=0.95$ in the experimental class on reliability probability $4.59 < X^*_{T1} < 4.7$, in the control class $3.26 < X^*_{H} < 3.34$ showed that (Table 1).

It was found that the arithmetic mean value intervals of the students of the experimental classes were different and superior to those of the students of the control class. $\alpha=0,95$ represented by the reliability probability[2].

The result of each lesson observed during the teaching experience was analyzed in this context. The general result of the quantitative analysis is presented, and the information related to the respondents in the classes, their grades and the confidence interval of the result is presented in Tables 4 and 5.

Table 4. The result of the control work obtained during the training experience.

T/p	Observed Lesson Topic (Grade 3)	X_{r1}	X_H	\square_1	\square_3
1.	Types of speech according to purpose?	4.26	3.62	1.17	1.08
2.	Read each sentence in the text with a specific tone.	4.49	3.64	1.23	1.03
3.	Separate and write the interrogative sentences in the book "Reading" from the work "A Scientific Millennium".	4.43	3.47	1.28	1.24
4.	Write the command sentences from the text and read aloud.	4.17	3.97	1.05	1.02
5.	Determine the limits of the sentences given in the text.	4.44	3.3	1.35	1.12
6.	Average value	4.36	3.6	1.21	1.09
4th grade					
1.	Types of sentences and the use of punctuation marks according to the purpose of expression.	4.4	3.7	1.08	1.19
2.	Sentence and text structure.	4.03	3.56	1.04	1.13
3.	Read the sentences from the epic "Alpomish" following the tone.	4.4	4.26	1.09	1.03
4.	Put a title on the text and make a sentence algorithm.	4.07	3.98	1.01	1.02
5.	Determine how many sentences there are in the given poem.	4.64	4.36	1.32	1.07
6.	Average value	4.3	3.95	1.12	1.09
Grade average		4.32	3.97	1.12	1.09

Table 5. Statistical analysis of the results of teaching experience by lessons

Observed lesson number	Classes involved in the experiment	N	«5»	«4»	«3»	«2»	The average value of the grade	Confidence interval	Efficiency
3rd class									
1-lesson	Experience class	90	41	32	16	1	4.26	0.049882	$\bar{x}_1=1.17$
	Control class	90	18	28	36	8	3.62	0.041576	$\bar{x}_3=1.08$
2-lesson	Experience class	90	53	28	9	0	4.49	0.055176	$\bar{x}_1=1.23$
	Control class	89	17	32	31	9	3.64	0.042128	$\bar{x}_3=1.03$
3-lesson	Experience class	90	51	27	12	0	4.43	0.053838	$\bar{x}_1=1.28$
	Control class	90	12	29	38	11	3.47	0.041348	$\bar{x}_3=1.24$
4-lesson	Experience class	90	37	33	18	2	4.17	0.048119	$\bar{x}_1=1.05$

	Control class	90	29	33	24	4	3.97	0.044785	$\bar{\pi}_3=1.02$
5-lesson	Experience class	90	49	32	9	0	4.44	0.054102	$\bar{\pi}_1=1.35$
	Control class	90	9	23	44	14	3.3	0.041986	$\bar{\pi}_3=1.12$
4rd class									
1-lesson	Experience class	90	44	38	8	0	4.4	0.053057	$\bar{\pi}_1=1.29$
	Control class	90	12	26	39	13	3.41	0.04146	$\bar{\pi}_3=1.19$
2-lesson	Experience class	90	32	29	29	0	4.03	0.045791	$\bar{\pi}_1=1.18$
	Control class	89	10	27	41	11	3.40	0.041951	$\bar{\pi}_3=1.13$
3-lesson	Experience class	90	47	32	11	0	4.4	0.053057	$\bar{\pi}_1=1.13$
	Control class	90	18	47	23	2	3.9	0.043895	$\bar{\pi}_3=1.03$
4-lesson	Experience class	90	33	32	23	2	4.07	0.046335	$\bar{\pi}_1=1.04$
	Control class	90	21	43	24	2	3.92	0.044179	$\bar{\pi}_3=1.02$
5-lesson	Experience class	90	62	24	4	0	4.64	0.059143	$\bar{\pi}_1=1.41$
	Control class	90	12	20	41	17	3.3	0.041986	$\bar{\pi}_3=1.07$
6-lesson	Experience class	90	35	46	9	0	4.29	0.050582	$\bar{\pi}_1=1.30$
	Control class	90	8	29	34	19	3.29	0.04206	$\bar{\pi}_3=1.04$
7-lesson	Experience class	90	36	40	14	0	4.24	0.049653	$\bar{\pi}_1=1.23$
	Control class	90	12	31	33	14	3.46	0.041362	$\bar{\pi}_3=1.15$

From the values in the table, it can be observed that some control results were significantly different in the experimental classes and the Control class. For example, according to the results of lesson 5 in the 2nd grade $X^*_{T1}=4,64$, $X^*_{T2}=4,36$, $X^*_H=3,3$ and the effectiveness of teaching in the 1st Experience class compared to teaching in the Control class was 1.41. The reason for these results is lesson 11 in this lesson section, in each previous lesson, the students of Experience class 1 managed to complete one to five more exercises than the students of Control class, students of Experience class completed exercises individually, each lesson was tested based on more than ten questions, etc. . So, the students of the 1st Experience class have mastered all the material in the chapter related to this lesson. The students of the control class had time to perform only 2 or 3 types of exercises in each lesson. Even then, the active participation of all students in the class was not ensured. Since not all students can accept the teacher's explanations in the same way, most of the students had a hard time completing the tasks.

In this lesson, the efficiency of teaching in the 2-Experience class was 1.32 compared to the teaching in the Control class. All the ideas and information from the project used in the 1st Experience class are embodied in the design of students' creative activities in mother tongue education. However, the level of mastery of the material was lower than in the 1st Experience class due to the relatively difficult nature of the tasks aimed at students' thinking, and the slowness of the processes (see Table 4.6: the efficiency of the teaching in the 1st Experience class is 7% more than the teaching in the 2nd Experience class).

It is possible to analyze the 5th lesson conducted in the 4th grade as the lesson with the smallest difference between the methods.

This lesson describes the task "Put a title on the text and make a sentence algorithm". In this assignment, only two tasks were planned, and in the Control class, these exercises were fully completed. Due to the fact that more information about the construction of the sentence algorithm was given in the task, the result was 4% higher than the mastery in the Control class. When the task "Put a title to the text and build a sentence algorithm" was taught based on the traditional methodology, only 1.01 efficiency was achieved due to its low capabilities.

The statistical analysis of teaching experience by classes is presented in the table below.

Table 6. Statistical analysis of the results of teaching experience by classes.

Observed class	Classes involved in the experiment	N	«5»	«4»	«3»	«2»	Arithmetic average value of the grade	Confidence interval	Efficiency
3-class	Experience class	450	231	152	64	3	4.36	0.010326	$\eta_1=1.21$
	Control class	449	85	145	173	46	3.6	0.008243	$\eta_3=1.09$
4-class	Experience class	630	289	241	98	2	4.3	0.007181	$\eta_1=1.22$
	Control class	629	93	223	235	78	3.53	0.05859	$\eta_3=1.09$
Total	Experience class	1080	520	393	162	5	4.32	0.004232	$\eta_1=1.22$
	Control class	1078	178	368	408	124	3.56	0.00342	$\eta_3=1.09$

We calculate the quality indicators of experimental work from the obtained results. We know

$$X = 4.32; \quad Y = 3.56 \quad \Delta_x = 0.004; \quad \Delta_y = 0.003 \quad \text{is equal to.}$$

Quality indicators from this:

$$K = \frac{(\bar{X} - \Delta_x)}{(\bar{Y} + \Delta_y)} = \frac{4.32 - 0.004}{3.56 + 0.003} = \frac{4.316}{3.563} = 1.21 > 1;$$

$$K = (\bar{X} - \Delta_x) - (\bar{Y} - \Delta_y) = (4.32 - 0.004) - (3.56 - 0.003) = 4.316 - 3.557 = 0.759 > 0.$$

From the obtained results, it can be seen that the criterion for evaluating the effectiveness of teaching has a value of one, and the criterion for evaluating the level of knowledge has a value of zero. It is known that the mastery rate in the experimental group is higher than the mastery in the control group[2].

The above statistical analysis shows that the statistical analysis conducted on the results of the research and presented in the dissertation shows that the experimental work is effective and our intended purpose is confirmed.

3 Conclusion

A pedagogical experiment was conducted in order to study the practice of organizing, managing, controlling the creative activity of students in mother tongue education and its effectiveness. Collected the results related to the proof of concept of the research and processed them based on the methods of mathematical statistics. All forms of the experiment were carried out on the basis of options, using the forms of the test-testing (confirmatory), research, teaching experience. The results of the control work were analyzed quantitatively and qualitatively.

It has been proven that the results of pedagogical experience in designing creative activities of students in mother tongue education are effective. This was shown by the fact that the students of the Experience class achieved high mastery in each observed lesson, and the efficiency was 24%.

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