Торайғыров университетінің
ҒЫЛЫМИ ЖУРНАЛЫ

НАУЧНЫЙ ЖУРНАЛ
Торайгыров университета

ТОРАЙҒЫРОВ УНИВЕРСИТЕТІНІҢ ХАБАРШЫСЫ

Педагогикалық сериясы

1997 жылдан бастап шығады

TORAIGHYROV UNIVERSITY

ВЕСТНИК ТОРАЙГЫРОВ УНИВЕРСИТЕТА

Педагогическая серия

Издается с 1997 года

ISSN 2710-2661

№ 4 (2025)

Павлодар

НАУЧНЫЙ ЖУРНАЛ
Торайгыров университета

Педагогическая серия
выходит 4 раза в год

СВИДЕТЕЛЬСТВО
о постановке на переучет периодического печатного издания,
информационного агентства и сетевого издания
№ KZ03VPY00029269
выдано
Министерством информации и коммуникаций
Республики Казахстан

Тематическая направленность
публикация материалов в области педагогики,
психологии и методики преподавания

Подписной индекс – 76137

https://doi.org10.48081/UWEH8749

SRSTI 14.35.07

https://doi.org/10.48081/YBXE7574

N. V. Ryvkina[1], *A. S. Tulebekova[2], G. T. Tleulenova[3], I. T. Matin[4]

[1,2,3,4]L. N. Gumilyov Eurasian National University, Republic of Kazakhstan, Astana.

[1]ORCID: https://orcid.org/0000-0002-4646-3348

[2]ORCID: https://orcid.org/0000-0001-8553-3081

[3]ORCID: https://orcid.org/0000-0003-2806-1588

[4]ORCID: https://orcid.org/0009-0003-4194-1923

*e-mail: krasavka5@mail.ru

RESEARCH ON THE FORMATION OF PROFESSIONAL COMPETENCIES OF BACHELORS IN TECHNICAL FIELDS OF STUDY

Training of qualified engineers is an important direction for any country today. The place the state occupies in the world community according to the research results is determined, first, by the intellectual potential, and high level of competencies of specialists who have received engineering education. The importance of achieving conformity of the content and quality of engineering professional education to the ever-increasing requirements of the modern economy is an urgent issue. This can be achieved by developing quality educational programs that consider the peculiarities of different sectors of the economy and the needs of regions for highly qualified personnel. In conditions of acute shortage of qualified engineering and technical personnel in the field of construction, operation, and modernization of engineering systems, a high percentage of deterioration of housing stock and engineering systems of its provision, the search for ways to solve this problem is relevant for future bachelors in the direction of training «Civil Engineering». This article presents a model of forming professional competencies in the study of disciplines in the specialty «Civil Engineering». The model includes theoretical and practical components aimed at developing key skills necessary for effective work in the construction industry. Special attention is paid to integrating knowledge and skills through learning methods.

Keywords: professional competencies, model, technical fields, curriculum development, formation.

Introduction

For quality training of a bachelor, it is necessary to combine the requirements of employers with the professional activity of a specialist and the goals of technical education with the help of the competence approach [1]. Professional competencies of a Bachelor of Engineering are the competencies that determine the ability and readiness to solve a set of professional problems based on knowledge, skills, and abilities acquired in the process of education, considering the specific type of professional activity and personal potential [2]. The structure of professional competencies of a bachelor of technical direction includes the following components: cognitive and thinking, which includes knowledge necessary for solving professional tasks; functional, considering the ways of performing various actions in solving professional tasks; and individual, focused on the ability of self-organization and self-management. The list of professional competencies is determined by the main types of professional activities of a specialist in a particular field.

Pedagogical means of realization of conditions of formation of professional competencies of bachelor include development considering the modular approach. In the modular organization of the learning process, the content of the modular learning technology is presented in a visual and suitable for comprehension and application [3]. Formation of professional competencies based on professional knowledge and skills. The more effective method is using dynamically changing methods of pedagogical modeling of learning activity according to the demands of the labor market.

Thus, it is important to have an approach where the learning process is aimed at the integration of theory and practice. Thus, disciplines related to engineering specialties require not only theoretical mastery of physics and mathematics, but also the ability to apply this knowledge to solve practical problems, such as design, modeling, calculation of structures, and other professional tasks [4].

The best practices of the world show the effectiveness of using active learning methods [5], such as project methodology, and case method, as well as working in groups and on simulators [6]. These methods allow students not only to master theoretical knowledge but also to apply it in conditions close to real professional practice. This is especially important for specialized disciplines, where the ability to work with real projects and tasks is an integral part of professional competence.

As noted in the work that the development of communication competencies is essential to meet university requirements and support graduate employment [7].

However, students show significant deficiencies in this area. This study proposes using a learning contract to address these deficiencies, with the main goal being to analyze its impact on the development of oral speech and presentation skills.

Another investigation [8] highlights the importance of equipping technical students with employability skills by implementing a Task-Based methodology that mimics real-world professional challenges. It integrates Intercultural Competence to prepare students for diverse workplaces, fostering skills such as cultural awareness, empathy, and effective communication. This research [9] defines competencies and proposes a new competency model based on expert opinions using the Delphi technique. The study identifies 22 competencies across three domains: knowledge, skills, and attitudes, and refines these through multiple rounds of surveys with experts in Curriculum and Instruction. The resulting model aligns with the European Qualifications Framework (EQF) and the National Qualifications Framework for Higher Education in Türkiye, enhancing the quality of doctoral programs in this field.

Authors presented of peculiarities of utilizing and adapting the Delphi Method for use in qualitative research [10].

The results demonstrate a strong correlation between this approach and improved employability skills, emphasizing its value in enhancing students' personal and professional development.

Materials and methods

The research on the formation of professional competencies of bachelors was carried out during the study of profile disciplines in the direction of «Engineering systems and networks». In this regard, to create a model of theoretical and practical component taking into account the labor market, the following works were carried out:

1 Determination of the names of professional modules;

2 Determination of the relationship between elective modules (elective courses) and compulsory modules (compulsory component), determination of profile disciplines forming competences within the limits of studying this module;

3 Defining the method of teaching.

In order to solve task 1, the names of professional modules were determined. The modules were designed to maximally meet the needs for specific knowledge and skills that are necessary for successful professional activity in the chosen field. The process of defining the module names included the following stages:

Analysis of Key Competencies and Areas of Knowledge: A review was conducted to identify the key competencies required for professionals in the field of engineering systems, such as heating, ventilation, air conditioning, water supply, and drainage systems. This analysis informed the content of the modules.

Development of Professional Module Names: Based on the analysis, the following modules were identified, each representing a key area of knowledge and competence: Design of Engineering Systems; Operation and Maintenance of Engineering Systems; Diagnostics and Management of Engineering Systems; Energy and Environmental Aspects of Engineering Systems; Innovative Technologies in Engineering Systems.

In the second task, the primary objective was to design a logical and sequential framework that allows for in-depth exploration of professional disciplines while maintaining a strong theoretical foundation. The relationship between mandatory and elective modules is presented in Table 1.

Table 1 – Mandatory and elective modules peculiarities

Mandatory Modules	Elective Modules	Relationships and Competencies Developed
Basics of Engineering Systems Design	Innovative Technologies in Engineering Systems	Developing skills in applying new technologies in design
Technology of Engineering Systems Installation	Automation and Control of Engineering Systems	Competencies in managing modern engineering systems
Fundamentals of Engineering Systems Operation	Energy Efficiency in Engineering Systems	Knowledge in energy-saving technologies
Standards and Regulations in Engineering Systems	Environmental Aspects of Engineering Systems	Understanding sustainable and eco-friendly design and operation

Task 3 includes the development of professional modules for the «Engineering Systems» program, a special emphasis was placed on integrating practical and active learning methods that align with the program's core competencies. These methods include Project Method, Case Study Method, Modeling, and Field Practices. Each teaching method was used as a framework to shape the content and structure of the professional modules. Project Method forms the basis for creating modules that emphasize applying theoretical knowledge in real-life projects. This method allows students to gain practical experience and learn how to work in teams, manage resources, and approach complex engineering problems in a structured way. Case Study Method involves using real-world scenarios to analyze and solve engineering problems. It encourages students to critically evaluate different approaches to challenges in engineering systems, promoting problem-solving and

decision-making skills. The case study approach was integrated into modules focused on diagnostic and troubleshooting processes.

Modeling involves using simulations and models to replicate real-world engineering systems. It allows students to test various engineering solutions without the risk of failure in real-life systems. Modules based on modeling teach students to analyze system behavior, predict performance and optimize designs before actual implementation. Field practices provide students with the opportunity to observe and participate in the real-world functioning of engineering systems. By working on-site, students can directly apply their theoretical knowledge to solve practical problems and gain a deeper understanding of the engineering process in various environments. Modules based on field practices focus on direct interaction with working engineering systems.

Results and discussions

As a result, the structure of formation of students' competencies (Table 2) has the integrity of the process of formation of professional competencies and is based on the correspondence of the educational program objectives to the disciplines that form general professional and professional competencies of bachelors. So, the formation of professional competence «Ability to carry out all types of professional activities in the field of design, construction and operation of water supply, drainage systems, providing microclimate of buildings and structures» occurs during the study of disciplines «Heating systems of buildings», «Sanitary and technical devices of buildings», «Automated design of engineering systems». Adaptation to the requirements of the labor market through a modular approach combines these disciplines in the «Module of technology and engineering equipment», which is studied after the acquisition of general professional competencies in the «Module of theoretical foundations of professional activity», that is, the first module is essentially the foundation for the study of subsequent ones.

Table 2 – Structure of formation of students' competencies

Moduule name	Competency Fformed	Main disciplines
1 Module of Fundamental Engineering Sciences	Ability to build mathematical models of objects, design and develop components and blocks of engineering systems using computer-aided design tools.	Mathematics, Engineering Mechanics, Surveying, Architectural and Construction Drawing, BIM Design Technology
2 Minor Module of General Construction Disciplines	Ability to forecast urban planning social needs and use them at various stages of engineering systems and networks design.	Building Materials, Architecture and Structural Design, Geotechnics
3 Module of Theoretical Foundations of Professional Activity	Ability to analyze hydraulic and thermal processes and modes for the subsequent design of engineering systems.	Hydraulics and Aerodynamics, Heat Engineering, Building Thermophysics
4 Module of Engineering Equipment and Technology	Ability to carry out all types of professional activities in the design, construction, and operation of water supply, sewage systems, and climate control of buildings and structures.	Pumps, Fans, Compressors, Sanitary Engineering Systems in Buildings, Ventilation and Air Conditioning, Heating Systems for Buildings, Automated Design of Engineering Systems
5 Module of Design, Construction, and Operation of Engineering Systems and Networks	Ability to carry out all types of professional activities in the design, construction, and operation of water supply and sewage networks in settlements; water intake and treatment plants, heat sources, heating and gas supply networks in settlements.	Water Intake Facilities, Water Purification Technology, External Water Supply Networks, External Sewerage Networks, Wastewater Treatment Technology, Heat Generation Units, Non-traditional and Renewable Energy Sources, Gas Networks and Equipment, Heat Supply, Water Resources and Air Protection Technologies

6 Module of Construction and Engineering Technologies	Ability to organize and manage the process of preparation and implementation of construction, reconstruction, modernization, and optimization of engineering systems.	Economics and Management of Engineering Systems, Construction and Installation Technology, Diagnostics, Adjustment, and Operation of Engineering Systems, Reconstruction and Modernization of Engineering Systems

The selected learning methods for each module are summarized in Figure1.

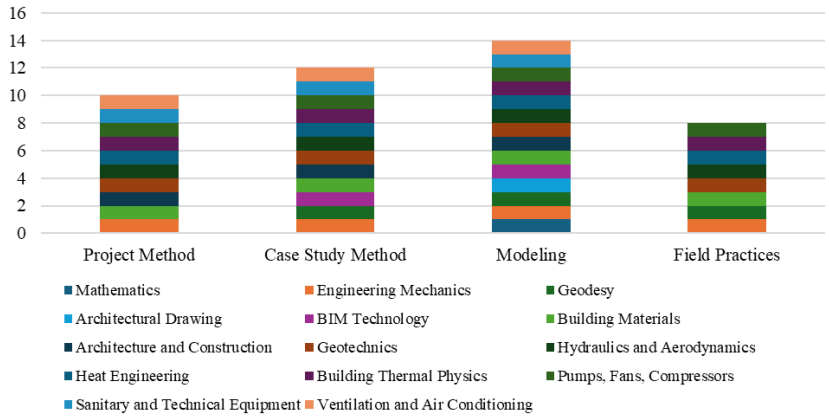

Figure 1 – Learning methods

Considering the above requirements and considering the formation of necessary professional competencies, the model of professional competencies formation is built (Figure 2). This model outlines the key components and processes necessary for acquiring and enhancing competencies in the professional field. The division into basic, intermediate, and advanced levels aligns with the progression of knowledge and skills acquired throughout study, ensuring that students are gradually prepared for increasingly complex tasks and responsibilities in the construction industry.

Basic Level (Bachelor's Year 1): In the first year of the program, students acquire foundational knowledge in construction principles, mathematics, engineering basics, and technical drawing. This stage focuses on building core competencies such as understanding construction materials, basic design concepts, and fundamental project management skills.

Intermediate Level (Bachelor's Year 2-3): As students advance, they deepen their understanding of construction processes, structural design, building systems, and environmental considerations. They also start applying theoretical knowledge to more complex problems, such as conducting site analysis and participating in real-world projects. At this stage, students develop skills in areas like construction planning, budgeting, and quality control.

Advanced Level (Bachelor's Year 4): In the final year, students are expected to integrate and apply their acquired knowledge to advanced topics such as construction law, sustainability, advanced project management, and innovative building technologies. They work on complex projects, demonstrating their ability to manage teams, lead projects, and make strategic decisions within the construction industry.

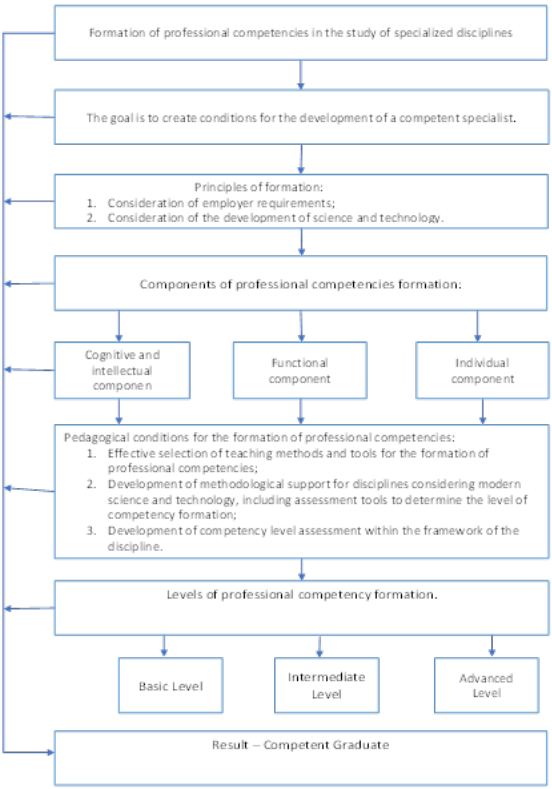

Figure 2 – Developed model of professional competencies

This hierarchical structure ensures that students gradually progress from acquiring basic knowledge to mastering specialized and advanced competencies, ultimately preparing them for professional practice in the construction industry. It also allows for a systematic approach to competency development, ensuring that graduates possess the necessary skills to meet industry demands.

Conclusion

Considering the requirements of employers, the names of professional modules have been defined, the sequential structure of their study has been created, the relationship between elective modules and compulsory modules has been determined, the profile disciplines forming competencies within the study of this module have been defined. The set and content of general professional and professional competences of bachelor's degree in «Civil Enginering» training direction for each module of profile disciplines is defined and disclosed. Theoretically substantiated and developed a structural-functional model of the process of professional competences formation, which includes a set of components such as cognitive-thought; functional; individual. At that, each component has its own goals, content, tasks, is formed using specific methods and means and is evaluated separately.

Funding information

This research is funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP26195121 «Development of an educational digital platform for future builders with simulation of construction processes and integration with measuring devices via IoT»).

References

1 An Exploratory Examination of the Psycho-Emotional Profiles and Complex Thinking Competencies Among Freshman Students in Mexico / J.C. Vázquez-Parra, M. Carlos Arroyo, M. Cruz Sandoval, L. Glasserman // The International Journal of Adult, Community and Professional Learning. — 2024. — T. 31, № 2. – p. 43–66. https://doi.org/10.18848/2328-6318/CGP/v31i02/43-66

2 The International Journal of Educational Technology in Higher Education: content and authorship analysis 2010–2024 / M. Bond // International Journal of Educational Technology in Higher Education. — 2024. — Vol. 21, No. 1. — P. 60. https://doi.org/10.1186/s41239-024-00492-z

3 The Boundaries of Competency within Lisbon and Bologna: The Short-Cycle/foundation Learner / J. Brine // European Educational Research Journal. – 2008. – Vol. 7, No. 3. – P. 344–357. https://doi.org/10.2304/eerj.2008.7.3.344

4 Online Teaching and Learning: Perspectives of Faculty and Students from the Cyber-Trenches / L.S. Anderson, M. J. Carter, A. A. DiRenzo // SCHOLE: A Journal of Leisure Studies and Recreation Education. — 2022. — Vol. 37, No. 1–2. — P. 112–122. https://doi.org/10.1080/1937156X.2021.1897901

5 Scoping review methodology and its use to review online project-based learning in higher education, 2020-2023 / E. Jaleniauskiene, D. Lisaite // Interdisciplinary Journal of Problem-Based Learning. – 2023. – T. 17, № 2. https://doi.org/10.14434/ijpbl.v17i2.36659

6 Implementation of a Machine Learning-Based MOOC Recommender System Using Learner Motivation Prediction / S. Assami, N. Daoudi, R. Ajhoun // International Journal of Engineering Pedagogy (iJEP). – 2022. – T. 12, № 5. – p. 68–85. https://doi.org/10.3991/ijep.v12i5.30523

7 El Contrato de Aprendizaje como Estrategia para Fomentar las Competencias Comunicativas / R. Gil-Galván, I. Martín-Espinosa, F.J. Gil-Galván // REICE. Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educación. — 2023. – T. 22, № 1. – p. 27–44. https://doi.org/10.15366/reice2024.22.1.002

8 The impact of intercultural competence on task-based approach for developing employability skills among technical students / M. Kailas, V. Bhatt // Millenium - Journal of Education. — 2024. — Vol. Technologies. — P. e34482 Páginas. https://doi.org10.29352/MILL0224.34482

9 Defining competencies in curriculum and instruction and developing a new competency model / M. Kart, H. Şimşek // Humanities and Social Sciences Communications. – 2024. – Vol. 11, No. 1. – P. 1496. https://doi.org/10.1057/s41599-024-03917-2

10 Utilizing and Adapting the Delphi Method for Use in Qualitative Research / S.R. Brady // International Journal of Qualitative Methods. – 2015. – Vol. 14, No. 5. – P. 1609406915621381. https://doi.org/10.1177/1609406915621381

Received 05.12.24.
Received in revised form 08.10.25.
Accepted for publication 25.11.25.

*Н. В. Рывкина[1], *А. С. Тулебекова[2],*
Г. Т. Тлеуленова[3], И. Т. Матин[4]
[1,2,3,4]Л. Н. Гумилев атындағы Еуразия ұлттық университеті,
Қазақстан Республикасы, Астана қ.
05.12.24 ж. баспаға түсті.
08.10.25 ж. түзетулерімен түсті.
25.11.25 ж. басып шығаруға қабылданды.

КӘСІБИ ҚҰЗЫРЕТТІЛІКТЕРДІ ҚАЛЫПТАСТЫРУДЫ ЗЕРТТЕУ БАКАЛАВРЛАРДЫҢ ТЕХНИКАЛЫҚ БІЛІМ БЕРУ БАҒДАРЛАМАЛАРЫ БОЙЫНША

Білікті инженерлерді даярлау бүгінгі таңда кез келген ел үшін маңызды бағыт болып табылады. Елдің әлемдік қауымдастықтағы орны зерттеулер нәтижелері бойынша, ең алдымен, интеллектуалдық әлеуетімен және инженерлік білім алған мамандардың жоғары кәсіби құзыреттілігімен анықталады. Инженерлік кәсіби білімнің мазмұны мен сапасының заманауи экономиканың үнемі өсіп келе жатқан талаптарына сәйкестігін қамтамасыз ету маңызды мәселе болып табылады. Бұл әртүрлі экономикалық салалардың ерекшеліктерін және өңірлердің жоғары білікті кадрларға деген қажеттілігін ескеретін сапалы білім беру бағдарламаларын әзірлеу арқылы жүзеге асырылуы мүмкін. Құрылыс, пайдалану және инженерлік жүйелерді модернизациялау саласында инженерлік және техникалық кадрлардың жетіспеушілігі жағдайында, тұрғын үй қорын және оның қамтамасыз ету жүйелерінің тозуының жоғары пайызы кезінде осы мәселені шешу жолдарын іздеу «Құрылыс» бағыт бойынша болашақ бакалаврлар үшін өзекті болып табылады. Бұл мақалада «Құрылыс» бағыт бойынша пәндерді оқуда кәсіби құзыреттіліктерді қалыптастыру моделі ұсынылған. Модель теориялық және практикалық компоненттерді қамтиды, олар құрылыс саласында тиімді жұмыс істеуге қажетті негізгі дағдыларды дамытуға бағытталған. Білім мен дағдыларды оқу әдістері арқылы интеграциялауға ерекше назар аударылған.

Кілтті сөздер: кәсіби құзыреттіліктер, модель, техникалық салалар, оқу бағдарламаларын әзірлеу, қалыптастыру.

Н. В. Рывкина[1], А. С. Тулебекова[2],
Г. Т. Тлеуленова[3], И. Т. Матин[4]
[1,2,3,4]Евразийский Национальный
университет имени Л. Н. Гумилева,
Республика Казахстан, г. Астана
Поступило в редакцию 05.12.24.
Поступило с исправлениями 08.10.25.
Принято в печать 25.11.25.

ИССЛЕДОВАНИЕ ФОРМИРОВАНИЯ ПРОФЕССИОНАЛЬНЫХ КОМПЕТЕНЦИЙ БАКАЛАВРОВ В ТЕХНИЧЕСКИХ ОБРАЗОВАТЕЛЬНЫХ ПРОГРАММАХ

Подготовка квалифицированных инженеров является важным направлением для любой страны на сегодняшний день. Место, которое страна занимает в мировом сообществе по результатам исследований, определяется, прежде всего, интеллектуальным потенциалом и высоким уровнем компетенций специалистов, получивших инженерное образование. Важность достижения соответствия содержания и качества инженерного профессионального образования постоянно возрастающим требованиям современной экономики является актуальной проблемой. Этого можно достичь путем разработки качественных образовательных программ, которые учитывают особенности различных секторов экономики и потребности регионов в высококвалифицированных кадрах. В условиях острого дефицита квалифицированных инженерно-технических кадров в области строительства, эксплуатации и модернизации инженерных систем, высокого процента износа жилищного фонда и инженерных систем его обеспечения, поиск путей решения этой проблемы является актуальным для будущих бакалавров по направлению подготовки «Строительство». В данной статье представлена модель формирования профессиональных компетенций при изучении дисциплин по направлению «Строительство». Модель включает теоретические и практические компоненты, направленные на развитие ключевых навыков, необходимых для эффективной работы в строительной отрасли. Особое внимание уделено интеграции знаний и навыков через методы обучения.

Ключевые слова: профессиональные компетенции, модель, технические области, разработка учебных программ, формирование.

Теруге 25.11.2025 ж. жіберілді. Басуға 30.12.2025 ж. қол қойылды.
Электронды баспа
9,42 Kb RAM
Шартты баспа табағы 31,59.
Таралымы 300 дана. Бағасы келісім бойынша.
Компьютерде беттеген З. Ж. Шокубаева
Корректорлар: А. Р. Омарова, Д. А. Қожас
Тапсырыс № 4485

Сдано в набор 21.11.2025 г. Подписано в печать 30.12.2025 г.
Электронное издание
9,42 Kb RAM
Усл.п.л. 32,63. Тираж 300 экз. Цена договорная.
Компьютерная верстка З. Ж. Шокубаева
Корректоры: А. Р. Омарова, Д. А. Қожас
Заказ № 4485

«Toraighyrov University» баспасынан басылып шығарылған
Торайғыров университеті
140008, Павлодар қ., Ломов к., 64, 137 каб.

«Toraighyrov University» баспасы
Торайғыров университеті
140008, Павлодар қ., Ломов к., 64, 137 каб.
8 (7182) 67-36-69
e-mail: kereku@tou.edu.kz
www.pedagogic-vestnik.tou.edu.kz