



Research Article

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Methods for Measuring the Formation of Design and Research Activity of Students

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Abstract

The paper investigates a methodology for measuring and assessing the formation of design and research activities of students in the study of the theory of limits in mathematical analysis. The research required solving the problem of measuring the impact of problem-based learning, independent study on the level of students' design and research activities. To control the quality of students' knowledge, the indicators of mastering the materials are conventionally divided into 4 levels: the level of familiarity, the level of reproduction, the level of skills and abilities and the level of creativity. The results of the study showed that experimental materials had a positive effect on the growth of the level of knowledge, skills and abilities of students, and experimental materials can be included in the content of the main course of mathematical analysis.

Keywords: thinking, development, design and research activity, assessment, measurement, method and units of measurement, measurement results

1. Introduction

Determining the level of development of thinking or mental development of students is a difficult but promising work necessary to assess the developing side of learning.

Mental development is the result of students' cognitive activity, and therefore it becomes necessary to identify the levels of formation of students' cognitive activity.

Measuring and evaluating the results of students' cognitive activity is the most important concept of didactics. Evaluation is a conclusion about the qualitative characteristics of the phenomenon or process of interest to us, expressed in a descriptive or quantitative form. An objective assessment is always based on measurement results. At the same time, the measurement acts as a fundamental principle, and the measurement result is the most powerful argument in the aspect of

assessment. Evaluation summarizes the measurement results.

The measurement process includes the following components: object of measurement (measured value); method and units of measurement; an experimenter (or a recording device) who measures and records the measurement results; measurement results (in the form of named numbers).

In our study, the object of measurement is the cognitive activity of students in the classroom.

2. Method

Currently, there are several points of view regarding the unit of measurement of educational material and cognitive activity of students. The practice of teaching is attracted by two directions: element-by-element analysis, with the help of which the dissection and systematization of educational material is carried out, and the concept of the phased formation of mental operations, which develops in terms of programming the mental activity of students during training.

In the first direction, it is argued that in didactics, it is advisable to take the "semantic element", in particular, the "exercise" (Erdniev, 1992) and the concept (Fridman, 1991) as a unit of breaking down knowledge and educational material and others. In teaching methods, a relatively simple way of dividing educational material is used: the so-called "cognitive objects" (formulas, laws, phenomena, rules of proof, computational procedures, etc.) are distinguished. The unit of measurement is the "educational element" - the smallest portion of the educational material, which can include concepts, judgments, inferences, and logical conclusions. In other words, these are fragments of text that are complete in meaning.

The second direction identifies "operation" as a unit of measurement.

With types of scientific knowledge, i.e. with its logical form, certain activities are associated. Every day in the classroom, students perform various actions that make up their daily cognitive activity. Therefore, we believe that first it is necessary to determine the methodology for measuring the formation of the level of students' cognitive activity. Therefore, we used the following methods below (mathematical and statistical processing of experimental materials. (Reliability of research results).

Statement of the question. In addition to verbal methods of evidence, the problems raised experimental research methods are widely used in the work. This paragraph sets out the following questions:

- a. Measurements of quantities characterizing the author's assumptions;
- b. Static processing of measurement results;
- c. Revealing their reliability using the methods of mathematical statistics.

First, we will give a general presentation, and then fill it with specific calculations.

Measurement of quantities. The study required solving the problem of measuring the impact of problem learning, self-study and play methods on the level of cognitive activity of students.

Such a measurement was carried out by us using the method of VP Bespalko, published in the book "The terms of pedagogical technology" (Bespalko, 1989).

The coefficient of assimilation is introduced K_α ; $K_\alpha = a/p$; here $(0 \leq K_\alpha \leq 1) \rightarrow (0 \leq a \leq p)$.

It is compared with any rating scale. Finding " K_α " is the operation of measuring the quality of assimilation H_0 , the coefficient of assimilation judges the completion of the learning process. The studies carried out show that the $K_\alpha \geq 0,7$ learning process can be considered complete, because in subsequent activities, the student is able to improve his knowledge in the course of self-study. When assimilating with $K_\alpha < 0,7$ the student, in the subsequent activity, he commits systematic errors and is not capable of correcting them (Dadanov et.al 1992).

We will adhere to the indicated provisions found by Bespalko. There are four levels of

assimilation $\alpha_1, \alpha_2, \alpha_3, \alpha_4$, the selection principle of which is indicated above. With the growth of the index, the experience and knowledge of students grow.

We have compiled special tasks to measure each level.

Coefficients $K_{\alpha}^j = \frac{a^j}{P}$ for each problem (i) and each student are different ($i=1,2,3,4$; j - depends on i - and students).

As a result of the measurement, 4 variation series will be obtained: $i=1,2,3,4$; j - number of students. $\sum_{j=1}^j n_i^{(j)} = n_i$.

K_{α}	K_{α}^1	K_{α}^2	K_{α}^3	...	K_{α}^j
n_i	n_i^1	n_i^2	n_i^3		n_i^j

Statistical Processing of Measurement Results

1) For each student (j) find the average value. $\bar{K}_a^{(j)} = \frac{1}{4}(\bar{K}_{\alpha_1}^{(j)} + \bar{K}_{\alpha_2}^{(j)} + \bar{K}_{\alpha_3}^{(j)} + \bar{K}_{\alpha_4}^{(j)})$, j -student number.

2) We write down the variation series:

$\bar{K}_a^{(j)}$	\bar{K}_a^1	\bar{K}_a^2	\bar{K}_a^3	...	\bar{K}_a^j
m	m_1	m_2	m_3		m_j

3) Calculate: $\bar{K}_a = \frac{1}{N}(\bar{K}_{\alpha_1}^{(1)} \cdot m_1 + \bar{K}_{\alpha_2}^{(2)} \cdot m_2 + \dots + \bar{K}_{\alpha_j}^{(j)} \cdot m_j)$, $N = m_1 + m_2 + m_3 + \dots + m_j$.

4) Mean square deviation: $\sigma_a = \sqrt{\frac{1}{N}[(\bar{K}_{\alpha_1}^{(1)} - \bar{K}_a)^2 \cdot m_1 + (\bar{K}_{\alpha_2}^{(2)} - \bar{K}_a)^2 \cdot m_2 + \dots + (\bar{K}_{\alpha_j}^{(j)} - \bar{K}_a)^2 \cdot m_j]}$.

5) Find point 3 and 4 for the control ($K_{\alpha}^{(b)}, \sigma_{\alpha}^{(b)}$) and experimental ($\bar{K}_{\alpha}^{(r)}, \sigma_{\alpha}^{(r)}$) groups.

Testing the Hypothesis: The Reliability of the Result

Introduces hypothesis H_0 - mathematical expectations $\bar{K}_{\alpha}^{(a)}$ and $\bar{K}_{\alpha}^{(r)}$ coincide. Her alternative H_1 - do not match. Let's choose the level of significance $\beta = 0,05$. According to the theory [4. 59 p.] For

the match $\bar{K}_{\alpha}^{(a)}, \bar{K}_{\alpha}^{(r)}$ the relation must be fulfilled $P(|\bar{K}_{\alpha}^{(a)} - \bar{K}_{\alpha}^{(r)}| \leq t \cdot \sqrt{\frac{(\sigma_{\alpha}^{(a)})^2}{N_a} + \frac{(\sigma_{\alpha}^{(r)})^2}{N_r}} = 2 \quad \phi(t) = 0,95$

Here $\phi(t)$ is the Laplace function, which is given by the table [4]. The table is used to find $t = 1,96$ (for a significance level of 0.05).

If the inequality $P(|\bar{K}_{\alpha}^{(a)} - \bar{K}_{\alpha}^{(r)}| \leq t \cdot \sqrt{\frac{(\sigma_{\alpha}^{(a)})^2}{N_a} + \frac{(\sigma_{\alpha}^{(r)})^2}{N_r}} = 2$ is satisfied, then the hypothesis H_0 with a reliability of 0.95 is accepted. If the reverse inequality holds, then the hypothesis is accepted H_1 .

Verification of Experimental Data. According to Points 1-4 - We Get Data for the Experimental and Control Groups

- We write down the proposed tasks.
- We write down the table with the answers.
- We compose the variation series for K_{α} .
- We calculate all the values.

E. We test the hypothesis H_0 . Why do we count $|\bar{K}_{\alpha}^{(a)} - \bar{K}_{\alpha}^{(r)}|: |\bar{K}_{\alpha}^{(a)} - \bar{K}_{\alpha}^{(r)}| \geq 1,96 \sqrt{\frac{(\sigma_{\alpha}^{(a)})^2}{N_a} + \frac{(\sigma_{\alpha}^{(r)})^2}{N_r}}$, i. e. the hypothesis H_1 is accepted.

Conclusion

3. Results

Quality control of students' knowledge, based on specially created materials-tasks. For each level of assimilation (imitative, reproductive, search-performing and creative cognitive activity) of experience, in order to identify the degree of its assimilation, the corresponding tasks should be developed. The task consists of assignments for the activity of a given level and standard, i.e. a sample of complete and correct performance of an action. By the standard it is easy to determine the number (p) of essential operations leading to the solution of problems. Comparison of the student's answer with the standard by the number of operations correctly performed by students (a) the task makes it possible to determine the assimilation coefficient K

Tasks to control the level of assimilation of experience.

I.1 $\lim_{x \rightarrow \infty} (x^3 - 6x^2 + 5x - 1)$	I.2 $\lim_{x \rightarrow \infty} \left(\frac{5x^4 - 7x^2 + 5x - 4}{x^4 + x^2 + x + 1} \right)$
I.3 $\lim_{x \rightarrow \infty} \left(\frac{x^3 + x + 2}{x^2 - x + 1} \right)$	I.4 $\lim_{x \rightarrow \infty} \left(\frac{3x^3 - 2x^2 + x}{2x^3 + x - 1} \right)$
II.1 $\lim_{n \rightarrow \infty} (\sqrt{n^2 + n} - n)$.	II.2 $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 1} - \sqrt{x})$.
II.3 $\lim_{x \rightarrow 2} (5x^3 - 6x^2 + x - 5)$	II.4 $\lim_{x \rightarrow \infty} \left(5 + \frac{2}{x} - \frac{3}{x^2} \right)$
III.1 $\lim_{x \rightarrow 0} \frac{\sqrt{1+x^2} - 1}{\cos(e^x - 1) - 1}$.	III.2 $P = \lim_{x \rightarrow 0} (\cos x)^{1/(1-3^x)}$.
III.3 $P = \lim_{x \rightarrow 0} \frac{\sin x - \operatorname{tg} x}{x^3}$.	III.4 $\lim_{x \rightarrow \infty} x^{\frac{3}{2}} (\sqrt{x^3 + 2} - \sqrt{x^3 - 2})$
IV.1 $\lim_{x \rightarrow 0} \frac{\sqrt{1+x^2} - 1}{x^2}$	IV.2 $\lim_{x \rightarrow 0} \frac{\sqrt{1+x^2} - 1}{x^2}$
IV.3 $\lim_{x \rightarrow 0} \frac{\sin(2x)}{x}$	IV.4 $\lim_{x \rightarrow -\infty} x \left(\frac{\pi}{2} + \operatorname{arctg}(x) \right)$

The first level: characterized by the ability to reproduce the method on a specific content and in its original form;

The second level: characterized by the ability to give a materialized (verbal or schematic) description of the studied method;

The third level: characterized by the ability to transfer the learned method.

- I. complete answer - 4 points;
- II. the answer is partially complete - 3 points;
- III. the answer is not complete (fragmentary) - 2 points;
- IV. satisfactory answer with attempts to solve - 1 point;
- V. did not start the task - 0 points.

4. Discussion

Psychologists and didactics define the essence of "cognitive activity" in different ways. One of them defines it as "cheerful mood", "cheerfulness", "a certain pace of work", "friendly climate" in the classroom (Shmorgun, 1966); others - as a combination of individual and collective forms of cognition (Aristova 1988); the third - as the systematic increase in the cognitive difficulty of educational work (Polevnikov, 1991); fourth, how to teach students rational methods of cognitive activity (Mavlyanova,

1989); fifth, how the formation of internal stimuli for learning, self-education (Schukina, 1972); sixth – as the formation of positive motives of learning among students (Shamova, 1982).

The analysis of scientific research has shown that the psychological and pedagogical features of design and research activities are mainly scientifically interpreted in relation to the general education school Kosikov (2013), Gorev and Oshergina, (2015), Kruglik (2013), T.S. Tsybikova (2014), Khlapushin and Savina (2015), Lipatnikova (2012), Perevoshchikov (2015) and others. The issues of its organization at the university are actualized in the dissertation research of Charikova (2017), Zakirova (2020), Zadorozhnaya (2011), Kuznetsov (2013), Omarova (2021). These works have theoretical and practical significance, but the authors do not disclose the essence of students' design and research activities, the methods they have developed for organizing this activity in the educational process imply parallel or sequential involvement of students in design and research activities. Zadorozhnaya and Kochetkov (2018), Kalimbetov, Omarova and Ibragimov (2019) consider the possibility of introducing the fundamentals of project activities to expand and deepen knowledge of mathematical analysis through the implementation of educational projects.

The inclusion of students in project activities allows transforming theoretical knowledge into professional experience and creates conditions for personal self-development, allows them to realize their creative potential, helps students to self-determine and self-actualize, which, ultimately, forms the general and professional competencies of graduates of higher education, ensuring competitiveness and demand for labor market.

Psychological and pedagogical studies have recorded various levels of students' cognitive activity.

Studies of didactics and great thinkers (I.F. Kharlamova (1995), Lerner (1981), Makhmutova (1975), etc.) and our experimental data have shown that the design and research activities of students can be performed at four levels: at the imitative, at the reproductive (reproducing), at the search-performing and creative.

With the imitative nature of the activity of students' cognitive activity of mastering knowledge, skills and abilities given in finished form, the approximate basis of cognitive actions is perceived and remembered;

The operations that can be understood are mainly based on visual, auditory perception and motor-motor memory; the action is performed according to ready-made samples, at the level of imitation, copying, the level of cognitive activity and independence does not go beyond reproduction; schoolchildren have difficulty in justifying the methods of performing operations; the actions performed are unstable to changing conditions, their transfer to new tasks is difficult, students are deprived of the opportunity to independently solve theoretical and practical issues.

With the reproductive nature of mastering knowledge, abilities and skills (reproductive activity), the orienting basis of the action is clearly recognized and remembered; assimilated theoretical positions are organically combined with their practical applications.

With the search-executive nature of mastering knowledge, abilities and skills at the stage of perception and comprehension, they are guided by the solution of other mathematical problems;

The fourth level: characterized by the ability to apply the learned method (method) to solve problems in life.

The results of the control work were determined according to the conventionally allocated five levels with an assessment for each task:

Basically, actions are most observed in the manifestation of the highest form of activity and independence in the process of discovering subjectively new unknown knowledge about the conditions and methods of action; the assimilation of knowledge takes place at a high theoretical level, in close connection with practical application, the scope of search activity expands in the process of mastering the theoretical basis of skills:

With the creative nature of mastering knowledge, abilities and skills, there is a different difference in the content and nature of the content, operational and motivational aspects of cognitive activity.

Higher education is called upon to educate the young generation capable of thinking and acting independently. That is why, didactics and advanced teachers with particular persistence are looking for ways of development among students, the formation of active cognitive activity.

Eretsky and Porotsky (1978) in his research reflects four levels of assimilation (level of activity): I-level of acquaintance, II-level of reproduction, III-level of skills and abilities and IV-level of creativity.

Students who have reached level I are able to recognize the studied subjects, objects, properties, but only if they are presented with them themselves or their description, image, characteristics - in this case they have knowledge-acquaintances.

At this level, the following types of student activity can be outlined: identification, discrimination, correlation.

At the II level of assimilation, a student can recollect (repeat) information, operations, actions learned during training, - he has knowledge-copies.

At this level, one can notice the following types of student activity: literal and reconstructive reproduction.

At the III level of assimilation, the student is able to perform actions, the general methodology and sequence (algorithm) of which were studied in the classroom, but the content and conditions for their implementation are new: skill, skill.

At the IV level of assimilation, the student is able to independently navigate in new for him, unexplored situations, draw up a program (methodology) of actions and carry it out, offer new, previously unknown solutions. His activity is of a research "search character".

There are two types of creative activity: solving a given problem, posing a problem and solving it.

Assimilation is subordinated to the principle of a hierarchy of levels: a student cannot reach a given level without having mastered the educational element in previous lessons. So, in order to master any educational element at the III level, you must first master it at the I and II levels.

5. Confirmations

The most important stage of our research is the study and generalization of its experimental results. The pedagogical experiment was carried out in order to determine the pedagogical work on the use of didactic tools that increase the active cognitive activity of students, to check the availability and effectiveness of the proposed recommendations.

Analysis of the results obtained showed the following:

First, the most preferred means of activation at all stages of educational cognition is conversation, which is also consistent with the results of observation of the lessons. Another means of activation, which was named by 78% of teachers surveyed, is independent work.

Secondly, it turned out that teachers in 86% of cases showed a lack of understanding of the essence of the problematic approach to teaching.

Third, the answer to the question about teaching students cognitive skills caused a big difficulty. 35% of teachers did not answer this question.

Fourth, many teachers associate the main difficulty in organizing active cognitive activity with the lack of textbooks; overload of their content (72%), poor methodological apparatus (65%). Among the difficulties is the lack of didactic materials that help organize a system of independent work of students (61%) and allow an individual approach to learning (82%).

Thus, the survey of teachers showed that their difficulties in the formation of active cognitive activity of students are largely associated with objective reasons (textbooks, didactic materials, educational and methodological literature), but they are also caused by the lack of understanding by many teachers of the essence of the formation of active cognitive activity of students, the lack of their knowledge of the ways and means of enhancing the teaching of students, and this is confirmed by the results of the tests.

Control works, carried out at various intervals, showed that approximately 26-28% of freshmen did not cope with solving problems. They were especially challenged by tasks of a creative and problematic nature.

The last cycle of practice made it possible to identify expedient means of mentoring, forms of organizing educational work on the proposed list. The search results were checked on the basis of analysis and comparison of the quality of the questions posed in the control and test groups. Below are some indicators of many materials obtained in the first and second stages.

When determining the above indicators, the fulfillment of control works planned in the educational schedule was checked in order to determine the degree of mastering the program material by students. Having prepared the methods of conducting practical exercises, we felt the need to pay special attention to the following pedagogical conditions:

- a. in order to develop the educational activities of students, the content opportunities of the educational material were used (to master any knowledge, students must choose tasks that require the process of improving a certain type of their scientific and project activities of students (SPAS);
- b. when performing tasks, ensure that the design and research activities of each student correspond to their capabilities (if the learning process is individualized with design calculations differentiated by types of design and research activities), it is possible to achieve such compliance);
- c. maintaining a high level of improvement of the SPAS in the course of classes (for this purpose, it is necessary to ensure the renewal of the forms of activities of subjects in the classroom).

To obtain extensive and objective data on the degree of improvement of the SPAS, future specialists in mathematics in universities of practice and control, the following principles of the methodology for preparing control papers were chosen:

1. introduction of tasks requiring various degrees of design and research activity of future mathematicians in the study of the theory of limits into the content of test papers;
2. the degree of complexity of students' development, the choice of tasks corresponding to design and research activities in teaching the theory of limits;
3. ensure the absence of random situations when choosing problems that have developed in a difficult or required degree on the part of students.

The tests were carried out in two versions for each semester. In these variants, tasks are presented at four different levels, each of which combined tasks according to its degree of difficulty (four tasks on one page) and included 16 tasks in total. The statement of this situation allows students to independently choose tasks of different levels. Thus, the requirement was set to fulfill the level assignments.

The tasks of the first option are given in ascending order in the process of solving them in accordance with the degree of maturity of the design and research activities of students: four tasks-I, four tasks - II, four tasks - III, four tasks-IV level.

In the second version, 16 reports were placed in scattered form in checklists, and even complex calculations were obtained. In this case, we assume that: if students are given only the first option, they can only select the first four problems in the test. This situation prevents students from knowing judgments in choosing a level in the order of the tasks.

In the second option, there may be the following cases:

I. suppose that in different variants the students have chosen the first four problems. In this case, no attention is paid to solving the problems of the first option. The presence of a solution to the second option allows you to evaluate the results of the answer to all four levels of tasks.

II. The choice of reports in the first and second types does not correspond to each other. Thus, students consciously choose tasks of four different levels.

Conclusions about the results of practice are made based on the following facts:

- firstly, at the choice of students, tasks, the solution of which is associated with renewal or

- active mental actions of various degrees .;
- secondly, by determining the complexity of tasks on the part of students;
- thirdly, a conclusion was made based on a discussion of the reasons, arguments based on their actions.

This method of checking the results made it possible to obtain complete information about the reasons for improving the design and research activities of future mathematicians, their readiness to solve problems.

Table 1 below shows the average result for groups and years of study of students who completed the work from "75 to 86" points or 4 and 5 grades "from 86 to 100 points".

Table 1: The results of students who received the mark "4" or "5" for the performance of work in the control and practice groups

Number of students		First semester		Second semester	
Control	Experiment	Control %	Experiment %	Control %	Experiment %
54	86	30	57	28	59

We compared the marks received by the students of the control and experimental groups for completing the tasks. That is, we noticed that the number of students studying in the experimental group as excellent and good has increased significantly. Some information is presented in table 2:

Table 2: Indicator of student performance in control and experimental groups

Control	Experiment	«5»		«4»		«3»	
		Control %	Experiment %	Control %	Experiment %	Control %	Experiment %
54	86	29	60	40	25	31	15

The pedagogical experiment was conducted with the aim of determining the viability of our research, checking the content and volume of training materials, the value of the proposed recommendations, contributing to the study of active design methods, improving the design and research activities of future mathematicians. As a result of its implementation, we also had the opportunity to identify various methods and ways of activating in relation to the study of traditional materials, to determine the acceptable forms and means of organizing work.

The research was based on the following requirements:

- a. implementation of the logical unity of various methods that provide different approaches to solving the problem;
- b. in the system of internship, no changes should be made to the existing order of the educational system at the university;
- c. ensure the objectivity and reliability of the conclusions.

Comparison of the significance of the design and research activities of students in the control and experimental groups:

1. Choice of the volume and quality of mastering the material of the program;
2. various tasks and questions provided by the practice methodology were carried out according to the results performed by the students.

We used in practice the methods of daily and intermediate control in the form of oral interviews and written works. For oral questioning, questions, tasks or tests were asked in written works. Teachers conducted oral polls to communicate with students. The recording was used to activate the learning process.

The students of the experimental group were conscious of the choice of difficult tasks relative to the control group. In the design and research activities of each student, there was an increase in the choice of level tasks, the level of students' independent work increased. For example, we noticed that

the percentage of 1st year students responded to questionnaires.

In practice, in teaching on educational material, the interest of students from the experimental groups to mathematics increased (75.2%), the interest of the controlling groups increased only by 3.9%.

According to the results of the study, students from the experimental group showed that they most often used new methods for solving atypical problems (table 3).

Table 3: Results of solving atypical problems of students of experimental and control groups

Type of work	Experiment group%	Control group%
Solving problems in a textbook in a certain way	89,2	76,2
Solving simple problems in a new way	16,4	2,5
Solving atypical problems	44,4	7,5
Solving simple problems	57,6	17,4
Find new patterns in solving atypical problems	39,5	2,3

Thus, we managed to be convinced of the development of improving the design and research activities of the students of the experimental group.

Now, according to the above mathematical and statistical processing, the following tables can be compiled, reflecting the degree of improvement of the students' NPA.

Taking into account the results of the work of the experimental and control groups, we have achieved the following results. We present their results in the tables below (table 4, table 5).

Table 4: Indicators of the development of design and research activities of students of the experimental and control groups

groups	$\overline{K}^{(T)}$	σ_α	$\overline{K}^{(\delta)}$	σ_α
1	0,63	0,20	0,94	0,15
2	0,61	2,58	0,98	0,17
	$\overline{K}^{(T)} \approx 0,62$	$\sigma_\alpha \approx 0,77$	$\overline{K}^{(\delta)} \approx 0,96$	$\sigma_\alpha \approx 0,95$

$$\left| \overline{K}^{(\delta)} - \overline{K}^{(T)} \right| \geq 1,96 \cdot \sqrt{\frac{(\sigma_\alpha^{(\delta)})^2}{N_\delta} + \frac{(\sigma_\alpha^{(T)})^2}{N_T}}, \quad 0,34 > 0,16$$

Therefore, this assumption is true. The experimental results are confirmed.

Now, based on the above mathematical and statistical processing of experimental materials, it is possible to compile the following tables reflecting the levels of formation of NPDS, future specialists in mathematics:

Table 5: The growth of the degree of mastering knowledge (design and research activities by students of the experimental and control groups

Groups	quantity students	The level of design and research activities							
		I		II		III		IV	
			%		%		%		%
Experimental group	86	12	14	28	33	30	35	16	18
Control group	54	10	19	25	46	15	28	4	7
Total	140	22	16	53	38	45	32	20	14

The students of the experimental groups began to consciously approach the performance of tasks in relation to their peers in the control group. First, consider how students select tasks. Many of the

students in the control groups avoided difficult tasks whenever possible. Of these, 40% chose difficult problems of 1 degree and 25% - 2 degrees.

The students of the experimental and control groups showed that they distinguished between simple tasks on an equal level. Students of the control groups of medium and high degree of difficulty of the tasks could not clearly distinguish, and the students of the experimental groups showed the full level of the task.

Thus, the results of the practice showed that the students of the university had a positive effect on the growth of the level of knowledge, skills and abilities, the correctness of the material found, it can be concluded that the experimental and test materials can be included in the content of the main course.

At the same time, these findings showed that the university can prevent corresponding gaps and difficulties in teaching future mathematicians using design methods and multi-level tasks and role-playing games.

6. Conclusion

The system of means of enhancing the cognitive activity of students used by us has led to a wider combination of different independent work of students. One of the most significant qualitative changes in cognitive activity is the change in the nature of independent work of students.

The implementation of tested means of enhancing learning led to the fact that teachers began to use more tasks that ensure the activities of students in a similar and new situation than work according to the model.

These data indicate that the main condition that ensures active learning is the preparedness of students for independent cognitive activity, which depends on the students' availability of appropriate knowledge and skills to independently manage their own learning process. This self-governing activity is ensured by the ability to plan it, organize oneself for implementation. Thus, the use in a complex of techniques and methods for enhancing the cognitive activity of students allows them to develop their interest in knowledge at all stages of the educational process.

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