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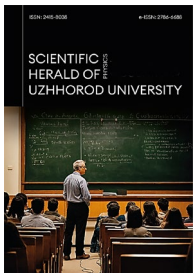

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Model for the formation of research competence of a future teacher of mathematics

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Abstract

Relevance. The study addresses the pressing need for educational reform in Kazakhstan, particularly in the training of pedagogical specialists, including future mathematics teachers. It emphasizes the importance of identifying and understanding the competencies required for effective educator preparation in the evolving educational landscape.

Purpose. This study aims to explore the model for cultivating research competence among future mathematics teachers and to differentiate between the terms "competency" and "competence". It seeks to highlight the implications of these distinctions for professional development and educational practice.

Methodology. The study likely utilizes qualitative research methods such as literature review and potentially case studies or interviews to investigate the formation of research competence in mathematics educators.

Results. The findings underscore the comprehensive nature of mathematics education, emphasizing the integration of didactic, educational, and organizational skills. It explores how these skills contribute to fostering students' holistic development across emotional, intellectual, and physical dimensions.

Conclusions. Effective mathematics teaching encompasses a blend of innate abilities, acquired skills, and personal traits, alongside a deep commitment to student welfare. The study underscores the necessity of aligning educational practices with contemporary societal demands and institutional frameworks. It advocates for the active integration of research

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competence models into teacher training programs to better prepare educators for the challenges of modern educational environments.

Keywords: students; academic performance; education; competence.

Introduction

The presumptions of the reform of the education system clearly define the general objectives of educational institutions, which state that teachers should strive for comprehensive and multidirectional development as the main goal of teaching activities. Future teachers of mathematics need to constantly adjust the way of transferring relevant knowledge, form skills and attitudes to mathematical activity, support individual studying, and awaken cognitive curiosity and motivation for further learning. The sources of the model for the formation of the research competence of a future mathematics teacher are seen in external, situational and empirically measurable conditions. The preference of any of the factors in determining the sources of educational achievements can serve as a basis for determining three main orientations in pedagogical education: technological orientation, humanistic orientation, and functional orientation [1]. Not everyone can be a good teacher, and not all students with special personal qualities achieve mastery in didactic and educational work. This issue concerns not only the teaching profession. Not every person who performs any kind of work can get an appropriate education and prepare for this job.

As long as the educational environment was elite, and only a small percentage of society was educated, teacher selection was based on the principle of natural selection, and the only concern of education reformers at the time was to create incentives that would motivate the brightest minds and teaching talents to engage in teaching. At present, it seems extremely important to find an ideal model of the research competence of the future teacher of the new era, the teacher of the future, who must solve new educational problems. The only rational effect of this search will be the belief that it is impossible to create a universal model of a mathematics teacher, that is, to make a list of those personality traits, knowledge, and skills that are necessary and sufficient to achieve good results in the teaching profession.

A significant percentage of teachers of mathematical specialities are characterized by an unsatisfactory level of knowledge and skills, as well as a low level of educational competencies [2]. Such teachers can be divided into two groups: teachers with a general resistance to pedagogy, working mainly by trial and error, trusting their own experience and routine; teachers characterized by a lack of critical understanding of their own actions and their broad context. Effective organization of research competence reveals positive aspects and elements of tasks, work planning and preparation of activities in general [3].

A mathematics teacher, who is characterized by a research attitude towards oneself, situations and knowledge gained because of pedagogical sciences, consciously creates their own, personal pedagogical knowledge. Such a teacher is a reflexive practitioner who reflects on their knowledge, manifested in action both during the action itself and within a certain time distance. One of the distinguishing features of the research competence of future mathematics teachers, who can create and maintain conditions for effective learning, is the ability to observe [4]. Such a teacher is a person of unshakable principles and broad horizons, carrying out their mission and sympathetically subordinating themselves to students. A rich, multifaceted personality who exemplifies educational virtues and qualities. Attention is drawn to a special triad of educational proxies, which consists of: an authorized institution, authorized teachers, and authorized students. There is a close causal relationship between the selected components of the educational triad. The presence or absence of educational proxies from the participants of the educational process is interdependent. Each component conditions inspires supports and develops each other. Optimization of pedagogical activity during classes concerns the correct choice and refinement of didactic and educational methods, and the creation of appropriate conditions necessary to fulfil the tasks [5; 6].

The purpose of the study is to consider the model of the formation of the research competence of a future mathematics teacher and differentiate the terms "competency" and "competence".

Materials and Methods

The methodological basis of the study consisted of the following approaches to the study of this topic: comparative, didactic, and pedagogical. The comparative method deals with the analysis of educational structures and phenomena of the Republic of Kazakhstan. Its integrating function proceeds from the need for a broad perception of educational phenomena in all respects with the constant crossing of the boundaries established by researchers, focusing their attention on certain areas of reality visible from the perspective of the discipline they represent. If the subject of comparison should mainly cover all issues of interest to teachers, then the comparator should establish contact with various specialists using research results and addressing research problems, which are necessary for the synthesis of a model of competence formation.

In this aspect, schools and higher educational institutions of Akmola, North Kazakhstan and Kostanay regions were considered. The pursuit of synthesis requires fundamental assessments. Especially in the research of various multilateral educational phenomena, the approach from different points of view is often fraught with the risk of error or even deliberate falsification. This function is intended to be performed by a comparative approach, the primary task of which is to overcome limitations.

The didactic method affects the effectiveness of the used model of formation of research competence of the future teacher of mathematics. The student's environment has a great influence on them. There are groups in which they adhere to different ideologies that do not always contribute to the acquisition of knowledge. Some youth subcultures even have an aversion to everything that has to do with the learning process. Weaker ones who want to increase their value in this way pursue often students with

high academic achievements. A teacher who does not see such phenomena may use the wrong teaching method. The results of such an erroneous analysis can lead to significant discrepancies between the expected and achieved effects of education and upbringing. Therefore, it seems necessary to constantly improve the professional skills of all teachers. This phenomenon significantly reduces independence, and hence the effectiveness of training. The result of an incorrectly applied method can lead to several errors. The current approach makes it possible to determine that the effectiveness of the use of didactic methods should be the subject of constant research to ensure that the effectiveness of their application is maintained at the desired level.

The pedagogical method of research refers to the way to achieve the goal set by the model of formation of research competence. It is a voice in the discussion about the practice of research aimed at creating knowledge and necessary competencies, which form an important thread of modern pedagogical reflection. The starting point for reflection is the analysis of the relationship between scientific theory and research practice in pedagogy and the resulting classification models. Theories and research programs are changing. Old concepts are increasingly losing their heuristic power. Science is moving forward through various breakthroughs and transitions, during which the theories and research standards that have been publicly shared so far are being replaced by various alternative models for the formation of the research competence of future mathematics teachers. In this context, efforts not only to follow but also to participate in the ongoing process of change become important. Several strong arguments, starting with general issues of the development of pedagogical sciences and changes in their educational practice, should support this approach.

Results and Discussion

Technological progress, cultural and social changes, progressive globalization, widespread media coverage, displacement of people, especially for economic reasons, and mental changes taking place in society occur very quickly and inevitably in the modern world. Unfortunately, most often all these changes mean that the methods of competent influence on young people are insufficient and outdated. Hence, the conclusion is that a mathematics teacher never fully achieves their professional development. Most of the teacher's research competence is constantly changing, which is due to the specifics of the teacher's work, the need for individualization of work and the uniqueness of the approach to students. There is no such educational system in the world that ignores the role of the teacher in the educational process. Although there are significant differences between these systems, the emergence of a new type of society poses new tasks and requirements for teachers [7; 8].

Teachers from the moment of study, and further in the process of improvement and self-education, must be prepared to respond to the needs of the modern world. All professional requirements that a teacher must meet as a mentor in the process of teaching and upbringing are included in the standards of professional competence. Competency capability depends on both the knowledge of the skill that the student acquires and the belief that this capability can be used. They, too, like the surrounding reality, undergo changes and modifications. The consequence of the teacher's improvement is not only their personal development and a sense of satisfaction but also the prospect of achieving high levels of professional abilities.

In recent years, there has been an acute question of what skills and knowledge a future teacher engaged in mathematical education should have, and whether there is a difference between the competencies and the competence of a teacher. The research competence of a teacher is usually perceived as a set of educational and professional knowledge, and the ability to implement them indicates appropriate competence. The concepts of competency and competence seem to be the same and are very often used as synonyms concerning the qualities, knowledge and experience of a mathematics teacher. However, in the case of developing processes and activities that promote the development of skills, it is important to understand the difference between these concepts and adequately apply them in an educational environment. Competencies are skills, knowledge, personal qualities and behaviour necessary for the effective performance of a certain role and achievement of goals [9].

In their main definition, competencies are divided into basic and additional, where the former includes skills such as, for example, industry knowledge, proficiency in tools and language aspects. Additional skills define social skills and personal qualities. Competencies can also be the rights, responsibilities, and authorities of a student. The very different meaning of competence is that it implies in its definition an element of knowledge and experience necessary to perform a particular professional activity. In each of these cases, competence must be formally proven. From the point of view of learning, both competencies and competence are extremely important and valuable elements, and they complement each other, having a huge impact on potential and effectiveness. That is why it is so important in the process of developing and forming professional skills to create a space for their continuous and complementary acquisition.

Most concepts define the competence process as a set of related human characteristics. Such a judgment is used, for example, for a positive description of skills, knowledge and for assessing professional qualifications. In many cases, the position depends on the subject of the description and varies depending on the boundaries set about the object. The competency of a future mathematics teacher is the competent performance of the duties assigned to them, which they understand and accept. These concepts are very common in all social and economic spheres of a person. In pedagogical disciplines, two fundamentally different concepts are often confused, but for the most part, this is due to the similarity of the source of the letter when teachers talk about the student or the subject of the narrative [10-12].

There is a simpler description of competency which explains it as an experience in the social and professional sphere of human activity, confirming their abilities in this field. If too takes one's judgment in the field of education, it reveals itself even more profoundly. Students' competencies are skills based on acquired knowledge, life experience and learning experience. All this multiplies and develops in the process of studying. In the aspect of

education, it is worth mentioning that teachers in their professional activities often use these concepts. In the educational sense, the explanation of these words is quite simple and is described by the ability to perform the right actions based on the knowledge and experience gained. Unlike definitions of verbal skills, current concepts have an impact on a broader field of thought. Evidence of their semantic proximity and conceptual interdependence are obvious and necessary as important elements describing the model of formation of research skills of future teachers of mathematics.

One of the priorities of modern educational institutions is the development of the mathematical competence of students, i.e. the development of the ability to make decisions, logical and analytical thinking, and strategy development skills. By the provisions contained in the main curriculum, mathematics performs important educational and developmental functions: it supports the mental, intellectual and social development of students. Students should be aware of the unity of the world, which is provided by inter-field correlations. They must be performed naturally because of problems because this is a practical aspect of the training content. A prerequisite for the effectiveness of training is the integration of transmitted messages that use logical thinking skills by creating an action strategy during team activities. Students' awareness of this is the basis for the formation of research competence.

According to many respondents who have been educated at a university that gives a teacher a formal qualification, research skills should be the initial stage of acquiring pedagogical competencies, in order to ensure a professional start and an endless process of growth. This is how they understand that their profession is creative and constantly evolving, so it is necessary to systematically enrich their knowledge and competencies. This, of course, may be an expression of the need to obtain additional degrees of professional advancement. For a future mathematics teacher, the key to the proper functioning of the educational system depends on the modern transformation of research competence [13; 14].

It is important to distinguish the advantages that are revealed when determining the motivational component of competencies and competence. Consequently, a distinctive feature of the second definition is the awareness of the value-semantic relationship in the description of the subject of the actions and experiences under consideration. It also cannot exist in isolation. Its use depends on the context in which the judgment can often exist independently of the process. Competence as a personality trait denotes the level of knowledge and skills developed in the field of competency. This means compliance with the standards and requirements established during the period of educational activity. After all, sometimes it becomes fundamental in terms of the differences between the two definitions. If the competency judgment considers a narrower degree of application of acquired skills and knowledge, then competence, in turn, gives a general description of the quality of training and the value of the subject's experience [15-17].

The inseparability of semantic definitions in the process of describing educational activities and the upbringing of a person affects the surrounding world through the areas of knowledge, skills and abilities. They define the norms and requirements for the educational process, and especially for the student, when describing them. Moreover, both definitions are somehow related to an assessment that can be measured in terms of the ability to assimilate information after studying the context. To master these skills, students must solve atypical problems in which it is important to demonstrate the ways of reasoning and the choice of mathematical tools appropriate to the problem being solved.

Currently, the term research competence serves as a guarantee of good work in the profession and achieving success. This term is used to characterize students with certain high competencies. It forms a cognitive structure consisting of skills, knowledge, predispositions and attitudes necessary for the effective performance of tasks arising from the educational concept. The competence model, which has become the basis for the creation of research tools, consists of a set of the following groups of elements: pragmatic and interpretative - communication, cooperation, creativity, information and the media. Future teachers of mathematics have a wide range of psychological, pedagogical and methodological knowledge in the field of mathematical education [18; 19].

The conviction that they can initially develop and organize integrated actions applies appropriate training methods, including activation and organizational forms. Mathematics teachers carefully select forms and methods of work of an activating nature, leading to creative problem solving, for example, integration games, visualization methods, conceptual maps, and problem methods. Appropriate conditions are created for them by forming the skills of searching and organizing information from different sources to detect relationships between different content. Various educational models increase the attractiveness of classes, taking into account the interests and abilities of students, stimulating them to develop creativity, independence and spontaneity, as well as the correct implementation of mathematical content. The most important research task at the fundamental level is due to the holistic development of all spheres of the student's professional personality [20-23].

From the point of view of the interviewed teachers of the Abai Kazakh National Pedagogical University, individual student performance is the most valuable. A thorough analysis of the educational process and the formation of research competence assesses the level of mathematical abilities of the student, their achievements and possible shortcomings. The knowledge gained from the survey is also important for the mathematics teacher who has taken on the current job. In addition to summing up the results, the reports sent to the institution immediately after the survey also include recommendations on methods of working with students offered to teachers. These recommendations are adapted to the results obtained by the students. They are designed to plan work with the next group of students starting their studies.

These results depend both on the work of teachers and on many other factors, regardless of individual abilities, conditions and atmosphere in general. The main purpose of the information collection is to provide teachers with information about their students' level of knowledge and

skills, as well as principles that can provide a basis for reflection on methods of teaching mathematics and on how to achieve the most important goals of mathematics education. The requirements of the basic mathematics curriculum are described not only as detailed conditions related to mathematical education but also as the studying objectives and the most important skills that a student must acquire. One of the goals of education is the ability of students to use their knowledge in performing and solving problems, and among the skills is to develop mathematical thinking, that is, the ability to use basic tools of mathematics in everyday life and to conduct elementary mathematical reasoning. Students are expected not only to learn these basic mathematical tools as described in the detailed requirements but also to be able to use them wisely.

According to the teachers of the multidisciplinary college at Sh. Ualikhanov Kokshetau University, teaching mathematics at all stages should form a single complete model of the formation of the research competence of future teachers of mathematics [24]. A less obvious conclusion follows from this evidence: students should have a good understanding of what their actions or inaction affect. Teachers must have tools to evaluate the effectiveness of the teaching methods they have adopted. It was highlighted that when solving problems in the field of mathematical imagination, the student, in addition to the ability to read a mathematical text, needs to correctly perceive and interpret reasoning, making rationally correct conclusions.

Their task is an effective process of checking the degree of development of students' basic intuition, that is, how effectively they can use mathematical figures in their imagination, and whether they know and understand the basic concepts associated with them. In the tasks in the field of mathematical imagination, the possession of the following professional skills included in the basic curriculum of general education was tested: the ability to use existing knowledge when performing tasks and solving problems; the ability to use the basic tools of mathematics in everyday life and conduct elementary mathematical reasoning. They help to diagnose the strengths and weaknesses of mathematical skills and lead teachers to reflect on the modification of the style of teaching mathematics at each stage of learning. The development of these elements of competencies requires the formation of attitudes characteristic of mathematical activity, which can occur only during a certain activity of students.

According to the teachers of Sh. Ualikhanov Kokshetau University, the model of research competence in mathematics includes several key components. These components encompass fundamental skills such as the ability to perform calculations, knowledge of measures and structures, and understanding of mathematical terms and concepts. Additionally, it involves the capability to analyse and evaluate various arguments and reasoning using mathematical methods. Effective communication in mathematical language and comprehension of mathematical proofs are also integral aspects. Furthermore, being well-versed in the types of questions that mathematics can address is considered essential within this model. However, the organization of specific models of activity, which is found in practice, can lead to serious obstacles that arise due to the deeply rooted beliefs of teachers [25-28]. It is often possible to meet the opinion that individual components of mathematical activity develop independently in the process of acquiring knowledge. At the same time, they do not understand the methodological meaning of the assumptions and do not see the difference between mathematical and empirical checks. Regardless of the acquisition of knowledge and skills specified in the educational program, students develop attitudes and behaviours that contradict those that teachers postulate as the goals of teaching mathematics. Meanwhile, a global trend is developing to return mathematical thinking to the rank of professional competence necessary for understanding the modern world and life in modern society. The model of formation of research competence assumes that students will make mistakes and, possibly, correct mistakes many times; however, this makes it possible to identify errors in students' thinking and allow provoking various types of mathematical activity. It is important to organize the student's activities so that they are as close as possible to the way of work characteristic of mathematics, which opens the elements of mathematical theory.

When studying the connections of the model of the formation of research competence between the characteristics of pedagogical institutions of Akmola, North Kazakhstan and Kostanay regions, a weak statistically significant relationship between the training program and student performance was discovered, which puts quality above the quantity of teacher training, acting as an important factor determining the effectiveness of training [29-31]. Having created a set of transparent expectations about teachers, candidates for the teaching profession should know what is expected of them and how these expectations will be met in the course of their training.

A teacher's knowledge should be based on components of subject knowledge and psycho-pedagogical knowledge, the ability to collaborate with other teachers, the ability to contribute to the life of the institution and other teachers, and the opportunity to continually improve. Education systems have not yet developed effective methods related to the choice of profession. For example, teachers may show gaps in interpersonal competencies or show gaps in mathematics knowledge. Only 1/3 of Kazakhstan's regions have special methods of selecting a mathematics teacher, including interviews, during which the candidate's motivation level is assessed. During the interview, it is possible to gather information about professional skills and attitudes. The quality of the selection process can be further improved by using the portfolio method, that is, by providing a more detailed description of its activities to date. Sometimes letters of recommendation may contain additional information. Therefore, in practice it becomes necessary to increase the research competence of candidates for pedagogical education, including teachers of mathematics [32; 33].

Comprehensive pedagogical competence of students at certain stages of education has become a necessity. It is designed to provide the best educational results, and students' mathematical competencies are structured by the applicable core curriculum and include content implemented at previous stages of learning. Competence

means responsibility, compliance and the right to a certain type of educational action and is the result of the learning process. Competency, in turn, cannot be identified only with knowledge and skills, but must also be related to the experience of this particular student, their beliefs, views and values. Most often, they are a function of time and professional activity, since the time and activity of the subject's professional life are subject to change, and competencies are not permanent.

For research purposes, the teacher needs general knowledge - objective and scientific-theoretical, which are the basis of thinking. In addition, teachers of individual subjects, such as mathematics, should consider their field of education in the context of related disciplines. The idea of integrating the content of various subjects is reflected in integrated learning at many educational levels [34; 35]. In any educational situation, a mathematics teacher should transfer knowledge, develop skills and motivate students to work on themselves, form their attitude to mathematical science. In turn, to implement the model of formation of research competence, it is necessary to acquire knowledge and skills related to conducting a dialogue with students, with a subjective and collaborative attitude towards students and respect for their autonomy [36; 37].

A modern future mathematics teacher should have several research competencies necessary for the development of cognitive independence of students. After all, this is not only the transfer of knowledge, but also education, the definition of the right attitude and the formation of relationships between students. A future mathematics teacher should indicate the direction of science and be a mentor and guardian on the path of learning, including in the world of information and computer space. Today's students are already critical and behave completely differently than their peers before digital technologies. Thus, it seems obvious that the teacher cannot and should not be outside the electronic society and that this digital environment of students should be natural for the teacher. The model of research competence brings to the fore aspects that seem important in the modern educational world [38-40].

These are informational and communicative competencies, which consist in the ability to use innovative technologies and apply them in training. The research competence model is well prepared to enrich classes with elements of computer technology, making them more attractive and effective. This is a kind of guide for the student in the electronic world, which indicates the direction in which the student must follow in order to succeed. This model prepares students for responsible and honest use of Internet sources while maintaining a reasonable balance between the analogy and the digital world. Many fields and professions are being automated. However, machines are no substitute for human beings who can think critically and at the same time creatively. Thus, it seems necessary to equip students with innovative competencies.

Conclusions

Thus, the model of formation of research competence is determined based on criteria and skills of proper planning, the choice of teaching methods, the use of activating methods, didactic tools, and applied forms of organizing students' work. Such processes are the result of the surrounding reality, which forces the constant improvement of research skills. Continuous professional development in the mathematical aspect is especially important for improving the effectiveness of teaching, since the achievement of students depends on the high competencies of future teachers.

A critical component is an assertion that teachers' professionalism is evidenced not only by cognitive arguments but also by personal arguments that encompass a world of values and feelings. It is they who determine the conscious, reflexive and responsible fulfilment by teachers of their professional role. To achieve this desired state, it is necessary to support future mathematics teachers in their professional development. The starting point is the recognition of the teacher's development phase and the use of appropriate stimulation models. This is a key element in passing the educational stages and in improving the process of becoming a teacher. To formulate such tasks, the future teacher of mathematics must be aware of the existence of related patterns and the possibility of justifying them by implementing the research components of a holistic model.

The reality around us is constantly changing. Many fields and professions are being automated. However, machines are no substitute for human beings who can think critically and at the same time creatively. Thus, it seems necessary to equip students with research competence, which is extremely important in mathematical activity and forms the basis of education. Innovation in the work of a teacher is manifested in the use of non-traditional models of research competence, teaching, and the offer of modern methodological solutions. It also includes participation in various educational projects, charity events and public meetings. Consequently, the future mathematics teacher must care both for the gifted student who wants to develop in a particular direction and for the student who is at risk of social exclusion.

After all, a modern teacher is a specialist in their field, constantly studying and looking for new methodological solutions; a person open to new things and able to skilfully innovate in working with students. The model of forming research competence of future mathematics teachers creates a space for an intuitive understanding of research for speculative reflections of the observer, but at the same time examines it systematically and empirically, which gives the greatest hope for progress in pedagogical education.

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Conflict of Interest
None.

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Модель формування дослідницької компетентності майбутнього вчителя математики

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Анотація

Актуальність. У дослідженні розглядається нагальна потреба реформування освіти в Казахстані, зокрема в підготовці педагогічних кадрів, у тому числі майбутніх учителів математики. Підкреслюється важливість визначення та розуміння компетентностей, необхідних для ефективної підготовки педагогів в умовах освітнього ландшафту, що розвивається.

Мета. Це дослідження має на меті дослідити модель формування дослідницької компетентності у майбутніх учителів математики та розмежувати терміни "компетентність" і "компетенція". Воно прагне висвітлити наслідки цих відмінностей для професійного розвитку та освітньої практики.

Методологія. У дослідженні, ймовірно, будуть використані якісні методи дослідження, такі як огляд літератури і, можливо, тематичні дослідження або інтерв'ю для вивчення формування дослідницької компетентності у вчителів математики.

Результати. Результати дослідження підкреслюють комплексний характер математичної освіти, наголошуючи на інтеграції дидактичних, виховних та організаційних навичок. Досліджено, як ці навички сприяють цілісному розвитку учнів в емоційному, інтелектуальному та фізичному вимірах.

Висновки. Ефективне викладання математики передбачає поєднання вроджених здібностей, набутих навичок та особистісних рис, а також глибоку прихильність до добробуту учнів. Дослідження підкреслює необхідність узгодження освітніх практик із сучасними суспільними вимогами та інституційними рамками. Воно закликає до активної інтеграції моделей дослідницької компетентності в програми підготовки вчителів, щоб краще підготувати педагогів до викликів сучасного освітнього середовища.

Ключові слова: студенти; академічна успішність; освіта; компетентність.