# Formation of the Bases of Professional and Mathematical Competence of Legal Professionals at the University

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**Abstract:** At the present stage of the development of Russian society and modernization of the higher education system there emerges an acute question of formation of professional competence of legal professionals and in particular, of formation of the bases of their professional-mathematical competence as one of the important components of professionalism of a specialist at large. Professional-mathematical preparation of students of legal specialization develops a system-theoretical thinking of future specialists and promotes the formation of logical, heuristic culture as an integral component of the educational-cognitive and professional activity. Studying mathematical disciplines by future lawyers at the university expands their arsenal of techniques for mastering legal science and fosters the culture of professional thinking. With the help of the hierarchy method (Saaty method), the study proved the priority of forming in students (future lawyers) of the system of interrelated professional and mathematical competence (informational-analytical, professional-logical, expert-technological, professional-modeling, optimization and predictive competence, special-professional competence). The study presents the levels of maturity of professional-mathematical competence of graduate lawyers (reproductive-algorithmic level; functional-technological; system-professional; professional-research). The study provides the data of a long-term teaching experiment which has proved that recent graduatesspecializing in law (the graduates of the university who participated in the experiment) successfully apply mathematical methods to solve professional tasks. It greatly increases their competitiveness and professional mobility in the modern labour market. The research results can be applied in practice of vocational training modernization for legal professionals.

**Key words:** Professional competence, legal professionals, professional-oriented mathematical training, higher education institution

## INTRODUCTION

An analysis of modern legal practice shows that mathematics is increasingly becoming an effective tool for researching legal entities. Thus, in particular, the volume of penal-statistical, criminological, regulatory and other legally significant information has increased. It requires its processing and interpretation through applying the methods of mathematical statistics, factor and cluster analysis and mathematical modeling.

In Russia, the Federal state educational standards of higher professional education forlegal specialties ("Law", "Law Enforcement", etc.) impose rather high demands for the mathematical preparedness of the graduates, who must not only understand the role and place of mathematical methods in legal, sociological, criminological andpenal-statistical studies but also be able to apply

mathematical tools for processing of arrays of professionally important information and handling professional tasks.

High level of professional and mathematical competence is especially important for future lawyers specializing in solving the offences in the economic sphere. In recent years, it has become increasingly evident that socio-economic transformations in Russia haveled to not only positive but also negative consequences and the criminalization of certain economic sectors, in particular. To detect crimes in the economic sphere, a certain level of professional-mathematical and economic competence is required. In addition, the basic academic disciplines of the university educational program of the specialty "Jurisprudence" are "Forensics" and "Criminology", informative-didactic units of which, in large measure are based on mathematical methods.

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According to Zhukova (2013), mathematical formalism plays a crucial role in contemporary forensic research and in particular, the mathematical calculations using formulas and the mathematical methods of neutralization of errors and random errors are used when performing indirect measurements to obtain quantitative characteristics. In recent years, the use of mathematical modeling methods in forensic ballistics has been extended.

Taking into account the modern realities of legal practice, leading scientists in the field of the theory and methods of professional mathematics education of specialists in law (Sumy, 2012; Tikhomirov and Shelekhov, 2011) are actively engaged in the research and development of new theoretical-methodological and substantive-methodological approaches to the teaching of such an important discipline as "Logic" because a distinctive feature of lawyer's work is the constant use of logical techniques and methods such as arguments and rebuttals, classifications and evidence.

Logical culture of a legal professional helps to develop forensic-investigative versions, make a clear investigation plan and outline the systems of operational and criminalistic actions (Andronikova *et al.*, 2010; Nikitina and Rudko, 2012; Welsh, 2012). Moreover, the emergence of the Russian Federation as the legal state involves carrying out enormous scope of the practical work associated with bringing all the diverse legislation in line with the requirement of its consistency. In this regard, the role of logic as one of the essential theoretical pillars of legal science and practice is enhanced.

All of the above-mentioned aspects objectively determine the relevance of research of the problem of professional-mathematical competence formation in legal professionals during the university training. Designing acompetence model of a graduate of the specialty "Jurisprudence" (multi-skilled lawyer) is associated with the system of theoretical-methodological and substantive-methodological difficulties, due to the fact that employment of graduates takes the legal form of various professions (judge, investigator, lawyer, legal adviser, corporate lawyer, etc.). One way to deal with these difficulties in Russia is to determine the specialization (professional profile) of the graduates of the specialty "Jurisprudence". This study focuses on the specialization in the field of financial, tax and business law.

**Literature review:** In science, there have appeared certain prerequisites for the development of theoretical and applied aspects of the problem of formation of future lawyer's professional-mathematical competence at the university.

The problem of professional-oriented mathematical training of specialists in social sciences and the humanities, including legal science, at the university has been considered in the publications of some specialists (Boesen *et al.*, 2014; Friedrich *et al.*, 2013; Nikitina and Rudko, 2012; Tikhomirov and Shelekhov, 2011; Zhukova, 2013).

The peculiarities of the development of a graduate's competence model and implementation of the competence approach in the system of continuous professional education have been reflected in works of many scientists (Berestneva *et al.*, 2015; Bergsmann *et al.*, 2015; Curry and Wergin, 1993; Esposito and Freda, 2015; Evers *et al.*, 1998; Everwijn *et al.*, 1993; Ezechil, 2013; Field and Drysdale, 1991; Fleming, 1993; Ulbosyn *et al.*, 2015; Mirabile, 1997; Nicolaou and Constantinou, 2014; Soare, 2013; Zimnyaya, 2003).

The problem of application of special mathematical and economic competences of a lawyer to identify and investigate specific types of crimes in the field of economy has been considered (Baryshnikov, 2012; Timchenko, 2001; Yudintsev, 2007; Welsh and Aitchison, 2013).

## MATERIALS AND METHODS

Methodological basis of the research, the results of which are given in the article, includes: philosophical position on the interrelation and interdependence of phenomena and the relationship between public-political, legislative, socio-economic changes in society and the update of the system of professional legal education, in particular; the concept of unity of purpose-oriented, content-related and procedural components of professional legal education; competence-based, personality-active and systemic approaches to professional training of specialists in law; methodological bases of pedagogical modeling of professional training at the university.

The researcher conducted a long-term pedagogical experiment (2002-2015) on the basis of Russian State Social University (RSSU). At different stages of the experiment, the study covered more than 480 students of the specialty "Jurisprudence", 53 university professors, 85 specialists in law of the internship organizations. All the members of the experimental work participated in it voluntarily and understood the goals and tasks of the pedagogical experiment on the development of professional-mathematical competence of future lawyers during the university education. The researchers applied a set of methods including observation, questionnaire, interview discussions, testing, analysis and synthesis,

generalization and systematization of empirical material, advanced teaching practices, teacher modeling and mathematical methods for quantitative and qualitative processing of the study's results.

## RESULTS AND DISCUSSION

The essence, structure and levels of manifestation of professional-mathematical competence of a legal specialist.The professional-mathematical competence of legal specialists is a required integrative result of their professional education which reflects the unity of theoretical knowledge and a practical ability to employ mathematical methods and technologies for solving professional tasks. This competence is expressed by the capabilityof specialists to master the set of knowledge, skills and ways of actions in the system "individual, information professional data analysis, making optimal decisions". It is manifested in the lawyer's ability to reveal causal relationships of the examined phenomenon and process, formulate the contradictions and problems and search for adequate means of solving them using mathematical tools.

The structure of professional-mathematical competence of a lawyer includes the following components (Fig. 1): the motivational-axiological component. It includes an understanding by young legal professionals of the value and the role of mathematics in modern society, the significance of professional-mathematical skills for successful employment and the need for their systematic improvement, the interest in numerous aspects of application of modern informational and mathematical methods in various branches of jurisprudence; the professional-cognitive component. It includes the integrated development of the mathematical tools used in their professional activities, the maturity of logical thinking, the proficiencyin mathematical technologyin audit, econometrics; mastering the technologies of mathematical modelling, risk assessment, etc.; the procedural-activity component. It implies an adequate use of professional-mathematical methods and technologies to solve specific tasks in professional activity.

Based on the findings of the theoretical and empirical analysis of the researched problem (e.g., multivariate analysis of the specifics of professional-mathematical competence in the activities of the highly qualified legal specialists under the real conditions of their professional activities) as well as the analysis of the results of the set of diagnostic techniques used in the study, there were developed the substantive characteristics of the following levels of manifestation of lawyer's professional-mathematical competence: the reproductive-algorithmic level, the functional-technological level, the system-professiona l level and the professional-research level (Fig. 1). Evaluation criteria of formation of the above-mentioned l levels of professional-mathematical competence of lawyers are:

**The axiological criterion:** It includes such indicators as young lawyer's consciousness of mastering the system of professional-mathematical competence to solve tasks of professional activity; positive attitude to professional work in law; the constant aspiration for self-education in the field of applied mathematics)

**The professional-gnostic criterion:** It implies the ownership of the system of fundamental-theoretical and professional-applied mathematical knowledge; a working knowledge of algorithmic and heuristic mathematical techniques; the formation of logical, analytical-prognostic way of thinking).

| Professional-mathematical competence of lawyers | | | | | |
|---|---|---|---|---|---|
| The structure of professional-mathematical competence of lawyers includes the following components: | | | | | |
| Motivational-axiological component | | Professional-cognitive component | | Procedural-activity component | |
| The levels of manifestation of professional-mathematical competence of lawyers | | | | | |
| Reproductive-algorithmic level | Functional-technological level | | System-professional level | | Professional-research level |
| Criteria for the assessment of development levelsof professional-mathematical competence of lawyers | | | | | |
| Axiological criterion | | Professional-gnostic criterion | | Activity-operational criterion | |
| Competences which constitute the substantivebasis of professional-mathematical competence of lawyers | | | | | |
| Informational-analytical competences | Professional-logical competences | Expert-technological competences | Professional-modelingcom petences | Optimizational and predictive competences | Special-professional competen |

Fig. 1: The characteristics of the concept "professional-mathematical competence of lawyers"

**The activity-operational criterion:** It includes the ability and practical preparednessof a lawyer for independent application of mathematical tools in professional activities while tackling standard and non-standard tasks; the ability to effectively solve professional tasks by reaching optimal solutions in the context of stringent rules and tough situations; the realization of the individualstyle of the professional application of mathematical tools for solving problems in various branches of jurisprudence. The substantive basis of professional-mathematical competence of a legal professional

According to the researcher of the study, the substantive basis of professional-mathematical competence of legal professionals is characterized by a set of competences: informational-analytical, professional-logical, expert-technological, professional modeling, optimizational and predictive and special professional competences (Fig. 1). These competences were identified through a systematic analysis of normative documents regulating requirements to the level and quality of professional training of legal professionals, as well as were based on the analysis of lawyer's experience in application of mathematical methods in practice.

In general, the System of Professional Mathematical Competences of Lawyers (SPMCL) can be represented in the form of a tuple: SPMCL = {ST, NSS, PS} where ST is the set of standard (typical) tasks of professional activity in which the mathematical competences are applicable NSS is the set of non-standard situations of professional activity of a lawyer which are solved by the use of these competences; PS is the set of professional skills efficiently implemented at the expense of formation of professional-mathematical competence of a specialist.

"Brief description of the process of formation of fundamentals of professional-mathematical competence of future legal specialists in higher education". The formation of professional-mathematical competence of a future lawyer at the university comes in several stages: the professional-propaedeutic stage which includes elucidating the role of mathematics in law; forecasting the prospects of professional-mathematical competence formation of lawyers in different specializations; the estimative-diagnostic stage at which the peculiarities of the student's contingent are analyzed and diagnosed; the original levels of the educational-cognitive activity and motivation of students while studying mathematical disciplines are determined; the levels of logical thinking and practical skills in applying the basic mathematical and logical apparatus when solving elementary tasks in the process of a lawyer's professional activity are established; the integrative connections between the

content of a course on mathematics and major courses in the educational process of the university are identified and implemented; the forming-training stage where students master the specialized vocational-applied mathematical skills; the mathematical tools are utilized while dealing with simple professional tasks; professional situations are simulated with the use of mathematical tools; the mathematical toolkit is applied in practice when solving professional tasks in the frames of different training practice (internship); the professional-integrative stage which implies technological solution of professional legal problems with the application of modern informational-mathematical methods; the use of the accumulated experience inthe implementation of professional-mathematical competence to perform standard and non-standard tasks in professional activity of a lawyer; the aspiration for self-education in the field of application of mathematical methods in law; a graduate has a professional mathematics portfolio of a legal professional.

In the course of experimental work on forming of professional-mathematica1 competence of future lawyers, a curriculum was implemented that reflected the above-listed stages of formation of this competence and included the following positions: the adaptation of the content of basic disciplines ("Computer Science and Mathematics", "Logic") and the disciplines of the university program ("Mathematical Modeling in Law") on the specialty "Jurisprudence" in accordance with the needs to ensure the quality of the system of professional-mathematical competence formation (authorial elective courses "Mathematical Models and Information Technology in Juridical Activity", "Mathematical Methods in Criminalistics"); the gradual formation of professional mathematics portfolio, a compilation of case studiesof a lawyer specializing in the economic investigation during the periods of theoretical training and while on work experience program; the preparation of projects and dissertations on the subject reflecting the specifics of the application of mathematical methods in the professional activity of a lawyer;the participation of practitioners and lawyers of internship organizations in the jury judging the competitions of the professional-applied projects onimplementation of informational-mathematical technologies in jurisprudence; the work of the section of the student scientific society "Mathematics in Jurisprudence";the implementation of student's projects of professional-applied mathematical orientation in internship organizations; the participation of potential employers in the commission for the final state certification of graduates.

Table 2: Results of the expert assessment of formation of graduate's professional-mathematical competence of the specialty "Jurisprudence" (on a 100-point scale)

| Competences | Graduation in 2011 | | Graduation in 2015 | | p-value |
|---|---|---|---|---|---|
| | $x_1$ | $\sigma_1$ | $x_2$ | $\sigma_2$ | |
| Informational-analytical | 75.32 | 8.14 | 87.69 | 6.19 | <0.05 |
| Professional-logical | 76.13 | 7.94 | 89.37 | 6.48 | <0.05 |
| Professional-modeling | 68.17 | 8.20 | 71.19 | 7.53 | >0.05 |
| Expert-technological | 66.31 | 7.68 | 81.27 | 6.17 | <0.05 |
| Optimizational-predictive | 59.82 | 9.34 | 61.93 | 8.26 | >0.05 |
| Special-professional | 57.89 | 9.12 | 80.46 | 7.73 | <0.05 |

t-values were compared with $t_{cr} =$ of 1.96 at the significance level $\alpha = 0.05$

In the process of formation of professional mathematical competence of future lawyers Microsoft Office tools (Excel) were used. In the study of such topics as "Mathematical Statistics", "Functions and Graphs", etc., the students worked in computer classrooms. The workshop on mathematical modeling was conducted with the use of universal mathematical packages Math CAD, MATLAB, etc., statistical packages Statgraphics, Econometric Views, etc.

In the process of studyinglogic by future lawyers, special attention is paid to such topic as "Modeling of the Logical Structure of Legal Norms". The logical structure of legal norms N can be represented as follows:

$$N = ((J \rightarrow D) \wedge (J \wedge \overline{D})) \rightarrow S$$

Where:
j = The condition of validity of the law (the legal situation)
D = A legal order
S = A sanction

The research problems required special attention to organization of different types of practice (internship), during which students performed professional-training tasks using mathematical technologies. After completing each practice within the university component a seminar-workshop was conducted. Different situations of employment requiring the use of algorithmic and heuristic mathematical technologies in the professional activity of lawyers of different specializations were discussed.

According to the results of predegree practice, as well as the results of the state final examination there was made a comparison of 10 expert estimates (6-lawyer's estimates from internship organizations, 4-the lecturers) of the system of professional-mathematical competence of students of the specialty "Jurisprudence" (Table 1). The table presents the dynamics of assimilation of the selected competences by the graduates in 2011 and 2015 with average expert assessment (on a 100-point scale), a probability of statistical significance of changes with the use of student criterion. To determine the consistency of expert opinions for each of the competences, the

coefficient of concordance W was determined. It showed the consistency of expert assessments from the average point (0.55) to strong point (0.86) in accordance with the different groups of competences. It allows considering a comprehensive assessment of the system of formation of graduate's professional-mathematical competence to be sufficiently faithful.

The proposed competences calculated on a 100-point grading scale have allowed one to define mathematically (to define numeric intervals) the levels of formation of professional and mathematical competence of graduates of the specialty "Jurisprudence" (PMCG): PMCL Professional-Mathematical Ccompetence of Lawyers: PMCL <30-reproductive-algorithmic level; 30 = PMCL<60 functional-technological level; 60 = PMCL<80 system-professional level; 80 = PMCL = 100 professional-researchlevel. A graduat"s personal level was identified according to the formula:

$$PMCL = K \times d$$

where, d is the length of the grading scale (in our case 100points):

$$K = \left( \sum_{i=1}^{N} n_i \right) \Big/ (n \times N) = \frac{n_1 + n_2 + ... + n_N}{n \times N}$$

Where:
N = The number of professional-mathematical projects performed by the student during the entire period of study at the university
$n_i$ = The number of correctly executed operations on the application of mathematical methods and technologies
n = The number of operations to be performed
K = The factor of formation of the system of professional-mathematical competence

Positive dynamics in the level of formation of bases of professional and mathematical competence of future lawyers is shown in Fig. 2. According to the results of the experimental work, changes in the use of mathematical tools in the final qualifying work (diploma project) by
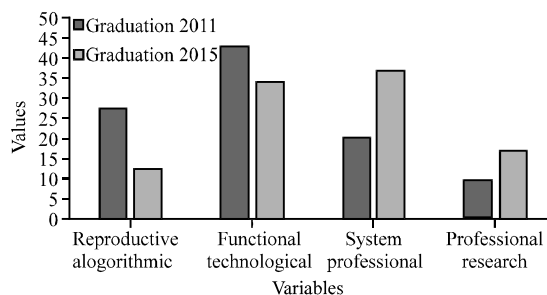
Fig. 2: Levels of formation of the bases of professional and mathematical competence of graduates of the specialty "Jurisprudence"

students of the specialty "Jurisprudence" were recorded. In 2015, 64 diplomas (in 2011, 62 diplomas) were analyzed. The following results (respectively) were obtained: the application of probability-statistical methods-55.3% (37.2%); the use of elements of the Graph theory-48.2% (35.7%); the use of the elements of the Risk theory-58.9% (32.5%); the application of mathematical modeling methods-52.8% (39.7%); the use of the elements of system analysis-50.6% (38.4%); the application of the methods of the Theory of optimization-29.3% (13.5%).

The results of the analysis demonstrated that students had learned to implement professional-applied mathematical methods to the solution of problems of professional life of legal experts systematically and consciously. The results of deferred control over independent professional activities of former participants of the experiment (the students of the specialty "Jurisprudence") who occupied the positions of legal professionals in different institutions and organizations, showed that young specialists successfully apply mathematical methods to solve professional tasks and therefore their competitiveness and professional mobility greatly increase.

## CONCLUSION

In today's labor market lawyersare required to possess a high level of professional-mathematical competence. In accordance with the Bologna Agreement, the transition of the Russian system of higher education to the competence-oriented model of higher education identified the requirements for the qualifications of the graduates of the university as a set of formed competences. These requirements are stipulated in the state educational standards of new generation.

Professional activity of a legal professional specializing in the area of economic crime, financial and tax law and legal statistics requires the formation of bases of professional and mathematical competence which provides high productivity of their labour. Professional-mathematical competence of specialists in law is considered as the requiredintegrative result of the university seducational activities, including not only a body of knowledge but also mastered ways of action, techniques and personal qualities which are necessary for productive activities to handle specific professional problems using mathematical methods and technologies.

This competence is formed at a Higher Educational Institution (HEI). The efficiency of this process can be ensured if: the professional-mathematical training has practice-oriented focus on the basis of integrative links with major disciplines and is based on the optimal combination of fundamental-scientific and applied aspects; the substantive-technological support for formation of competence reflects the qualification and occupational requirements fora legal professional of a narrow (particular) specialization; the process of competence formation is built incrementally, giving students the mastery of algorithmic and heuristic professional-mathematical practice-oriented methods; the students are motivated and active in learning the mathematical tools for solving professional tasks of varying complexity and scope; active involvement of students in real legal research, socio-legal projects in the process of practical training and research activities is performed (the students actively apply mathematical methods when implementing their research and projects). The main principles of formation of professional-mathematical competence in the HEI are: the principle of congruence (compliance of mathematical training with modern professional activity of a lawyer); the situational principle (sampling of the situations of a lawyer's professional activity that requires the display of mathematical competences; organizing the educational process on the basis of their analysis); the principle of specification (the peculiarities of professional activities in the substantive-technological basis of mathematical training of a lawyer in accordance with the particular area of law are taken into account); the principle of implantation (the mathematical training of lawyers is not an adjunct to economic, forensic and speciallaw specialization but naturally embedded in it; the structural and logical interdisciplinary connections of major academic disciplines promoting integration of professionally important knowledge and skills are implemented); the principle of development of professional mobility and competitiveness of a future legal specialist.

The study does not exhaust all aspects of the considered problem. The prospects for further development of the research problem can be: the development of self-education culture of students in the process of mastering of professional-mathematical competence of a lawyer; the integration of theoretical mathematics and professional activity of students during practical training (internship); training of lecturers to work on forming the system of professional-mathematical competence of future lawyers; the identification of qualitative differences in substantive-technological basis of formation of the system of professional-mathematical competence of lawyers depending on their specialization.

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