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Mathematical and Statistical Analysis of the Results of Experimental Work on Formation of Diagnostic Culture in Future Primary Class Teachers

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Abstract

In this article, experimental work on the formation of diagnostic culture in future primary school teachers, "Primary" of higher educational institutions of the Republic of Uzbekistan, such as Andijan State University, Tashkent State Pedagogical University, Jizzakh State Pedagogical University "education" specialty, initial and developmental experimental work was organized among the students of the 2-4 stages, and the students used pedagogical scientific research methods, i.e. observation, interview, questionnaire, question-and-answer methods, according to the preliminary results, the respondents were divided into experimental and control classes, specially developed lesson plans, educational technologies, non-traditional methods, innovative approaches, auto-training projects were presented to the experimental group, and based on these projects, pedagogic sciences training was conducted for 2 years, and finally the final results and that the initial results were summarized and analyzed using mathematical-statistical methods, each obtained result was presented as a separate table, deviations were calculated according to the ideas of Student, Firsh and Pearson, and as a result, the conducted research reflected an effective result, the scientific hypotheses put forward at the beginning of the research that it is scientifically proven, that the scientific researches, researches, analyzes and obtained indicators in connection with the formation of diagnostic culture in the future elementary school teachers revealed the specific features of the research work, that the work of the research in the personal and professional activity of the person Opinions about its necessity and its importance in the development of society are highlighted.

Keywords: *diagnosis, diagnostic culture, experiment-test, mathematical-statistical analysis, formation, research works.*

1. Introduction

Creative modular technologies for determining the priorities of continuous education and forming the diagnostic culture of future primary school teachers are being put into practice in world educational organizations. The UN agreement on education, science and

culture focuses on "Fundamental improvement of teaching by means of innovative pedagogical technologies" [1], on the basis of which, formation of diagnostic culture of future primary school teachers, innovative education effective work is being carried out in a systematic and sequential manner, aimed at the implementation of projects of practical importance for the implementation of pedagogical technologies in the environment, increasing the prospects of educational areas. The UN agreement on education, science and culture focuses on "Fundamental improvement of teaching by means of innovative pedagogical technologies" [1], on the basis of which, formation of diagnostic culture of future primary school teachers, innovative education effective work is being carried out in a systematic and sequential manner, aimed at the implementation of projects of practical importance for the implementation of pedagogical technologies in the environment, increasing the prospects of educational areas. In the development strategy of New Uzbekistan, "Development and implementation of a national program to improve the quality of education in schools, to bring the knowledge and skills of pedagogues to the international level, to ensure that young people receive excellent education at all stages of education"[2] was set as a priority. As a result, pedagogical conditions and didactic opportunities were created for the formation of diagnostic culture of future primary school teachers.

The main results and findings

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"On the Development Strategy of New Uzbekistan", No. PF-5748 dated October 8, 2019 "On Approval of the Concept of Development of the Higher Education System of the Republic of Uzbekistan until 2030", No. PF-5748 dated November 6, 2020 Decree No. 6108 "On Measures for the Development of Education and Science in Uzbekistan in the Period of New Development", Decree of the President of the Republic of Uzbekistan No. PQ-2909 of April 20, 2020 "The Higher Education System on measures for further development", No. PQ-4623 of February 27, 2020 "On measures for further development of the field of pedagogical education", No. PQ-4884 of November 6, 2020 "Ta "On additional measures for the further development of the education system" and the implementation of the tasks provided for in the legal and regulatory documents within the framework of this activity .

We can see the approaches of the authors during the reflection of their views on the formation of the diagnostic culture of representatives of a certain field of study at various stages of the educational system and educational activities of foreign, CIS and our country's research scientists. In particular, Zvereva V.I 1998 [19], Podlasi I.P. 2000[22], Maksimov V.G. 2002[20], and from the researchers of our Republic during the years of independence, M.Akhmedjanov 1994[16], Sh.Abdullayeva 2006[10], Z.Azimova 2008[11], Z.Azimova 2018[12], X .Ismailova 2021[14], D.Choriyeva 2021[13] was researched.

M.N.Boritko, as a mature pedagogic scientist, advocates that diagnostic competence is a high indicator in the development of the diagnostic culture of a modern teacher, the integration of theoretical knowledge and practical skills related to pedagogical diagnostics, and the correct selection of the necessary diagnostic methods.

This is a systematic and conceptual level, in which teachers-students and their parents establish mutual relations, make effective use of pedagogical diagnostics aimed at the further development of their personal and pedagogical characteristics, emphasizes the need for the teacher to recognize the opinions of students, the results of the diagnostic process as valuable information[17].

O.V.Yeremkina's determination of the components of the teacher's diagnostic culture is based on the structure of the teacher's personality. The researcher identifies components such as motivational-personal or meaningful, personal-activity, reflexive-perception. Cognitive-creative and instrumental-technological. The central component has motivational and

personal characteristics and includes humanistic and person-oriented attitude to students, personal reflexes, diagnostic orientation, moral standards, moral values[18].

E. A. Palmova emphasizes that the teacher's diagnostic culture has a double effect: it allows both the teacher's personality and its growth, and creates favorable conditions for the student's personality[21].

O.A.Yeremkina, one of the researchers of the teacher's diagnostic culture, considers it as a complex integrated psychological education of the teacher's personality. Its basis is a valuable and meaningful feature that determines the orientation of pedagogical activity to the implementation of diagnostics. Supporting the safe personal development of the child, which encourages creativity and professional development of the teacher[18].

Pedagogical scientist Z.E.Azimova concludes that "Educators know children and implement a diagnostic component in planned educational and educational activities" [11].

It can be seen from this that it is not an exaggeration to say that he put forward the idea of developing the diagnostic culture of the teacher.

A high level of diagnostic culture serves as a basis for the teacher's role in the formation of diagnostic culture during the teaching process[15].

Our research work includes students' diagnostic culture, teaching materials, learning, diagnostic task, diagnostic systems, methods, research, work on themselves, diagnosing students, institutions, organizations, labor, etc., summarizing indicators, analysis, disclosure of performance results, etc.

1. Students with a high level of diagnostic culture.
2. Students with an intermediate level of diagnostic culture.
3. Students with a low diagnostic culture.

The level of development of diagnostic culture, assessment, initial and final stages of experimental work, analysis of respondents' results, indicators are presented.

The purpose of the mathematical-statistical analysis of the results of the experiment is characterized by the evaluation of the effectiveness of teaching and the determination of the coefficients of the level of knowledge.

436 students of "Primary education and sports educational work" were involved in the experimental work as respondents. Of these, 237 are experimental and 199 control class respondents. The brief essence of the problem is reflected in this case: let two prime sets be given. We define the first as the average scores of the students in the experimental group and the second as the average scores of the students in the control group. The obtained grades are defined as having a normal distribution. This assumption is valid because the conditions for approximation to the normal distribution are simple and they are fulfilled.

As a result of the conducted experimental work, X and Y main selections are obtained. X is the average score of the knowledge of the respondents of the experimental class, and Y is the average score of the knowledge of the respondents of the control class. It is appropriate to consider that the grades have a normal distribution. Such an assumption is reasonable, because the conditions for approximation to the normal distribution are simple and they are fulfilled.

ni – xi (xi ϵX) is the number of occurrences of a random event, and mi – yi (yiϵY) is the number of occurrences of a random event.

Based on Figure 1, the hypothesis N1, which determines the efficiency of learning of the experimental and control groups, and the hypothesis N0, which is opposite to it, are determined.

The results of the respondents assigned to the control and experimental groups at the beginning and end of the experiment are summarized in the following table:

Indicators of the effectiveness of forming the diagnostic culture of students in an innovative educational environment (at the beginning of the experiment)

Figure 1.

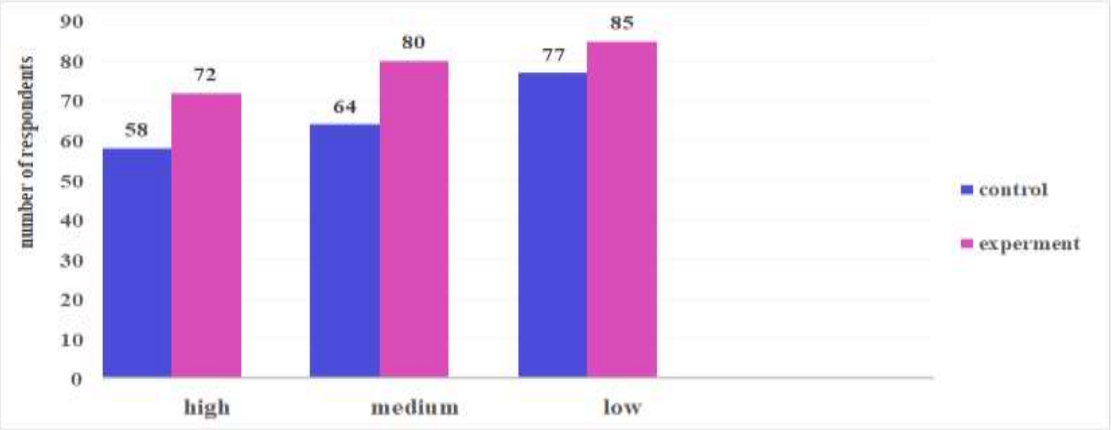


Figure 1. Diagram of indicators of effectiveness of educational materials aimed at forming the diagnostic culture of future elementary school teachers (at the beginning of the experiment).

Learning results and the number of respondents in the experimental classes, respectively, and the respondents in the control classes in the form of Хи, ни, and the respondents in the same control classes, it is possible to have the following statistically grouped variation sequence, as well as 3 points " High", 2 points "Medium", 1 point as a low indicator was determined in the form of points. These indicators reflect the following:

Achievement indicators of the respondent in the experimental class

$$\begin{cases} X_i & 3 & 2 & 1 \\ n_i & 72 & 80 & 85 \end{cases} \quad (n = 237)$$

Achievement indicators of respondents in the control class

$$\begin{cases} Y_j & 3 & 2 & 1 \\ m_j & 58 & 64 & 77 \end{cases} \quad (m = 199)$$

In order to facilitate the statistical analysis, the corresponding statistical probability of repetitions (frequency) ni and mj of the variational sequences given above consists of $P_i = \frac{n_i}{n}$ and $P_j = \frac{m_j}{m}$.

$$\begin{cases} X_i & 3 & 2 & 1 \\ P_i & 0{,}3 & 0{,}34 & 0{,}36 \end{cases} \text{ and } \begin{cases} Y_j & 3 & 2 & 1 \\ P_j & 0{,}29 & 0{,}32 & 0{,}39 \end{cases} \quad (2)$$

The diagram corresponding to these selections shows the following view:

Figure 2.

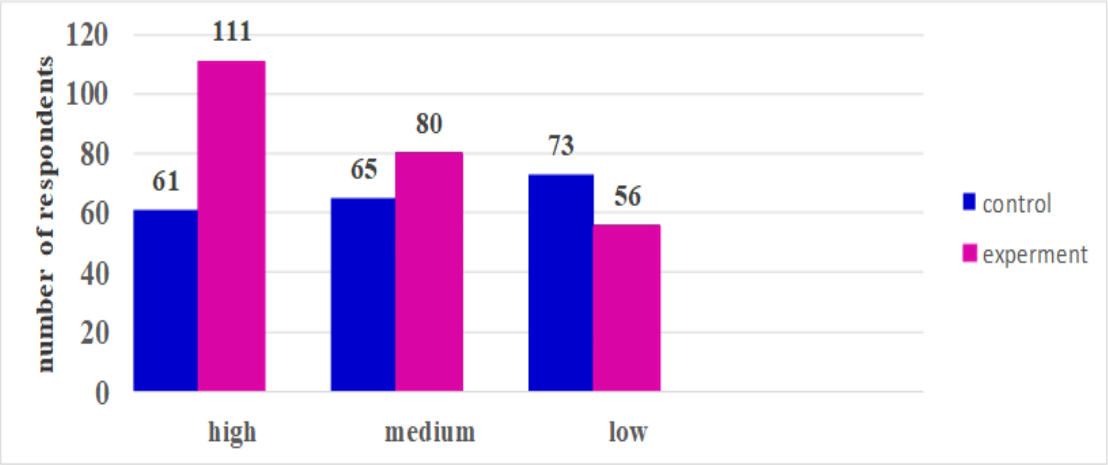


Figure 2. Diagram of indicators of effectiveness of educational materials aimed at forming the diagnostic culture of future primary school teachers (at the end of the experiment).

Our first task is to calculate and compare the average learning of the respondents in the experimental and control groups based on statistical analysis. At the end of the experiment, the following results were recorded regarding the average learning indicators.

$$\overline{X} = \sum_{i=1}^{3} P_i x_i = 0{,}3 \cdot 3 + 0{,}34 \cdot 2 + 0{,}36 \cdot 1 = 0{,}9 + 0{,}68 + 0{,}36 = 1{,}94$$

In percent $$\overline{X}\% = \frac{1{,}94}{3} \cdot 100\% = 64{,}6\%$$

$$\overline{Y} = \sum_{i=1}^{3} q_j y_j = 0{,}29 \cdot 3 + 0{,}32 \cdot 2 + 0{,}39 \cdot 1 = 0{,}87 + 0{,}64 + 0{,}39 = 1{,}9$$

Percent $$\overline{Y}\% = \frac{1{,}9}{3} \cdot 100\% = 63{,}3\%$$

Thus, the average mastery of the respondents in the experimental groups

It was clarified that $(64{,}6\text{-}63{,}3)\% = 1{,}3\%$ is higher. It was clarified that this, in turn, is higher than $\frac{64{,}6\%}{63{,}3\%} = 1{,}02$. This, in turn, means that it is twice as high and the achievement of efficiency is a low indicator. So, the results clearly show that no efficiency was achieved before the experiment.

In turn, it is intended to determine whether efficiency has been achieved or not from the results at the end of the experiment.

Performance indicators of formation of diagnostic culture of students in an innovative educational environment (at the end of the experiment)

Table 1.

Grades / Groups	3	2	1
experimental group.	111	80	56
control group.	61	65	73

The mastering indicators of the respondents in the experimental class and the number of respondents are determined as before the experiment. These indicators reflect the following:

Achievement indicators of respondents in the experimental class

$$\begin{cases} X_i & 3 & 2 & 1 \\ n_i & 111 & 80 & 56 \end{cases} \quad (n = 237)$$

Achievement indicators of respondents in the control class

$$\begin{cases} Y_j & 3 & 2 & 1 \\ m_j & 61 & 65 & 73 \end{cases} \quad (m = 199)$$

Formula (2) is used to facilitate statistical analysis:

$$\begin{cases} X_i & 3 & 2 & 1 \\ P_i & 0{,}59 & 0{,}28 & 0{,}13 \end{cases} \qquad \begin{cases} Y_j & 3 & 2 & 1 \\ P_j & 0{,}31 & 0{,}29 & 0{,}4 \end{cases}$$

The diagram corresponding to these selections is shown in the following form:

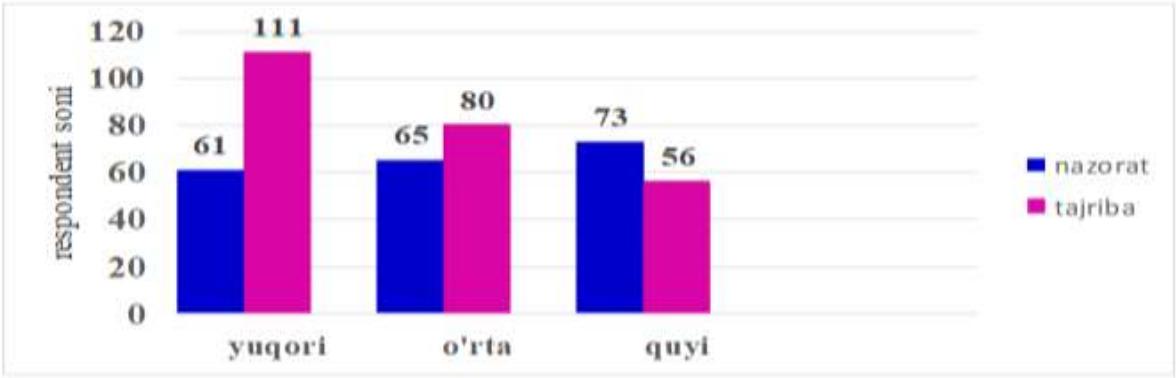


Figure 3. Diagram of indicators of the effectiveness of educational materials aimed at forming the diagnostic culture of students (at the end of the experiment).

It is appropriate to start the statistical analysis by calculating and comparing the average mastery of both groups. Below are the results of the average mastery rates at the end of the experiment:

$$\overline{X} = \sum_{i=1}^{3} P_i x_i = 0{,}47 \cdot 3 + 0{,}34 \cdot 2 + 0{,}24 \cdot 1 = 1{,}41 + 0{,}68 + 0{,}24 = 2{,}33$$

In percent $$\overline{X}\% = \frac{2{,}33}{3} \cdot 100\% = 77{,}7\%$$

$$\overline{Y} = \sum_{i=1}^{3} q_j y_j = 0{,}3 \cdot 3 + 0{,}33 \cdot 2 + 0{,}36 \cdot 1 = 0{,}9 + 0{,}66 + 0{,}36 = 1{,}92$$

In percent $$\overline{Y}\% = \frac{1{,}92}{3} \cdot 100\% = 64\%$$

The average mastery in the experimental class is higher by $(77{,}7\text{-}64)\% = 13{,}7\%$

And this, in turn, means $\frac{77{,}7\%}{64\%} = 1{,}21$ double excess.

In terms of determining errors that are often made in the process of determining mastery, the first goal was to determine the mean square and standard errors.

Mean square errors:

$$S_x^2 = \sum_{i=1}^{3} P_i x_i^2 - (\bar{x})^2 = 0{,}47 \cdot 3^2 + 0{,}34 \cdot 2^2 + 0{,}24 \cdot 1^2 - 2{,}33^2 = 0{,}47 \cdot 9 + 0{,}34 \cdot 4 + 0{,}24 \cdot 1 - 5{,}4289 =$$

$$= 4{,}23 + 1{,}36 + 0{,}24 - 5{,}4289 = 5{,}83 - 5{,}4289 = 0{,}4011$$

$$S_y^2 = \sum_{i=1}^{3} q_j y_j^2 - (\bar{y})^2 = 0{,}3 \cdot 3^2 + 0{,}33 \cdot 2^2 + 0{,}36 \cdot 1^2 - 1{,}92^2 = 0{,}3 \cdot 9 + 0{,}33 \cdot 4 + 0{,}36 \cdot 1 - 3{,}6864 =$$

$$= 2{,}7 + 1{,}32 + 0{,}36 - 3{,}6864 = 4{,}38 - 3{,}6864 = 0{,}6936$$

Standard errors are:

$$S_x = \sqrt{0{,}4011} = 0{,}63.\ S_y = \sqrt{0{,}6936} = 0{,}83.$$

Furthermore, the standard error of the experimental group was smaller than that of the control group, 0.83>0.63. In order to describe this situation on the basis of more accuracy, the accuracy of the average value on the surface of both statistical samples was calculated using the coefficients of variation, that is, Sx and Su based on the formula:

So, it was proved based on the formula that the accuracy of the average learning result in the control group is greater than that of the experimental group.

Now, taking into account the similarity of the unknown mean values of the two sets, the null hypothesis is tested on the basis of Student's selective criterion:

$$C_x = \frac{S_x}{\sqrt{n} \cdot \bar{x}} \cdot 100\% = \frac{0{,}63 \cdot 100\%}{\sqrt{237} \cdot 2{,}33} = \frac{63\%}{15{,}4 \cdot 2{,}33} = \frac{63\%}{35{,}9} = 1{,}75\% \approx 1{,}7\%$$

$$C_y = \frac{S_y}{\sqrt{n} \cdot \bar{y}} \cdot 100\% = \frac{0{,}83 \cdot 100\%}{\sqrt{199} \cdot 1{,}92} = \frac{83\%}{14{,}1 \cdot 1{,}92} = \frac{83\%}{27} = 3{,}07\% \approx 3{,}1\%$$

Based on this, the following calculation is made:

$$H_0 : \mu = \mu_y$$

The degree of freedom is determined based on the Student's criterion using the formula given below:

$$T_{x,y} = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{S_x^2}{n} + \frac{S_y^2}{m}}} = \frac{2{,}33 - 1{,}92}{\sqrt{\frac{0{,}4011}{237} + \frac{0{,}6936}{199}}} = \frac{0{,}41}{\sqrt{0{,}00169 + 0{,}00348}} = \frac{0{,}41}{\sqrt{0{,}00517}} = \frac{0{,}41}{0{,}069} = 5{,}8$$

$$K=\frac{\left(\frac{S_x^2}{n}+\frac{S_y^2}{m}\right)^2}{\frac{\left(\frac{S_x^2}{n}\right)^2}{n-1}+\frac{\left(\frac{S_y^2}{m}\right)^2}{m-1}}=\frac{\left(\frac{0{,}4011}{237}+\frac{0{,}6936}{199}\right)^2}{\frac{\left(\frac{0{,}4011}{237}\right)^2}{236}+\frac{\left(\frac{0{,}6936}{199}\right)^2}{198}}=\frac{(0{,}00169+0{,}00348)^2}{\frac{(0{,}00169)^2}{236}+\frac{(0{,}00348)^2}{198}}=$$

$$=\frac{(0{,}00517)^2}{\frac{0{,}0000028}{236}+\frac{0{,}000012}{198}}=\frac{0{,}00002672}{0{,}00000012+0{,}00000001}=\frac{0{,}00002672}{0{,}000000073}=366$$

If we take the value level of the statistical sign as α=0.05 for this probability, in this case it is equal to p=1-α=0,95and the degree of freedom is equal to k=366. The critical point of the binomial criterion from the distribution table of the Student's function:

$$t_{1-\frac{(1-p)}{2}}(k)=t_{1-\frac{(1-0{,}95)}{2}}(366)=t_{0{,}975}(366)=1{,}96$$

So, it is clear that the sampling value of the statistic is greater than the critical point:

Tx,y= 5,8> 1,96

Therefore, the N0 null hypothesis about the equality of the main means is rejected according to the purpose. It can be said with 95% confidence that the mean achievement scores of the control group are consistently lower than the average achievement scores of the experimental group, and they never overlap.

Now, we will consider the contrary to the hypothesis that the educational method in the experimental and control classes is different.

$K_0 : F_x = F_y$

In this case, the distribution of the two population distributions coincides.

In order to check the hypothesis that H_1 - the main set is normally distributed at the given value level of α, theoretical frequencies are first calculated, and then Pearson's correspondence criterion - X^2 - based on systems (1) and (2) based on the following formula:

$$\chi^2=\frac{1}{N\cdot M}\cdot\sum_{i=1}^{k}\frac{(n_iM-m_iN)^2}{n_i+m_i}.$$

For this purpose, we made a table based on Table 2 as follows:

Grades / Groups	3	2	1
experimental group.	111	80	56
control group.	61	65	73

We calculate the Pearson statistic:

$$\chi^2 = \frac{1}{237 \cdot 199} \cdot \left[\frac{(119 \cdot 111 - 237 \cdot 61)^2}{111 + 61} + \frac{(80 \cdot 119 - 65 \cdot 237)^2}{80 + 65} + \right.$$

$$\left. + \frac{(56 \cdot 199 - 73 \cdot 237)^2}{56 + 73} \right] = \frac{1}{47163} \cdot \left[\frac{(7632)^2}{172} + \frac{(515)^2}{145} + \frac{(6157)^2}{129} \right] =$$

$$= \frac{1}{47163} \cdot \left[\frac{58247424}{172} + \frac{265225}{145} + \frac{37908649}{129} \right] =$$

$$= \frac{1}{47163} \cdot [\, 338647{,}8 + 1829{,}1 + 293865{,}5 \,] = \frac{634342{,}4}{47163} = 134{,}5$$

The degree of freedom of Pearson's criterion is 1 less than the number of points:

k=3-1=2, k=2 which is the 95% critical point corresponding to $Z_{kp}(0{,}95) = 5{,}99$.

However, χ^2 = 134,5>5,991= Z_{kp} (0,95).

Therefore, hypothesis K is also rejected. It can be noted that the differences between the teaching methods in the experimental and control groups are not accidental, but on the contrary, they are legal and always lead to an increase in the mastery rates.

If the significance level of the statistical sign is taken as α= 0.05, then the critical point for statistics from the Laplace function table is determined from the equation Tkr: $T_{кр}$ 1,96. From this, reliable deviations of the estimate based on Neumann's idea are found:

$$\Phi(t_{кр}) = \frac{1 - 2\alpha}{2} = \frac{1 - 2 \cdot 0{,}05}{2} = \frac{0{,}9}{2} = 0{,}45$$

equal to, in the control class

while:

is equal to

$$\Delta_y = t_\gamma \cdot \frac{S_y}{\sqrt{n}} = 1{,}96 \cdot \frac{0{,}83}{\sqrt{199}} = 1{,}96 \cdot \frac{0{,}83}{14{,}1} = \frac{1{,}6268}{14{,}1} \approx 0{,}11$$

From the obtained results, a confidence interval for the experimental class is found:

$$\overline{X} - t_{кр} \cdot \frac{S_x}{\sqrt{n}} \le a_x \le \overline{X} + t_{кр} \cdot \frac{S_x}{\sqrt{n}}$$

confidence interval for the control class:

$2{,}33 - 0{,}08 \le a_x \le 2{,}33 + 0{,}08$ $\qquad$ $2{,}25 \le a_x \le 2{,}41$

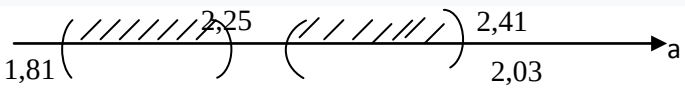
This can be represented geometrically:

$$\overline{Y} - t_{кр} \cdot \frac{S_y}{\sqrt{n}} \le a_y \le \overline{Y} + t_{кр} \cdot \frac{S_y}{\sqrt{n}}$$

$1{,}92 - 0{,}11 \le a_y \le 1{,}92 + 0{,}11$ $1{,}81 \le a_y \le 2{,}03$

This can be represented geometrically:

experimental class



control class

Based on the significance level of x=0.05, it should be noted that the average grade in the control group is lower than the average grade in the experimental group, and it should be

noted that the intervals do not coincide with each other. So, based on the mathematical-statistical analysis, it was determined that a positive result was achieved.

Based on the above indicators, it is necessary to calculate the efficiency indicators of the experiment.

As we know, equal to

$\overline{X}$ =2,33; $\overline{Y}$ =1,92; $\Delta_x = 0{,}08;\ \Delta_y = 0{,}11$

Quality indicators for us:

$$K_{усб} = \frac{(\overline{X} - \Delta_x)}{(\overline{Y} + \Delta_y)} = \frac{2{,}33 - 0{,}08}{1{,}92 + 0{,}11} = \frac{2{,}25}{2{,}03} = 1{,}11 > 1;$$

$$K_{ббб} = (\overline{X} - \Delta_x) - (\overline{Y} - \Delta_y) = (2{,}33 - 0{,}08) - (1{,}92 - 0{,}11) = 2{,}25 - 1{,}81 = 0{,}44 > 0;$$

As mentioned above, it was clarified that the average value of the scores in the control class is 13.7% lower than in the experimental group. It can be understood that organized scientific research studies have been proven to be effective.

From the obtained results, it can be noted that the criterion for evaluating the level of knowledge is greater than zero, and the criterion for evaluating the effectiveness of education is greater than one. It is known that the mastery of the respondents in the control group is lower than the mastery of the respondents in the experimental group. So, it was confirmed that the experimental work on forming the diagnostic culture of students during the educational process was effective.

2. Conclusion

Conclusions were made on the basis of the determined indicators of the conducted experimental work: the results of the pedagogical experimental work were used to find confirmation in practical activities of the hypothesis put forward regarding the formation of the diagnostic culture of students in the process of learning in an innovative educational environment. the developed model, the content-essence of education, the special intensive teaching methods selected for its purpose-task, methodological and technological developments of the lessons (lectures, practicals, seminars) developed based on these, scientifically proved that the organizational forms and tools for their implementation were selected in accordance with the purpose. The results of the experimental tests revealed that the theoretical knowledge, practical skills and qualifications of the respondents of the experimental classes are much lower than the respondents of the experimental classes.

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