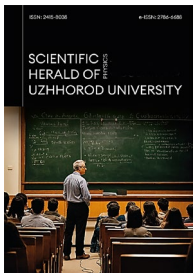
Scientific Herald of Uzhhorod University
Series "Physics"
Journal homepage: https://physics.uz.ua/en
Issue 55, 761–769
Received: 13.09.2023. Revised: 24.12.2023. Accepted: 28.02.2024



DOI: 10.54919/physics/55.2024.76lv1

Study of research competencies in bachelor's mathematics education

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Abstract

Relevance. The relevance of the study lies in the fact that research competencies in the mathematics education of future lawyers constitute knowledge, skills and attitudes that contribute to personal self-actualisation, activate their educational position, and help in the process of social integration. All research competencies are interdependent because they share common features - critical thinking, creativity, proactivity, problem solving, the ability to assess risks, make good decisions, and manage emotions constructively. They provide students with greater flexibility, enabling them to adapt more quickly to the rapid changes in a world of increasingly complex relationships between different areas of human activity. Such skills for future lawyers are a major factor in innovation, productivity and competitiveness, which affect motivation, satisfaction and quality of work.

Purpose. The purpose of the study is to examine aspects of acquiring research competencies in bachelor's mathematics education and to determine the level of mathematical literacy among future lawyers. The obligation to create optimal conditions for the development of research competencies in mathematics education according to their abilities, refers to broadly defined education. Their role is to develop the learner's overall ability to cope with a changing reality.

Methodology. Education should be personalised, especially in terms of acquiring skills for effective and systematic lifelong learning.

Results. The complex nature of today's reality requires constantly evolving knowledge, which can be acquired through information and modern technology. It is important for a law student to acquire reasoning and argumentation skills in addition to the necessary knowledge and subject skills in mathematics education. They are designed to make it easier for

Suggested Citation:
Kairdenov S, Stukalenko N, Nurmukhanbetova N, Ospanov Y, Zulkarnaeva Z. Study of research competencies in bachelor's mathematics education. *Sci Herald Uzhhorod Univ Ser Phys.* 2024;(55):761-769. DOI: 10.54919/physics/55.2024.76lv1

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students to understand the world around them, to enrich their knowledge in different areas, and to improve their learning of new ones.

Conclusions. The practical significance lies in determining the level of quality of research competence acquisition and mathematical literacy of future lawyers.

Keywords: mathematical literacy; research competencies; bachelors; future lawyers; students; mathematics education; skills; knowledge.

Introduction

The education system must adapt student activities to the demands of the present, to the changing world, in order to prepare the next generation to face the new challenges. Increasing globalisation and civilisational changes pose important challenges for educational institutions to train students in a wide range of different competencies that will enable them to function freely in their changing everyday lives. The core curriculum emphasises the need to develop students' thinking and logical skills [1]. Mathematical skills include the ability to add, subtract, multiply, divide, calculate proportions, make calculations in memory and on paper, and use weight and measure converters to solve many tasks and challenges of everyday life. Research competencies - also include the ability to apply mathematics to thinking – to think logically and analytically, to follow the reasoning of others, to abstract and generalise, and to distinguish proven claims from assumptions. The development of mathematical competencies requires understanding, practice, regularity, repetition, and correlation between the subject matter. They are also a source of inspiration for implementing various compatible activities, a source of choice of working methods and can be a reason for innovative activities [2].

Research competencies in mathematics education - represent the ability and willingness to apply mathematical ways of thinking – logical and spatial – and their representation in the form of formulas, models, constructions, diagrams or tables. When developing mathematical competencies, teachers should bear in mind the obligation to diagnose students' mathematical skills, recognise their abilities and needs. They should also organise work with students in a way that enables them to achieve a goal, including one that goes beyond the content specified in the core curriculum [3]. In the process of developing mathematical competencies, it is important to improve the following skills: calculation, inference, strategic thinking - the ability to plan the next steps of a procedure to solve a problem, mathematical reasoning, including a critical perspective on solving legal issues. It is worth remembering to plan mathematics education so that this knowledge is gradually organised into logically linked systems, leading from concrete-image thinking to conceptual thinking. The spiral and linear arrangement of the core curriculum content helps in the implementation of activities related to the development of mathematical competencies. The general developmental goals for the acquisition of competencies achieved by the students form the basis for the specific tasks assigned to the individual academic disciplines [4].

In daily work with future lawyers, the teacher implements the chosen curriculum developed from general education. He or she carefully examines the content to ensure that the methods of achieving the impact objectives can be adapted to the individual needs and abilities of the students [5]. Students are expected to acquire mathematical competencies in the learning phase by presenting skills in the following areas: accounting – the ability to perform simple calculations in memory or in writing in more complex actions, using the skills in practical situations, checking and interpreting the obtained results with meaningful solutions; using and creating information – the ability to read and interpret data presented in various forms, process it, create mathematical texts, represent data graphically, and use mathematical language to describe reasoning and findings. The development of mathematical competencies among students requires the attitude necessary for mathematical thinking, which seems to be an important skill for understanding the modern world and life in today's society. It is therefore worthwhile, and even necessary, to provoke different kinds of mathematical activity in an educational institution, and not just to provide it in a mathematics class. The future lawyer's activities should be organised in a way that is as close as possible to the manner of work characteristic of his or her profession [6; 7].

The purpose of the study is to examine aspects of acquiring research competencies in bachelor's mathematics education and to determine the level of mathematical literacy among future lawyers.

Materials and Methods

The methodological basis for the study was formed by the following approaches to the study of this subject: pedagogical experiment, activity-based, system-based. A pedagogical experiment - is a specific experimental activity. Its purpose is to test an assumption about problem solving and to find an answer to a question that has arisen as a result of an interest in the subject. In the beginning there is experience, i.e., the observation of events occurring spontaneously or induced chaotically. The pedagogical experiment on mathematical literacy of future lawyers was conducted at Shoqan Ualikhanov Kokshetau University. The project aimed to improve the mathematical competencies of students using modern teaching methods. This included experiential learning by organising classes that develop students' research competencies and talents, and by equipping the didactic base of a higher education institution with teaching aids and modern equipment. The project also covered teachers who will eventually improve their didactic competencies in the theoretical and practical foundations of working with the experimental method and the development of mathematical thinking skills.

According to the activity-based approach, pedagogical truth leads to effective action by formulating the bachelor's education concept. It is based on the interests and activities of the student in accordance with the principles of acting

through knowledge and knowing through action. Effective implementation of the method can only be achieved by stimulating innate forces, instincts and interests. The protest against the didactic formalism of traditional learning, the criticism of strict discipline and the passive nature of education, are characterised by ideas firmly embedded in the educational practices of alternative or liberal education as a result of industrialisation and urbanisation processes. The research attitude is implemented through laboratory experiments, the laws of social life and through active participation in the life of the institution. The relativism of moral and aesthetic values arouses students' interests, which works in complex action and is considered valuable in the mathematics education of future lawyers. An important role in creating the conditions for the development of this approach is played by the teacher. He or she has to create inspiring situations that in various ways trigger the creative and analytical abilities of students, who care about the process of learning rather than the outcome.

A systems paradigm - is a set of elements that reflect or create a systemically complex object of study for specific cognitive purposes. The system model considers the relationships that exist between the whole and the part of the system, and between its subsystems and supersystems or equivalent structures of the mathematical entity. It can be seen as a mechanism for creating or recreating the essence of cognition, which fulfils many functions in the process of research competence cognition, mathematical literacy and activity in general. Because of its origins, the method relates to those visual images and ideas about the surrounding world that emerge in each student's mind. The image built on this assumption is an accurate model of process theory, the essence of which is hidden from ordinary observation and experience. In the complex process of cognition, at both empirical and theoretical levels, the development of observational and experimental data on mathematical competencies is conditioned by the construction of theories. They have varying degrees of generality and abstractness, which are used at each learning stage.

Results and Discussion

Mathematical knowledge and skills play an important role in a student's professional life. At the same time, problem solving is the main axis of learning at every level of mathematics education. To prepare the future lawyer for the real world in the learning process, attention should be paid to the tasks that allow achieving the overall goals of teaching mathematics and enabling the development of key competencies. The tasks that form the skills and attitudes essential to modern people, irrespective of their area of activity, enable them to perform non-standard tasks. Solving them shapes, in particular, intellectual attitudes, manifested in logical, creative, independent thinking and coping with challenges. This improves the ability to analyse the content of the tasks and understand their global structure. Notably, in everyday situations, students are faced with broadly defined tasks, which are often poorly formulated – they have too much or too little data, or the data are contradictory. Such tasks, after mathematical processing, become simply non-standard. In the age of modern technology, obtaining information is not an obstacle. The main problem becomes the awareness in a given situation that there is an excess or insufficient amount of information. Thus, highly valuable skills, among others, the ability to select information, check data consistency and, in the case of tasks – identify data deficits, enable one to consider the best justification for an effective solution to the task ahead [8].

Literacy in mathematics education makes mathematics an integral part of everyday life for future lawyers, providing them with the knowledge they need to acquire professional skills. It strengthens confidence in one's own knowledge, filling in gaps and ensuring the all-round development of mathematical thinking. Students can work individually, in pairs or in small groups. They can test each other and possibly improve their work. After the students have drawn their own conclusions, they are presented with mathematical rules, during which the most appropriate formulation is chosen. Thus, the need to change the way of thinking regarding the competencies expected of today's student after an educational path is emphasised. These days of constant crisis necessitate the creation of a model lawyer with developed intellectual ability who can cope with different circumstances and challenges. And research competencies - represent what every bachelor needs for self-realisation and personal development. The key epithet means something important and useful for the individual and society, which is an essential element of learning. Process and action are important, knowledge is the basis for proper mathematical skills [9]. Furthermore, the ability and willingness to master mathematical ways of thinking and presentation: formulas, models, graphs, tables is also important. The possibility of using mathematics as a field of study emphasises conscious and creative participation in the educational process to develop competencies. It is assumed that in the context of an educational institution, the separation of socialisation from education is impossible. This is because the student always accumulates his or her cognitive experience within certain social processes that take place during classes, including mathematics.

The student learns such research competencies during mathematics classes by using various methods of study: developing the ability to draw conclusions and formulate hypotheses independently from the available information, improving the ability to interpret and process information, developing independence in acquiring knowledge and skills, gaining confidence in learning mathematics, the student's self-esteem increases and he or she becomes a researcher of mathematical rules and relations, enhancing intrinsic motivation due to the findings and their own successes, a weaker student regaining faith in his or her abilities, the responsibility for the learning process being shifted to the student. Frequent use of different tools increases the inductive reasoning ability of students. By learning relevant mathematical operations with the same tool, students at some point begin to see patterns and use the same thought processes to draw conclusions in other challenging situations, particularly in the field of law. In terms of practice, it is important to note that research competencies increase the creative attitude and its components in the cognitive and character areas, such as motivation to enrich skills, innovativeness and courage in taking up new legal tasks. This confirms the validity of the

accepted assumption of a certain mechanism regulating the functioning of conservative and creative personality. This may imply that subjective creative qualities supported by a predisposition to mathematical knowledge constitute important professional resources for the bachelor [10; 11].

The development of research competencies in bachelor's mathematics education, their validation and use in a competency-based perspective should be facilitated by establishing best practices. This should better support teaching staff in completing tasks and improving their learning by updating assessment methods and tools, testing and implementing new and innovative forms of teaching and learning. Supporting the validation of competences acquired in mathematical contexts will enable students to obtain full or, if necessary, partial qualifications. This process can be based on existing solutions for testing non-formal and formal learning. This provides a common reference framework for comparing qualification levels by identifying the competencies required to achieve them. Moreover, the assessment can help to structure learning processes and recommendations, contributing to the improvement of individual skills also in the context of changing labour market demands [12]. The definition of a set of research competencies for self-realisation, employment and social inclusion has been shaped not only by social and economic changes, but also by various initiatives. Special attention should be paid to improving mathematical skills, strengthening digital and entrepreneurial knowledge, the importance of shared values in the functioning of society, and encouraging more young people to take part in research activities. Education for sustainable development is, after all, an integral component of quality learning.

Every student has the right to a quality education throughout life to maintain and acquire skills that enable them to participate fully in society and to cope effectively with changes in the labour market. This also expresses each student's right to timely and personalised support to improve their employment prospects, including support for training, retraining and job search. Supporting the development of research competencies is one of the goals included in the vision of creating an educational space that will fully harness the potential of education and culture as drivers of employment, social justice and active citizenship, experiencing identity in all its diversity. Given the high ranking assigned to research competencies these days, theoretical considerations represent an attempt to look at a narrow fragment of the educational reality pertaining to the assessment of mathematical competencies. The assessment of individual elements of mathematical skills and the identification of areas that create opportunities for action that change students' attitudes towards mathematics, technology and research become interesting from a didactic perspective. Future lawyers need the right set of skills and competencies to maintain their current standard of living, keep employment high, and promote social cohesion in the context of tomorrow's society and world of work. Their support in acquiring mathematical skills and competencies for self-realisation helps to build resilience in times of rapid and profound change [13; 14].

In this regard, an experiment was conducted on the mathematical literacy of future lawyers using the example of the Shoqan Ualikhanov Kokshetau University. The analysis of the collected research material has revealed a difference between the suggestions and concepts of mathematics education of bachelor lawyers in urban and rural areas. The data were collected by means of an open-ended questionnaire, and the analysis itself was combined with the semantics of the individual rather complex verbal statements. Suggestions in the form of questions can be interpreted as an expression of students' cognitive curiosity and reflection. The question - is an invitation to reflection and answer. Responses were formulated by students from different courses who see possibilities for linking mathematical knowledge with everyday life and the law. The task they were given was to formulate a goal for the implementation of the previously formulated subject. All the students carried out this task in different ways. To analyse the collected material, the rationale data were divided into categories and groups: didactic objectives relating to the interests of the students, perception of the practical aspect of mathematics, difficulties in learning mathematics, regardless of location – urban or rural. The suggested activity considered the overall average score for the mathematical literacy of future lawyers. The results of the study are presented below (Figure 1).

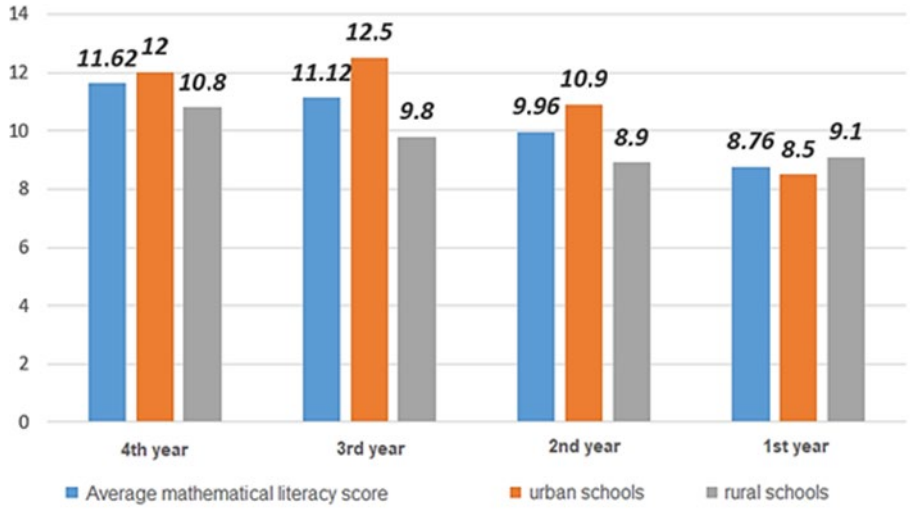

Figure 1. Average mathematical literacy score of students in the "Jurisprudence" programme

Through participation in the study, teachers at Sh. Ualikhanov Kokshetau University will be able to check whether students meet the requirements of the institution. They will help to identify strengths and weaknesses in the mathematics education of future lawyers, conduct detailed analysis of students' mistakes, typical and unusual solutions. It can be assumed that this picture of issues, to which teachers attach great importance in their day-to-day work, has left its mark on the suggestions. The materials submitted by the students reveal the monothematic nature of the lessons and the emphasis on mathematical skills and literacy in general. The average mathematical literacy score of law students in urban and rural areas shows a rather one-sided scholastic view of the benefits from participation in the process. It is therefore not surprising that their level of competence is far from what is expected. The practical aspect of exploring research competencies in mathematics in the context of future bachelor's studies was also emphasised. In their statements, the students clearly identified three forms of work known to them from everyday life [15]. In more than half of the suggestions, teamwork was emphasised as the most appropriate way of realising research competencies. In the category of suggestions involving teamwork, a subset of responses was identified. It refers to the atmosphere which, according to the respondents, should accompany the process of learning mathematics.

The development of research competencies with a particular focus on awareness of personal resources and the motivation to realise them is becoming a necessity in today's environment. This is important for the process of realising one's own potential, through its use in achieving educational goals. Knowledge about the relationship between competencies can be applied, among other things, to practical activities, to achieving goals and professional success in the future. These qualities should be reinforced by subjective qualities that shape attitudes towards openness, independence, activity, self-expression, and the need for creative expression. The activities supporting the creative abilities and aptitudes of a future lawyer should consider various areas and especially develop intellectual attitudes. Such a process should primarily involve deepening awareness of the level of mathematical knowledge and skills. It should also include motivation, understanding of the need for continuous personal development, and support for self-development against the background of the acquired research skills. Notably, such competencies are considered from both transgressive and creative perspectives. This shows an active student who creatively transforms his or her environment and self, focusing on change and development. Such a scenario could be realised under favourable external economic conditions. Failure to take advantage of the relatively good economic situation, despite the country's global crisis, is likely to lead to a regression of the knowledge system, an exodus of young specialists with high mathematical competencies and qualifications. Paradoxically, stagnation will result in competencies related to the ability to adapt to changing conditions having a stronger position in relation to the best professional competencies.

Nowadays, the requirements for research competence have changed with the increasing role of technology in all areas of work and life, and the increasing importance of social, civic and entrepreneurial competencies for ensuring sustainability [16]. At the same time, an experiment on the mathematical literacy of future lawyers on the example of Shoqan Ualikhanov Kokshetau University indicates a steadily high percentage of students with insufficient basic mathematical skills. Hence, today it is so important to invest in basic skills. The level of achievement in research skills increases thanks to quality education, including extracurricular activities, and a broad approach to developing the competencies in question. There is also a need to explore new ways of learning for an increasingly mobile and digital society. Digital technology is influencing the education of law students by creating more flexible learning environments adapted to the needs of a highly mobile society. In a knowledge-based economy, remembering the facts and procedures is important, but it is not enough to ensure progress and success. In a rapidly changing society, skills such as problem solving, critical thinking, cooperation skills, creative thinking, computational thinking, and self-regulation are more important than ever [17; 18]. They are tools that enable the application of real-time knowledge to generate new ideas, new theories, new products, and new knowledge.

To encourage more young people to acquire mathematical literacy effectively, educational institutions have begun to link education more closely to the fields of science and art [19-21]. This has been done through independent research involving a wide range of social actors and sectors. Although the definition of these competencies has not changed much over the years, supporting the development of mathematical competencies is becoming increasingly important. The need for such training is supported by the experience gained through working with future lawyers. This plays an important role in developing the necessary interpersonal, communication and cognitive skills such as critical thinking, analytical skills, creativity, problem solving, and resilience that contribute to the transition of young people to adulthood, active citizenship and labour activity. Building closer cooperation between different learning environments helps to promote diverse approaches to learning and research contexts [22]. To address the challenges of developing mathematical competencies for a lifelong learning perspective, support should be provided at all stages of education and training. This, in turn, provides opportunities for advanced training, further development of continuing professional training, and modernisation of higher education [23; 24]. Current processes should cover a wide range of mathematics education structures, both formal and non-formal, to establish a common understanding of competencies that can support transition and cooperation between different educational structures.

The study of research competencies in bachelor's mathematics education identifies good practices that can meet the needs of training personnel, employers and labour market stakeholders. Process, action and knowledge are very important, based on a good command of mathematical thinking skills. Mathematical competence relates to the ability and willingness to explain the natural world using existing knowledge and methods [25]. This includes observation and experimentation, formulating questions and drawing conclusions based on evidence. It is essential to be able to apply basic mathematical principles and

processes in everyday personal and professional contexts, and to track and evaluate argument chains. Mathematical reasoning, understanding of evidence and communication in mathematical language using appropriate aids, including statistics and graphs, and understanding of the digitisation mathematical aspects are necessary [26-28]. A positive attitude towards mathematics is based on respect for the truth and a willingness to look for arguments and assess their validity. The ability to use logical and rational thought to test hypotheses and the willingness to abandon one's beliefs when they contradict new scientific findings include the ability to use and manipulate technical tools, devices and scientific data to achieve a goal [29; 30]. It is important to understand how mathematical technologies can help with communication, creativity and innovation, and to be aware of the opportunities, limitations, impacts and risks associated with them [31-33].

The general principles, mechanisms and logic underpinning mathematical literacy provide the basic functions associated with the use of interdisciplinary learning. This strengthens the links between the various subjects in the curriculum and establishes a strong connection between what is being taught. The study of research competencies can be supported by systematically supplementing academic study, which becomes the basis for the development of bachelor mathematical skills. The development of research skills among students should serve the practical purpose of preparing future lawyers to solve unusual problems, eliminating ambiguity. The development of research skills among students should serve the practical purpose of preparing future lawyers to solve unusual problems, eliminating ambiguity. This definition corresponds to the concept of a holistic approach to law, involving the integration of legal knowledge with other sciences, in particular mathematics. The natural processes faced by students allow them to be stimulated to develop mathematical competencies, the basic skills of which include the use and application of knowledge by observing phenomena, checking, processing and revising. Modern training offerings aimed at engaging future lawyers in a mathematical field can usually be found at the end of an educational path, e.g. in the form of postgraduate studies [34]. In this case, to produce a fully competent lawyer completely prepared for the changing and ever-changing way of working in this area of the labour market, it is essential for students to learn about the tools of mathematical literacy from the very beginning of their studies, in addition to the core subjects [35; 36].

By imparting certain skills to undergraduate students and activating them through direct exposure in the form of exercises or seminars, given the current way young lawyers are trained, the transfer of theoretical knowledge can play a significant role in the process under discussion. By teaching students basic technological and mathematical principles in the field of legal intelligence, new problems are raised that can be solved by properly trained lawyers [37]. Nevertheless, future professionals still seem unconvinced, having identified non-legal skills, competencies and various innovations. The changes made in some law universities show that the younger generation of students is rather difficult to change their minds. This is because the work of a future lawyer will look very different from what it looks like today. It will therefore require new mathematical competencies in carrying it out. For instance, people in such positions today deal with standard tasks, such as preparing simple documents using templates or checking a large amount of papers. There are programmes that can do this for a person, but they require systematic updating of their capabilities depending on the evolution of regulations, practices and strategies. Therefore, mathematics education becomes the student's main activity and source of knowledge about the world, an indicator of moral attitudes, and a basis for the development of intellectual capacity, acquiring research knowledge, literacy and skills in a completely natural way.

Conclusions

Thus, the study of research competencies in bachelor's mathematics education is unique because, on the one hand, it aims to equip the student with relevant knowledge and, on the other hand, to provide opportunities that will enable him or her to develop specific habits and acquire practical skills. Furthermore, through action, it will help to shape an appropriate attitude in professional life. The natural processes faced by students allow them to be stimulated to develop mathematical competencies, which, along with other ones, form the basis of educational processes. They are important not only for further learning, but also for understanding the surrounding world and interacting with it. The research competencies of mathematics education are realised by developing and using intellectual thinking to solve tasks arising from everyday situations. Such competencies relate to the mastery, use and application of logical thinking. This facilitates problem solving and, above all, develops the imagination. The skills taught mainly in higher education institutions in the Republic of Kazakhstan are necessary for solving legal tasks in many fields and scientific disciplines. With a high level of mathematical knowledge, students can successfully find themselves in the demanding world of modern technology, which is overloaded with information and where choices and decisions need to be made every day.

As objective and authoritative data show, the level of mathematics education and literacy in Kazakh institutions is at an adequate level. There is no objective reason to introduce immediate corrective programmes in mathematics education. It is worth emphasising that the content of mathematics education is included in the core curriculum when applied in life situations and other areas to develop skills in strategic and logical thinking, understanding rules and creating one's own strategies and organisational rules. The correlation of subjects is clearly defined, ensuring coherence and effectiveness of undergraduate studies. The individual elements of mathematical competencies and the identification of areas that create opportunities for action that change students' attitudes towards mathematics are considered interesting from a didactic point of view. Ultimately, the research competencies of mathematics education are among the key competencies a high level of which is required to function adequately in today's society, the knowledge society. In the process of forming mathematical competencies, it is important to provide students with knowledge relating to basic mathematical concepts, but also to pay attention to process and activity, i.e. the formation and development of skills.

Acknowledgements
None.

Conflict of Interest
None.

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Дослідження дослідницьких компетентностей у математичній освіті бакалаврів

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Анотація

Актуальність. Актуальність дослідження полягає в тому, що дослідницькі компетентності в математичній освіті майбутніх юристів - це знання, уміння і навички, які сприяють самореалізації особистості, активізують її освітню позицію, допомагають у процесі соціальної інтеграції. Усі дослідницькі компетентності взаємозалежні, оскільки мають спільні риси - критичне мислення, креативність, проактивність, вміння вирішувати проблеми, оцінювати ризики, приймати правильні рішення та конструктивно керувати емоціями. Вони надають студентам більшої гнучкості, що дозволяє їм швидше адаптуватися до стрімких змін у світі, де дедалі більше ускладнюються взаємозв'язки між різними сферами людської діяльності. Такі навички для майбутніх юристів є важливим фактором інновацій, продуктивності та конкурентоспроможності, які впливають на мотивацію, задоволеність та якість роботи.

Мета. Метою дослідження є вивчення аспектів набуття дослідницьких компетентностей у процесі навчання математики на рівні бакалаврату та визначення рівня математичної грамотності майбутніх правників. Зобов'язання створити оптимальні умови для розвитку дослідницьких компетентностей у математичній освіті відповідно до їхніх здібностей відноситься до освіти в широкому розумінні. Їх роль полягає у розвитку загальної здатності учня справлятися з мінливою реальністю.

Методологія. Освіта має бути персоналізованою, особливо з точки зору набуття навичок ефективного та систематичного навчання впродовж життя.

Результати. Складний характер сучасної дійсності вимагає знань, що постійно розвиваються, які можна отримати завдяки інформації та сучасним технологіям. Студенту-правнику важливо набути навичок міркування та аргументації на додаток до необхідних знань та предметних навичок з математичної освіти. Вони покликані полегшити студентам розуміння навколишнього світу, збагатити їхні знання в різних галузях та покращити засвоєння нових.

Висновки. Практична значущість полягає у визначенні рівня якості формування дослідницької компетентності та математичної грамотності майбутніх юристів.

Ключові слова: математична грамотність; дослідницькі компетентності; бакалаври; майбутні юристи; студенти; математична освіта; вміння; знання.