Indian Journal of Science and Technology, *Vol 8(13), 59959, July 2015*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Results of the Pedagogical Experiment for Determination of Forming of the basic Knowledge in Mathematics

Aray Zhanys* and Saule Nurkasymova

[1]Department of Information Systems and Computer Science, Abay Myrzakhmetov Kokshetau University, Kazakhstan; aray.zhanys@gmail.com
[2]Department of General and Theoretical Physics, L.N. Gumilyov Eurasian National University, Kazakhstan; SauleNurkasim@mail.ru

Abstract

The primary purpose of this work is the design and modification of the methodical system of teaching mathematics to the bachelors of a nonmathematical specialty within the competence-contextual learning approach. To achieve this goal the following methods were used: analysis of psycho-pedagogical and methodological literature related to solving mathematical problems; systematization of students' mathematical knowledge; algorithms and programming training systems; mathematical methods based on probability theory and mathematical statistics. Mathematical competence level was also estimated by survey and testing. The results were statistically treated and compiled in the comparative figures which indicate the basic investigational index in experimental and control groups. The paper reflects the principles of the competence-based approach, the differentiation of tasks in terms of complexity, content and type. Diagnostic work contains three variants of the border works for students of technical and agronomical faculties. The data of the first and second variants of the border works proved that the absence of base knowledge is one of the reasons of poor solving of mathematical tasks by bachelors. As a result of the research, it was shown that only 52,7% of students solved mathematical tasks to a full degree; and 6,9% of students did not solve any mathematical tasks. The educational technology of V. M. Monakhov, creating conditions for level differentiation of the learning process and taking into account the personal characteristics of students, and technology of planning of the methodical system for mathematics teacher by T. K. Smykovskaya are taken as the basis. Scientific novelty lies in the formation of a system for measuring core competencies through special tasks and competence-contextual learning approach, the use of which will contribute to the formation of basic blocks of knowledge, interconnections between these blocks, and thereby to a solution of tasks and systematization of students' knowledge in mathematics. This system promotes the modernization of teaching mathematics to students of different specialties.

Keywords: Competence-contextual Approach, Educational Technology, Integral Assessment, Mathematics Basic Knowledge, Task Solution

1. Introduction

In the pedagogical experiment various tests and control works have been organized with the aim to determine the level of formation of the basic knowledge in mathematics. The pedagogical experiment has been conducted in three stages, in the period of 2005-2010, on various topics of the course of "Higher Mathematics" for bachelors on nonmathematical specialty.

The first stage of the pedagogical experiment carried the establishing character. As it was mentioned before, solving of mathematical tasks from different professional areas is the aim of teaching mathematics on nonmathematical specialties and it supposes forming of the system of mathematical knowledge and selection of this knowledge for the decision of professional tasks[1]. As L.M. Friedman fairly notices: "Task solving is a difficult activity. In order to assimilate it consciously, it is necessary,

** Author for correspondence*

firstly, to have a clear idea about its objects and essence, secondly, to comprehend those elementary actions and operations this activity consists of, and, finally, to know the basic methods of its implementation and be able to use them[2]".

Bachelors, as our researches showed, poorly solve mathematical tasks and professional tasks related to them[3]. Our study showed that the basic reason is the absence of the basic mathematical knowledge and fundamental basis, on which solving of tasks and ability to set connections between a subject domain and mathematical knowledge is built. At this stage of research we carried out the choice of the educational material for the study of that expedient defined the base blocks of mathematical knowledge, and then organized its forming and showed the connections between them, which helped to teach bachelors the generalized reception of solving of mathematical tasks.

Our researches showed that after studying the course of "Higher mathematics", the bachelors of nonmathematicians use this knowledge for decisions of professional tasks very badly. We found out that difficulties are related to the establishment of mathematics within a professional area.

2. Discussion

According to R. C. Jaeger, one of the main methods for identifying and evaluating competencies are observation, questioning and testing, which were used to assess the level of formation of the competence components of mathematics future teachers[4].

The notion of knowledge is of great interest to educators and researchers since Shulman[5] introduced the notion of pedagogical content knowledge[6]. During learning of mathematics, students face a wide range of new concepts and find some mathematical concepts and principles too abstract to comprehend[7]. They need to integrate new mathematical aspects and develop pervious concepts[8].

Evidence is now emerging that curricula and teaching practices consistent with some recent efforts toward educational reform show promise for improving students' learning of mathematical skills with deeper conceptual understanding[9].

We will set a concept of the basic block of knowledge of mathematics and criterion it is formed on. As it is generally known, for solving tasks we use one or a few mathematical facts (determination, theorem, investigation and other), and geometrical and algebraic receptions. Under the basic block of knowledge we understand such block of knowledge that contains a geometrical and algebraic fact and receptions of its use in practice of solving tasks[10,11]. The criteria of the formed basic block of knowledge are:

- Theoretical knowledge and understanding of the mathematical fact;
- Ability to direct and (at simplest level) practically use the mathematical fact with the help of elementary mathematical receptions (type of action above shots, degrees, roots and etc.);
- Establishing connections between the blocks of knowledge[12,13].

It was discovered at this stage that it is possible to examine the process of teaching bachelors about the connections between the blocks of knowledge, after they were formed, as one of the directions of teaching the decision mathematical tasks to students. It supposes the generalized reception: to solve a task, you need to split a task into elementary (well-known) under tasks, solve them, and to collect all solutions in one logically coherent unit[14]. Therefore, at this stage we conducted an experiment during which the following information was checked up:

- Whether the basic blocks of knowledge are formed purposefully on the lessons of higher mathematics.
- Whether the unformed corresponding basic blocks of knowledge is one of the reasons of bad solving of mathematical tasks.
- Choice of educational material.
- Presence of possibilities for realization of purposeful work on forming of the basic blocks of knowledge for the bachelor.
- Presence of realization of purposeful work on teaching connections between these blocks using context approach for students.
- Relation of students to the computer on the mathematics lessons.

Our supervisions, attendance of lessons, conversations with professorial-pedagogical members, gave us the full answers for the first part of this experiment. The answers of the professorial-pedagogical members were: it is not required by scientifically methodical literature; it requires educational extra-time which we do not have; bachelors are not able to master what required by curricula, and this will be the additional loading for them[15–17].

On the basis of this questioning and personal experience in institution of higher education there has been concluded that the purposeful work on selection and formation of the basic blocks of knowledge in mathematics is not conducted at the lessons.

At this stage of experiment we proved that the unformed basic blocks of knowledge is one of reasons for bad solving of mathematical tasks by students non mathematicians. For this purpose the border works were conducted on the special chart in three variants. All variants of the border works are identical on the level of complication and maintenance. Below the texts of the border works are presented:

2.1 Border Task

Variant №1

1. Give the determination of parabola and write the formulas of all its elements.
2. Give the determination of module (length) vector.
3. Write the determination and formulas for the second remarkable limit
4. Calculate the determinant of this matrix using the method of Sarrusa and method of triangles.

$$\begin{pmatrix} 1 & 0 & 2 \\ 3 & -1 & 0 \\ 1 & 1 & -2 \end{pmatrix} \tag{1}$$

5. Find the matrix 2A * B, if:

$$A = \begin{pmatrix} 2 & 1 & 1 \\ 3 & 0 & 1 \end{pmatrix} \tag{2}$$

$$B = \begin{pmatrix} 3 & 1 \\ 2 & 1 \\ 1 & 0 \end{pmatrix} \tag{3}$$

6. Solve this system of equalizations using the method of Gausse and Cramer.

$$\begin{cases} 2x + 3y + 5z = 10 \\ 3x + 7y + 4z = 3 \\ x + 2y + 2z = 3 \end{cases} \tag{4}$$

7. A triangle is given with tops A (-2; 1; 3), B (0; 3; 4) and C (1; 5; 3). Calculate the length of the bisector of internal corner of A.
8. Work out an equation of line passing through points A (-1; 8) and B (7; 1).
9. Calculate the limit:

$$\lim_{x \to 1} \frac{x^2 - 2x + 1}{x^2 + 3} \tag{5}$$

10. Find the derivative of function:

$$y = \frac{5}{4}x^3 - 3\mathrm{Sin}\frac{x}{2} \tag{6}$$

Variant №2

1. If corresponding elements at a determinant will be proportional, then what is equal to its determinant?
2. Define equalization of the plane passing through a point and perpendicular vector.
3. Write the determination and formulas of the first remarkable limit.
4. Calculate the inverse matrix of this matrix.

$$\begin{pmatrix} -3 & 0 & 1 \\ 1 & 3 & -1 \\ 2 & 4 & 2 \end{pmatrix} \tag{7}$$

5. Find the matrix 2A * B^{-1}, if:

$$A = \begin{pmatrix} 5 & 8 & -4 \\ 6 & 9 & -5 \\ 4 & 7 & -3 \end{pmatrix} \tag{8}$$

$$B = \begin{pmatrix} 3 & 2 & 5 \\ 4 & -1 & 3 \\ 9 & 6 & 5 \end{pmatrix} \tag{9}$$

6. Solve this system of equalizations using the method of Gausse and Cramer.

$$\begin{cases} 2x - y - z = 4 \\ 3x + 4y - 2z = 11 \\ 3x - 2y + 4z = 11 \end{cases} \tag{10}$$

7. Write canonical equalization of circumference.
8. Tops of triangle are in points A (2; 1), B (-1; -2) and C (3; 1). Find the length of the height conducted from a point A and write its equalization.
9. Calculate the limit.

$$\lim_{x \to 4} \frac{\sqrt{x^2 - 2}}{x^2} \tag{11}$$

10. Find the derivative of function.

$$y = 3\frac{\sqrt[3]{x^2 + x + 1}}{x + 1} \tag{12}$$

Variant №3

1. Write canonical equalization of hyperbola and formula of all its elements.
2. In the linear system of equalizations specify the sufficient and necessary condition of compatibility.
3. Give the determination to the reverse function.
4. Calculate the determinant of this matrix using the method of Sarrusa and the method of triangles.

$$\begin{pmatrix} 1 & 0 & 2 \\ 3 & -1 & 0 \\ 1 & 1 & -2 \end{pmatrix} \tag{13}$$

5. Find the increase of two matrices.

$$\begin{pmatrix} 1 & 2 & 2 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{pmatrix} * \begin{pmatrix} 1 & -2 & 4 \\ -1 & -2 & 4 \\ 1 & 2 & 4 \end{pmatrix} \tag{14}$$

6. Solve this system of equalizations using the method of Gausse and Cramer.5)

$$\begin{cases} 2x + y - z = 2 \\ x + 2y + z = 4 \\ x + y + 2z = 4 \end{cases} \tag{15}$$

7. A triangle is given with tops A (-2; 1; 3), B (0; 3; 4) and C (1; 5; 3). Calculate the length of the median from a top A.
8. Work out an equation of line passing through points A (-1; 8) and B (7; 1).
9. Calculate the limit.

$$\lim_{\to} \frac{x \quad -6x+9}{x \qquad x} \tag{16}$$

10. Find the derivative of function

$$y = \frac{4+3x^3}{\sqrt[x^3]{(2+x^3)^2}} \tag{17}$$

The border works were conducted in the institutions of higher education in three different groups. The first variant of the border work was conducted in all groups simultaneously and at equal terms. The basic terms of its realization were the following: without special preparation and warning; after (not less) 4-6 weeks of study of topics to which those tasks are devoted; without any assistance from outside (including prompts of students from each other and from a teacher, cribs, reference books, visual aids and etc).

The results of the first variant of the border works are shown on the Tables 1 (technical faculty) and 2 (agronomical faculty). Analyzing Tables 1 and 2 it is possible to mark that:

- On the basic indexes of mastering of knowledge (progress and quality) engineers (90% and 70%) and agriculturists (90% and 69%) are identical.
- The result confirmed the weakness in solving of the mathematical tasks, and the problem of its teaching is actual.

The second variant of the border work was conducted in 2 weeks. On technical faculty it was conducted on the same terms, and on agronomical faculty – on a board with a reference source, consisting of those mathematical facts (determinations, theorems, properties and formulas) that are needed for solving of the offered tasks. This knowledge is a base for solving of the problem data. In the number of the placards there were:

- Formulas of matrices.
- Methods of calculation of determinants of the third and “n” order.
- System of linear equalizations of the third and higher order.
- Vector and its property.
- Determinations and formulas of curves of the second order.
- Equalization of line.
- First and second remarkable limit.

The results of this part (variant 2) of the experiment are driven to Tables 3 and 4.

The analysis of Tables 1 and 2 shows that many students do not own base knowledge necessary for solving of tasks. So on technical faculty the indexes from the first time of realization of the border work to the second did not absolutely change (Tables 2 and 4), and on agronomical faculty the progress is increased by 5% (=95%–90%), and quality – by 11% (=81%–70%). These data show that the absence of base knowledge is one of the reasons of poor solving of mathematical tasks by bachelors.

The third variant of the border work took place after realization certain work on forming of some basic blocks of knowledge necessary for solving of problem data. The analysis showed that for solving of all tasks, mentioned before, three variants needed for students of one (general for all) basic block of knowledge are formed. In this way we found the possibility and method of selection of basic blocks of knowledge. During 4 weeks on technical faculty we conducted the purposeful work on forming of basic blocks of knowledge for bachelors: solving of the system of linear equalizations of the third order. Students first studied the solution of the separately taken determinant of the third order in different ways, requiring theoretical knowledge and understanding of the mathematical facts, after – selection and solution of the determinant and its properties in composition of any system of linear equalizations, using data general for all tasks.

We used a special system of educational tasks (consisting of questions, exercises and tasks of corresponding maintenance and increasing degree of complication), connected with forming of the basic blocks of knowledge. We showed the possibility itself and one of the methods of forming of basic blocks of knowledge.

The results of realization of the third variant of the border work №1 are shown in Tables 5 and 6. As we see from all tables, the indexes on technical faculty, during all three border works, remain unchanged (Table 2, 4 and 6), and on agronomical faculty, the progress grew by 5%, and quality – on 16% (Tables 1 and 5).

Tables 7, 8 and Figures 1and 2 illustrate the state and dynamics of the increase of the basic investigational indexes at this stage.

On Table 8 we can see:

- only 52,7% of students solved mathematical tasks to a full degree.
- a part of students in amount of 30,5% partly solved mathematical tasks.
- 6,9% of students did not solve mathematical tasks.

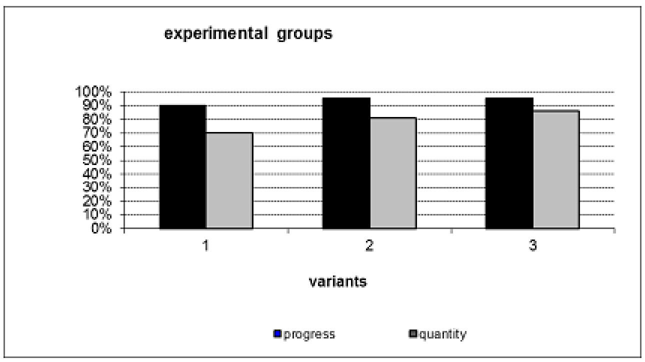

Figure 1. Basic investigational index in experimental groups.

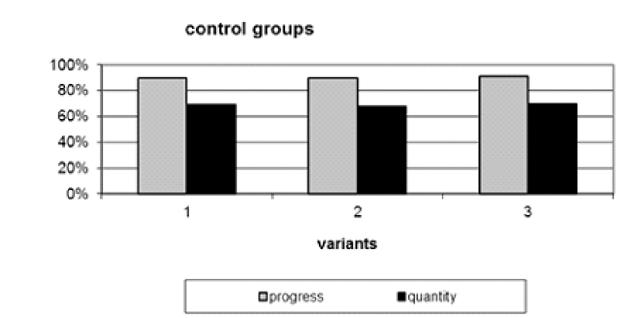

Figure 2. Basic investigational index in control groups.

During this stage of the experiment the necessity and possibility of teaching bachelors about connections between the basic blocks of knowledge and professional tasks of certain subject domain was shown. As it was specified, the process of solving any mathematical task is performed by means of a set of receptions. Every reception, as a rule, supposes the usage of present knowledge, including – the formed (well-known) receptions. If a bachelor of the nonmathematical specialty can choose a certain reception of knowledge necessary for implementation, set the sequence of its use (that is conditioned by vision of connections), then it results in realization of reception and solution of this task. Consequently, the information that this reception is applied for solution of a professional task can correctly testify by implication, from one side, about ability to choose a necessary block from the system of corresponding mathematical knowledge, and from another side – about the presence of working connections between knowledge making basis of certain reception. If a few receptions of solution of tasks of certain type are correctly applied, then it grounds for a conclusion about the presence of effective connections between types of knowledge and ability to realize solutions of professional tasks.

In our research we used the criterion, system of linear equalizations and task on the solution of the system of linear equalizations of "n" order (their solution was constrained with the use of receptions of matrices and determinants of "n" order)[18]. Such tasks were offered to bachelors in form context for solution of professional tasks. For example, for the analysis of operations coming to the linear optimization, transport task, minimization of network and others[19].

To have more objective information about the investigated ability (to combine the educational and professional types of knowledge), we required: firstly, to place the tasks of different levels of complication on the border works; secondly, to characterize the realization of establishing connections between students during realization of certain receptions.

A system of tasks for forming of basic blocks of knowledge, consisting of questions, exercises (to these questions) for verbal solutions and tasks of increasing degree of complication was compiled in a test form and realized as flowsheets.

As a result, we noticed the economy of educational time (8-12 minutes from a lesson) and intensified interest of students to mathematics. We made sure of the necessity and possibility of the use of the context learning, as means of educating for solving professional tasks[20].

Therefore, in the process of the experiment the following was established:

- The quality of teaching of mathematical tasks solving in a professional context remains rather low (35%),

Table 1. The results of the first variant of the border work (technical faculty)

Technical Faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
TTTT-11	28	8 (28,5%)	10 (35,7%)	6 (21,4%)	4 (14,3%)	90 %	63 %
A -22	12	5 (41,6%)	3 (25%)	3 (25%)	1 (8,3%)	89 %	45 %
TTTT-12	30	10 (33,3%)	9 (30%)	9 (30,0%)	2 (6,6%)	95 %	60 %
Total (mean value)	**70**	**23 (32,8%)**	**22 (31,4%)**	**18 (25,7%)**	**7 (10%)**	**90 %**	**50 %**

Table 2. The results of the first variant of the border work (agronomical faculty)

Agronomical faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
Agro -11	30	14 (46,6%)	10 (30%)	4 (13,3%)	2 (6,6%)	93%	68%
O-11	28	15 (53,5%)	8 (28,5%)	2 (7,2%)	3 (10,7%)	88%	60%
L -12	14	6 (42,8%)	2 (14,3%)	4 (28,5%)	2 (14,3%)	93%	67%
Total (mean value)	**2**	**35 (48,6%)**	**20 (28,5%)**	**10 (14,2%)**	**7 (10%)**	**90%**	**69%**

Table 3. The results of the second variant of the border work (technical faculty)

Technical Faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
TTTT-11	28	15 (53,5%)	10 (35,7%)	5 (17,8%)	-	94%	79%
A -22	12	7 (58,3%)	3 (25%)	1 (3,5%)	1 (3,5%)	97%	90%
TTTT-12	30	16 (53,3%)	10 (33,3%)	3 (10%)	1 (3%)	90%	70%
Total (mean value)	**70**	**38 (54,3%)**	**23 (32,8%)**	**9 (12,8%)**	**2 (2%)**	**95%**	**81%**

Table 4. The results of the second variant of the border work (agronomical faculty)

Agronomical faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
Agro -11	30	18 (60%)	7 (23,3%)	3 (10%)	2 (6%)	93%	68%
O-11	28	14 (50%)	11 (39,3%)	2 (7%)	3 (10,7%)	88%	60%
L -12	14	6 (42,8%)	5 (35,7%)	2 (14,3%)	1 (7,2%)	90%	63%
Total (mean value)	**72**	**38 (52,7%)**	**23 (31,9%)**	**7 (9,7%)**	**6 (8,3%)**	**90%**	**68%**

Table 5. The results of the third variant of the border work (technical faculty)

Technical faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
TTTT-11	28	8 (28,5%)	10 (35,7%)	6 (21,4%)	4 (14,3%)	90 %	63 %
A -22	12	5 (41,6%)	3(25%)	3 (25%)	1 (8,3%)	89 %	45 %
TTTT-12	30	10 (33,3%)	9 (30%)	9 (30,0%)	2 (6,6%)	95 %	60 %
Total (mean value)	**70**	**23 (32,8%)**	**22 (31,4%)**	**18 (25,7%)**	**7 (10%)**	**90 %**	**50 %**

Table 6. The results of the third variant of the border work (agronomical faculty)

Agronomical faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
Agro -11	30	20 (66,6%)	6 (20%)	3 (10%)	1 (3%)	93%	68%
O-11	28	16 (57,2%)	10 (35,7%)	2 (7,2%)	-	88%	60%
L -12	14	7 (50%)	5 (35,7%)	2 (14,3%)	-	90%	63%
Total (mean value)	**72**	**43 (62%)**	**21 (30%)**	**7 (9,7%)**	**1 (1,4%)**	**90%**	**68%**

Table 7. State and dynamics of the increase of the basic investigational indexes (technical faculty)

Technical Faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
Variant 1	70	23 (32,8%)	22 (31,4%)	18 (25,7%)	7 (10%)	90%	70%
Variant 2	70	38 (54,3%)	23 (32,8%)	9 (12,8%)	2 (2,8%)	95%	81%
Variant 3	70	23 (32,8%)	22 (31,4%)	18 (25,7%)	7 (10%)	95%	86%

Table 8. State and dynamics of the increase of the basic investigational indexes (agronomical faculty)

Agronomical faculty	Quantity of bachelors	All of the tasks are solved	50% of tasks are solved	One task is solved	Neither of tasks is solved	Progress (Marks 3, 4, 5)	Quality (Marks 4 and 5)
Variant 1	72	35 (48,6%)	20(27,7%)	10 (13,8%)	7 (9,7%)	90%	69%
Variant 2	72	38 (52,7%)	23 (31,9%)	7 (9,7%)	6 (8,3%)	90%	68%
Variant 3	72	43 (59,7%)	21 (29,2%)	7 (9,7%)	1 (1,3%)	91%	70%
Mean value	**72**	**38 (52,7%)**	**22 (30,5%)**	**8 (11,1%)**	**5(6,9%)**	**90%**	**69%**

and the investigated problem is actual.

- No purposeful work on selection and formation of basic blocks of knowledge for solving of mathematical tasks is conducted.
- Formation of the base blocks of knowledge improves the quality of solving of professional tasks and it is possible to consider it as one of directions of educating students on mathematical on nonmathematical specialties.
- In institutions of higher education there is real possibility of realization of purposeful work on educating for forming of basic blocks of mathematics knowledge and establishing connections between mathematical and professional tasks.
- There is a need of search of methods and facilities of selection and forming of basic blocks of knowledge and educating students to set connections between these blocks, that in fact is teaching to solve professional tasks with mathematical maintenance (fully or partly).

The second stage of the experiment was related to the development of methodical materials, collection of flowsheets and pursuing the aim of forming of basic blocks of knowledge and abilities to set connections between this knowledge helping students in professional tasks solving.

The finishing stage of the experimental research carried the teaching character and pursued an aim – to check the influence of the described methodical system of mathematics teaching on solution of professional tasks with the use of mathematical knowledge for bachelors of nonmathematical specialties.

3. Conclusion

The paper presents the technology of the educational process planning that ensures the formation of professional competencies defined by the educational standards of the new generation.

Competence-contextual approach promotes effective professional self-determination and professional identity of students in the teaching profession. The implementation of the ideas of the competence-contextual approach in the process of training bachelors of non-mathematical specialties allows providing focused actualization of the unity of personal-professional and social values and meanings of future activities.

During the implementation and planning of the system of education with the properties, set in advance, special value acquires the model of dynamics fixing of making diagnostics of all current evaluation parameters of functioning educational system, their adequacy and degree of approaching to the set properties[21]. Naturally, that is also applied to planning of constructional strategy of the methodical system of teaching of mathematics to the bachelors of nonmathematical specialty. At formulation of the set properties of the system the special value is acquired by semantic transparency of formulations, technological possibility of their estimation and technology of operative control and management by quality of the educational system functioning.

The teacher or instructor controls the instructional and educational procedure, the context is delivered to the whole class and the teacher or instructor emphasize on factual knowledge and corrective thinking[22] that is why the competence-contextual learning approach is applied for designing a system of students' knowledge formation.

4. References

1. Bordovskyi GA. Methods of pedagogical of innovative processes at school and institution of higher education. St. Petersburg, Russia: Herzen State Pedagogical University of Russia; 2002.
2. Polonsky VM. Interdisciplinary researches in pedagogics. Moscow, Russia; 1994.
3. Monahov VM. Introduction to the theory of pedagogical technologies. Volgograd, Russia: Change; 2006.
4. Jaeger RM. Sampling in education and the social sciences. New York: Longman; 1984.
5. Shulman LS. Knowledge and teaching: foundation of the new reform. Harv Educ Rev. 1987 Feb; 57(1):1–22.
6. Maat SM, Zakaria E. Analyzing Pedagogical Content Knowledge of Algebra using Confirmatory Factor Analysis. Indian Journal of Science and Technology. 2014 Mar; 7(3):249–53.
7. Amir-Mofidi S, Amiripour P, Bijan-zadeh MH. Instruction of mathematical concepts through analogical reasoning skills. Indian Journal of Science and Technology. 2012 Jun; 5(6):2916–22.
8. Babaei A, Chaiichi-Mellatshahi M, Najafi M. Intuition and its effects on mathematical learning. Indian Journal of Science and Technology. 2012 Jul; 5(7):3069–72.
9. Amiripour P, Amir-Mofidi S, Shahvarani A. Scaffolding as effective method for mathematical learning. Indian Journal of Science and Technology. 2012 Sep; 5(9):3328–31.
10. Kolin KK. About conception of modernisation of Russian education. Announcer of higher school. 2002; 2:73–9.
11. Smirnov CD. Pedagogics and psychology of higher education. From activity to personality. Moscow, Russia: Publ. Center Academy; 2005.
12. Abdulgalimov GL. Setting of norms for teacher's professional competence. Standards and monitoring in education. 2009; 5:67–74.
13. Kraevskyi VV. Table of contents of education: forward to the past. Moscow, Russia: Russian pedagogical society; 2000.
14. Leontyev AN. Activity, Consciousness, Personality. Moscow, Russia: Politizdat; 1975.
15. Monahov VM. Conception of creation and introduction of informative NT of educating. Planning of informative NT of educating. 1991; 4:17–26.
16. Monahov VM. Axiomatic understanding of planning of pedagogical technologies. Pedagogics. 1997; 6:42–8.
17. Turbovskyi YS, Provorotov VP. Diagnostic bases of teleologism in education. Moscow, Russia: ITO & P RAO; 1995.
18. Smykovskaya TK. Technology of planning of the methodical system for teacher of mathematics and informatics. Volgograd, Russia; 2000.
19. Bespalko VP, Tatur YG. System-methodical providing of learning and educational processes for preparation of specialists. Moscow, Russia: Higher school; 1984.
20. Verbitskyi AA. Active teaching at higher school: context approach. Moscow, Russia: Higher school; 1991.
21. Sork TJ. Planning educational programs. In: Wilson AL, Hayes ER, editors. Handbook of adult and continuing education (New edition). San Francisco: Jossey-Bass; 2000. p. 171–90.
22. Golijani-Moghadam E, Amiripour P, Shahvarani A. The role of intelligent instruction on deep learning in mathematics. Indian Journal of Science and Technology. 2012 May; 5(5):2770–6.