VI International Forum on Teacher Education

Beginning Math Teachers` Support

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Abstract

The role of mathematical education constantly increases in actual world. Educators play the main role in developing the mathematical competence and preserving the traditions of Russian mathematical school. One of the crucial problems in contemporary mathematical education is the low level of graduates` assigning to schools. The article reveals the period of adapting beginning teachers of math. Highly qualified and systematic methodological support for young teachers allows identifying the main difficulties and mistakes within their pedagogical performance, and designing the recommendations to overcome it. Observations enable to reveal the ways improving future math teachers` training that turns out to be the purpose of current research work. We used the observation as the leading research method to monitor the performance of beginning teachers within the first three years after university. As a result, we designed recommendations for adjusting the special, psychological, pedagogical and methodological training of future teachers contributing the competitiveness of graduates and ensuring the success in chosen profession. The study is of practical importance. It includes the designing of methodological recommendations for beginning teachers and the approximate program for individual self-development.

Keywords: methodological training of future teachers, beginning math teacher, adaptation and methodological support for beginning teachers.

Published by Kazan federal university and peer-reviewed under responsibility of IFTE-2020 (VI

International Forum on Teacher Education)

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Introduction

Information and digital civilization as well as economics based on knowledge, require new kinds of mathematical competence and culture. The creation of means and tools of information and communication technologies is primarily mathematical performance. The concepts acquired in the process of studying mathematics, such as proof, algorithm, measurement, models are universal, general cultural, applied in many areas of human life. Mathematics is recognized as an important element of the national culture of Russia, and its competitive advantage. The development of mathematical competence is the task of education at all levels. The teacher plays a decisive role in this.

The relevance of the declared topic is also determined by the fact that the personnel development concept is called one of the main problems in the Concept for the Development of Mathematical Education in Russia (2013): "There are not enough teachers who can teach mathematics in an appropriate manner teach mathematics. Most graduates do not meet qualification requirements, professional standards; have little experience in teaching and applying pedagogical knowledge".

Despite the system of grants established by the state, one has to admit the poor fixability of young teachers in school. Some graduates of pedagogical universities do not go to work in their specialty. Those who went to work at school do not stand even a year. The first two years are especially difficult. The reasons for this lie in the absence of serious methodological support for beginning teachers, their large weekly load, and the distribution of classes according to the so called residual principle. Gaps in the special, psychological, pedagogical and methodological training of future teachers also affect the situation.

The early years of professional development are particularly important. The young teacher needs high - quality methodological support. He needs to be provided by tutorial support.

The issues of tutorial support for future teachers are included into many foreign and Russian research works. Their works are devoted to the study of the main directions and functions of tutorial support for a future teacher at university (Dubakov, 2016); the study of the effectiveness of distant learning forms of such supervision (Esquincalha, 2016) including online learning (Kao, 2015); work led by a university mentor (Bansilal, 2015); implementation of targeted training programs in the continuing education system (Zhizhina, 2014), (Ignateva, 2009). Of particular interest are scientific works on the development of a system of principles for tutoring young teachers, on designing the stages of interaction between a tutor and a young teacher (Gromova, 2012).

The tutor introduces young teachers to their team and helps to understand the corporate culture and work technology. Tutoring provides extensive research material and helps to identify the professional "deficiency" and some certain gaps in training.

A number of researchers highlight the development of student`s professional and methodological competence defining it as the possession of a complex of professional and methodological competencies, which means his willingness to consciously and qualitatively carry out professional and methodological performance (Mamontova, 2013).

Purpose and objectives of the study

The purpose of the study was to identify typical errors and difficulties experienced by young specialists; analysis of its reasons, as a result, adjustment of methodological training of future mathematics teachers contributing to increase of competitiveness of graduates and ensuring success in the chosen profession.

The research objectives were:
- to identify the main difficulties and mistakes of young teachers;
- to determine the cases of its occurrence;
- to develop individual trajectories for professional development of young teachers;
- to correct special, psychological, pedagogical and methodological training of future math teachers.

Literature review

A key problem of beginning teachers is self-determination in profession. In this regard, methodological training should be aimed at accelerating the adaptation of young specialists to the features of the professional performance in teaching mathematics (Makarchenko, 2008). The most important in the adaptation process is a tutoring system. (Kulikova, 2018).

Of particular importance are the early years of professional development. The beginning teacher especially needs high-quality methodological support within that period. He needs to be provided by tutorial help. A number of foreign and Russian researchers explores the issues of tutorial support for beginning teachers. Their works are devoted to the study of the main directions and functions of tutorial support for beginning teacher in a university (Dubakov, 2016) and the process of interaction between tutor and a young specialist (Gromova, 2012). Many studies reveal the efficiency of distant forms of tutoring (Esquincalha, 2016),

online teaching (Kao, 2015), and work under the supervision of university tutor (Bansilal, 2015). Zhizhina (2014) and Ignateva (2009) study the implementation of training programs in the system of professional development.

Methodology

Teacher training universities need to reconstruct the system of teacher training – they need to move from knowledge-based paradigm to competence-based one. The collaboration between university teachers and those who conduct the advanced training and retraining courses plays a significant role in finding the ways to increase the efficiency of specialist and methodological training. That kind of interaction can be presented in reviewing the creative works of teachers and students in schools, in research supervision in schools, and joint conduction of teaching practices. Universities must be in touch with graduates. Often this happens formally, and as a rule, it is not possible to receive a feedback directly. We carried out systematic observation and tutorial assistance to beginning teachers during their adaptation in several schools. It should be noted that a number of forms of collaboration between university and beginning teachers are also being implemented in the other countries (Herrelko, 2015; Perkkila, 2013).

A tutor accompanies and supports the process of self-education and the individual educational route (Erofeeva et al., 2015). For the successful formation of a young teacher in his professional performance the following techniques, forms of tutoring were used: conversations, paired and group tutorial consultations; joint lesson planning; attendance and analysis of lessons; conducting workshops; work with students.

The purpose of the tutor's work was to identify typical mistakes and difficulties faced by young specialists; analysis of the reasons for this; work to overcome them; and, as a consequence, the adjustment of the methodological training of future mathematics teachers which contributes to increasing the competitiveness of graduates and ensuring success in the chosen profession.

Observations of more than 100 lessons revealed the contradiction between theoretical knowledge of young teachers and their ability to put them into practice, and the idea of work and "situation of success".

The research study employed two types of methods: theoretical (analysis of pedagogical, psychological, scientific and methodological literature); and empirical (conversations, observations, analysis of school documentation within 2015-2020).

Results

Our aim was to distribute the data of monographic research of young teachers` performance. Within the study, an activity of over 20 graduates of mathematical department was examinated and 100 recorded observations were made. An analysis, generalization and systematization of main difficulties and errors in the first years of work were carried out by means of observation and peer assessment.

We distinguished three types of novices according to their work experience: Cluster 1 – graduates who just left university; Cluster 2 – teachers with work experience up to 2 years; Cluster 3 - whose work experience is up to 3 years.

The current study presented results of the first year of tutoring support.

Teachers from 1ˢᵗ and 2ⁿᵈ cluster graduated from the pedagogical department of university with honors. The weekly load was 25 hours. In the first year, methodologists attended and analyzed over 30 lessons for each teacher.

They worked in the 5ᵗʰ grades for the first year. Analysis showed that teacher was motivated, but quite inert and inactive. The lessons were conducted according to the lesson plan with a slight consideration of class`s characteristics. In a greater degree, teacher could manage the lessons in classes with good discipline so one could fully implement his plans. At the same time, raising of voice was considered the main tool of disciplining in the class. It was not always possible to ensure the quality of knowledge as well as students` abilities and skills in mathematics.

The analyzed information resulted in identifying the following causes of difficulties:
- Subjective or personal that included the underdevelopment of emotional sphere (lessons were monotonous, eventless, it was not always possible to motivate students);
- Objective that revealed in lack of experience and large weekly load.

Teachers of Cluster 2, on the contrast, were motivated to work as a teacher with prominent organizational skills. They has been working in school since graduation. Work experience is 2 years. A large weekly load, inability and lack of time for self-awareness and self-education interfered with professional growth. Teachers felt the need for professional communication not only with colleagues, but also with more experienced teachers from university.

Teachers from Cluster 3. Work experience in school 3 years. More than 20 lessons were attended and analyzed. Teachers used capabilities both mathematical and methodical although not to the full. Was not always properly prepared for the lessons. It resulted in indefinite goal of the lesson, and random selection of content and teaching methods.

Peer assessment consisted of 2 parts. The level of forming skills of self-analysis and self-esteem connected with a block of mistakes in novice teachers was assessed on the following criteria: does not see errors and notes insignificant ones (0 points); sees partially, but is not able to understand the reasons (1 point); sees, understands, but does not see a way to eliminate (2 points); sees and knows how to overcome them (3 points) (Table 1).

The readiness of beginning teachers to identify their own mistakes and the awareness of their reasons was assessed on the following criteria: does not see errors (o points); has an idea of typical mistakes in various types of pedagogical activity (1 point); knows the reasons and ways to fix them (2 points); owns methods of self-control and self-analysis (3 points) (Table 2).

Table 1. Peer assessment of teachers` professional skills

Work experience/ criteria / amount (%) Skills	Graduates				1st year				2nd year			
	0	**1**	**2**	**3**	**0**	**1**	**2**	**3**	**0**	**1**	**2**	**3**
To form lesson goals	0	60	35	5	0	35	60	5	0	5	40	55
To select methods according with lesson goals	0	15	75	10	0	35	60	5	0	0	35	65
Clearly plan the lesson	10	15	70	5	0	5	45	50	0	0	25	75
Rationally measure time	25	40	30	5	0	10	35	55	0	15	60	25
Create problem situation and solve it within a lesson	75	15	10	0	25	35	30	10	5	20	55	20
To control knowledge and skills of students at various stages of the lesson	5	70	25	0	0	50	40	10	0	35	50	15
Establish conscious discipline in lesson	55	35	10	0	30	40	25	5	5	20	45	30
Discuss the results, receive feedback	10	35	40	15	10	15	55	20	0	10	60	30
Formulate homework and provide guidance	5	55	25	15	0	40	35	25	0	25	45	30

Table 2. Self-esteem and peer assessment of professional knowledge connected with preparing for lesson

Self-esteem / Peer assessment **(%)**	1st year of work	1st year of work	2nd or 3rd years of work
Know how to:			
Conduct stage of setting a goal in lesson	100 / 10	83 / 17	100 / 87
Make the transition from previously studied material to a new one	74 / 26	95 / 80	97 / 80
Select assignments to guide students to learn new material	65 / 35	86 / 14	96 / 82
Select tasks for fixing new material	100 / 35	88 / 40	100 / 90
Pick assignments for an accompanying repetition	80 / 20	85 / 45	100 / 87
Develop a test (independent work) in order to verify assimilation of a new concept (method of action, theorem, rule, algorithm)	80 / 20	90 / 70	100 / 92
Analyze the nature of student mistakes	80 / 20	80 / 40	100 / 90
Outline an error correction plan	80 / 20	100 / 80	100 / 90
Anticipate possible student mistakes and difficulties	80 / 17	90 / 70	100 / 90

Analysis shows that teachers inadequately evaluate their own skills related to formulation of the lesson goals, choice of teaching methods; as well as the ability to plan and implement the stage of updating knowledge, create problem situations in the lesson, etc.

Most offer teaching methods only by the source of knowledge (verbal, visual, practical). Many sheets practically do not reflect the methods by the nature of cognitive activity of students (explanatory, illustrative, partially search - heuristic, problematic, research). And some teachers confuse teaching methods with the form of training (for example, a frontal survey) or with the method of working in a lesson (for example, "repeating the passed material", "working with a book", "individual method of working in notebooks", "working at blackboard" and etc.).

Table 3 presented comparative results of self-esteem of beginning teachers and peer assessment of some of professional skills.

Table 3. Self-esteem and assessment of professional skills

Professional skills	First years of work		Work experience (1-2 years)	
	self-esteem (5 points)	Score of tutors (5 points)	self-esteem (5 points)	Score of tutors (5 points)
Lesson planning	5,0	3,7	4,5	4,2
Conducting lessons	4,7	3,8	4,2	4,0
Maintaining discipline in the classroom	5	3,6	4,1	4,0
Adequate monitoring and evaluation of student knowledge	4,0	3,2	4,0	3,8
Analysis and self-analysis of lessons	2,5	2,0	3,3	3,0

The data presented in the table show that beginning teachers estimate the formation of pedagogical skills higher than in subsequent years, as they improve the quality (objectivity) of self-esteem. And the degree of coincidence of self-esteem and assessment demonstrates the growth and dynamics of the adequacy of self-esteem.

Thus, it is obvious that self-analysis and self-assessment of the level of competence helps to identify problems in vocational training and outline an individual plan for professional development.

Discussions

The study of novice teachers` performance provides a unique opportunity to receive feedback that allows seeing the main disadvantages in professional training of future teachers. It is highlighted by ignorance of age-related psychology and ignorance of the teaching techniques, inability to work on mathematical operations and teach students appropriately. It is worth noting that beginning teachers have theoretical knowledge, but the corresponding level in practical work has not been achieved yet. They evidently had lack of organizational, motivational, communicative, constructive functional skills. Gnostic function was one that especially affected. A novice teacher could not provide a good assimilation of mathematical concepts, algorithms, properties, and methods. The emotional state of beginning teachers also left much to be desired as they experienced feelings of confusion, dissatisfaction, anxiety and stress. Often they needed psychological help from a senior mentor.

That kind of support was provided by tutors. Accordingly, an individual route was chosen for novice teachers according to their personal needs. As an initial recommendation *Cluster 1* was suggested:

1. To conduct lesson on the same topic in parallel grades which is convenient from organizational and self-improving points of view;

2. To distinguish the objectives of lesson and apparently select the right content and teaching methods;

3. To implement the methodology of working with concepts, tasks, pay attention to the methodology for drilling mathematical operations;

4. To improve techniques of pedagogical performance, demand for feedback and complete the lesson with some individual work.

Recommendations for *Cluster 2* included the following points:

1. To work on improving the quality of students' knowledge;

2. To boost pedagogical techniques, and to establish friendly but demanding relationships with students;

3. To organize students` individual cognitive performance in lessons;

4. To work on students` cognitive interest;

5. To implement technology of cooperation with students by means of expressing his own attitude towards maths;

6. To apply active forms and methods of teaching.

Recommendations for *Cluster 3* were the following:

1. To think over the forms and methods of work that allow increasing the level of knowledge, abilities and skills of students, to apply the collective teaching method, to enlarge of didactic units;

2. To organize educational and cognitive performance of students in obtaining new knowledge (create problem situations, rely on subjective experience of students, use the method of so called "appropriate tasks";

3. To pay more attention to students` individual work within lesson;

4. To work with the whole class;

5. To design content of work both in classroom and at home;

6. To obtain self-awareness and transfer solid knowledge (Manvelov, 2005);

7. To increase students' interest in mathematics using various stimulation methods.

Conclusion

Observations of the professional activities of novice teachers showed that it is necessary to increase the number of practical classes and improve the methodology. In order to increase competitiveness, promote success in chosen profession, reduce the period of adaptation it is proposed to apply innovative technologies for the training of future mathematics teachers. Flipped learning can be one of the prospective ones in teaching elementary mathematics. At first, students are offered a task that they perform at home separately. Later in the classroom, they discuss possible solutions with a teacher.

It is also necessary to improve the content of bachelor training. The curricula should include two additional courses. The first one can be represented as a special course on pedagogy and pedagogical engineering that reveal techniques for students` discipline and provide tips of maintaining their interest and attention. The second one can be added to a senior year and include real problems in teaching mathematics considering latest technologies, forms and methods such as didactic games, project method and modeling.

Particular attention should be paid to the psychological training of teachers, and namely to the development of motivational, volitional and emotional sphere of future teachers of mathematics. Novice teachers` motivation means realizing its social mission. Volitional sphere assumes duty, responsibility and discipline, while emotional sphere includes feelings of satisfaction and pleasure from work, and therefore a successful result. Future teachers should also be confident about chosen profession and its social need.

The present paper explores the crucial difficulties in activity of novice teachers related to:
- content of "Maths" subject, particularly in insufficient level of generalizing and systematizing mathematical knowledge;
- means and methods of pedagogical influence on students, such as inability to consider part mistakes,
- insufficient flexibility in modifying tasks during the lesson, lack of discipline;
- individual psychological characteristics of a teacher, particularly temperament and personal qualities;
- insufficient self-reflection.

All mentioned above allowed creating recommendations for beginning mathematics teachers in preparing and conducting lessons. Teachers are suggested to:
- create pedagogical conditions for students to acquire knowledge on their own;
- involve students in the process by means of setting significant problems and motivating them to solve it;
- design the content based on systematic knowledge and students` integrative skills;

- stimulate the educational and cognitive activities of students, encouraging their activity in solving mathematical problems and organizing a constructive dialogue;

- select methods and forms of training that allow students to independently solve problems, anticipate situations, develop intuition.

At the same time, it is necessary to conduct a reflection of professional activity (self-analysis, self-esteem, self-improvement), which allows one to adequately assess the level of professional skills and causes of failures and mistakes, as well as determine ways to eliminate them.

Acknowledgements

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