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МЕТОДОЛОГІЧНІ ОСНОВИ РОЗВИТКУ ПРОФЕСІЙНОЇ КОМПЕТЕНТНОСТІ МАЙБУТНІХ БАКАЛАВРІВ ЕКОНОМІКИ НА ЗАСАДАХ STEM-ОСВІТИ

Анотація. *Розвиток професійної компетентності майбутніх економістів у контексті STEM-освіти ґрунтується на синтезі різних (педагогічних, психологічних та технологічних) підходів, спрямованих на формування комплексних знань, практичних умінь і інноваційного мислення. Сучасні підходи до підготовки бакалаврів потребують значних змін, оскільки мають відповідати вимогам ринку праці та технологічним тенденціям. Тому STEM-освіта може стати основою для модерніхації підготовки бакалаврів з економіки, при якій компетентнісний, діяльнісний та міждисциплінарний підходи дозволять розвинути у студентів знання й навички, необхідні для успішного виконання професійних завдань. У статті обґрунтовано, що компетентнісний підхід є необхідним кроком у відповідь на виклики цифрової епохи, оскільки він розвиває здатність до роботи в умовах четвертої промислової революції для розвитку інноваційної економіки. Показано, що діяльнісний підхід у поєднанні з принципами STEM-освіти створює потужний механізм формування професійної компетентності майбутніх бакалаврів економіки. Він дозволяє не лише ефективно передавати знання, але й формувати практичні навички, професійне мислення та здатність до постійного самовдосконалення, що може стати драйверами інноваційного розвитку економіки. Доведено, що міждисциплінарний підхід дозволяє готувати фахівців нового типу, які володіють не тільки глибокими економічними знаннями, але й здатністю застосовувати інструментарій точних наук і технологій для аналізу та вирішення складних професійних завдань. Результати впровадження такого підходу сприятимуть підготовці конкурентоспроможних фахівців, здатних стати драйверами інноваційного розвитку суспільства. Використовуючи такі підходи, університети можуть не тільки покращити освітній досвід для своїх студентів, але й сприяти розвитку кваліфікованої робочої сили, здатної орієнтуватися в тонкощах світової економіки.*

Ключові слова: *STEM-освіта; підготовки бакалаврів з економіки; компетентнісний підхід; діяльнісний підхід; міждисциплінарний підхід; професійна освіта.*

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METHODOLOGICAL FOUNDATIONS FOR THE DEVELOPMENT OF ECONOMICS BACHELOR PROFESSIONAL COMPETENCE BASED ON STEM EDUCATION

Abstract. *The development of future economic professional competence in STEM education is based on the synthesis of various (pedagogical, psychological, and technological) approaches aimed at forming comprehensive knowledge, practical skills, and innovative thinking. Modern approaches to the training of bachelors require significant changes, as they must meet the requirements of the labor market and technological trends. Therefore, STEM education can become the basis for modernizing the training of bachelors in economics, in which competency-based, activity-based, and interdisciplinary approaches will allow students to develop the knowledge and skills necessary for the successful performance of professional tasks. The article substantiates that the competence approach is a step required in response to the challenges of the digital age, as it develops the ability to work in the conditions of the fourth industrial revolution to develop an innovative economy. It is shown that the activity approach, combined with the principles of STEM education, creates a powerful mechanism for forming professional competence of future bachelors of economics. It allows not only the effective transfer of knowledge but also the formation of practical skills, professional thinking, and the ability to continuously improve, which can become drivers of innovative economic development. It has been proved that the interdisciplinary approach allows training specialists of a new type who have not only deep economic knowledge but also the ability to apply the tools of exact sciences and technologies to analyze and solve complex professional problems. The results of implementing this approach will contribute to the training of competitive specialists who can become drivers of the innovative development of society. By using such approaches, universities can not only improve the educational experience for their students but also promote the development of a skilled workforce capable of navigating the intricacies of the global economy.*

Keywords: *STEM education; bachelor's training in economics; competence approach; activity approach; interdisciplinary approach; vocational education.*

Problem statement. In the modern educational space, in particular in the field of economics, the model of bachelor's training requires significant changes to meet the requirements of the labor market and technological trends [4; 10; 19]. One such model is STEM education, which integrates science, technology, engineering, and mathematics [9; 15]. In this context, competency-based, activity-based, and interdisciplinary approaches are used, which allow students to form the skills and knowledge necessary for the successful performance of professional tasks.

Analysis of current research. The training of bachelors in economics today is being modernized in various areas, such as the use of IT in educational training [13] and the use of game teaching methods [14], deepening of mathematical training [2], training in studying mathematical disciplines [17], profiling of training [16], the development of personal qualities, in particular, emotional intelligence and communication culture [6] and other directions. At the same time, scientists are looking for strategies to improve learning outcomes that correspond to modern technological developments. This aspect determines the appeal of STEM education [11] and is indirectly based on competency, activity, and interdisciplinary approaches.

The competency-based approach in education focuses on forming students' knowledge and skills that best meet the dynamic conditions of the labor market. In STEM education, competencies include critical thinking, analytical skills, and teamwork [1]. The education system should create conditions for developing these competencies in students by implementing practical projects, research projects, and other active forms of learning. Using case methods combines theory with practice, allowing students to consciously apply the knowledge gained in actual conditions.

The activity approach in the preparation of a Bachelor of Economics focuses on the active involvement of students in the educational process. The main goal of this approach is to ensure that students not only gain knowledge but also are able to apply it in practical situations actively. In particular, this may include group projects, simulations of business processes, or participation in startups [5]. Students can develop their creativity, time and resource management skills, and teamwork through an activity-based approach. This is especially important in today's business environment, where leadership and effective communication are key elements of success [3].

This is especially true in STEM education because science subjects, technical knowledge, and economic concepts interact and complement each other. With the help of an interdisciplinary approach, students get the opportunity to consider problems comprehensively, which in turn contributes to the formation of systems thinking. That cannot be analyzed within the same discipline. This contributes to a deeper understanding of the topic in a general context and develops research skills [12].

Thus, the preliminary analysis indicates the prospects of using competency-based, activity-based, and interdisciplinary approaches in the training of a Bachelor of Economics. Therefore, the **article aims** to substantiate the feasibility of using competency-based, activity-based, and multidisciplinary approaches to develop the professional competence of future students based on STEM education.

Research methods: the use of the system analysis method to analyze complex systems related to professional competence and determine the relationships between different components; the use of the process of comparative analysis to compare different approaches to the development of professional competence, including competent, activity and interdisciplinary approaches, and determine which of them are the most effective.

Results. Based on the results of the system and comparative analysis, we can provide the following arguments in favor of using approaches for developing the professional competence of future students based on STEM education.

Substantiation of the Competence Approach to the Development of Professional Competence of Future Bachelors of Economics based on STEM Education

The current stage of economic development is characterized by rapid digitalization [22] and automation of processes, which puts forward new requirements for the training of specialists in economics. Traditional approaches to learning, focused on the transfer of knowledge in a ready-made form, no longer meet the needs of the labor market. Therefore, the competency-based approach becomes an approach to forming professional competence for future Bachelor's of Economics.

The competence approach is focused on the learning outcome, which is expressed not only in the assimilation of theoretical knowledge but also in the formation of the ability to apply this knowledge to solve real professional problems [8]. This is especially true for economic education, where graduates must analyze complex data, make decisions in the face of uncertainty, and adapt to rapid changes in the digital environment. STEM education, which combines science, technology, engineering, and mathematics, can become the basis for implementing a competency-based approach, as it naturally integrates theoretical knowledge with practical skills.

Implementing the competence approach in economic education [20] based on STEM involves several key aspects. The first is the emphasis on interdisciplinarity, where students learn to apply mathematical methods and technological tools to analyze economic processes. For example, the study of econometrics is enhanced by hands-on Python or R programming classes, which allow students to understand statistical models and build and test them on actual data on their own. Secondly, the competency-based approach involves actively using project-based teaching methods when students work on real cases that simulate professional situations. This can be developing financial models for businesses, analyzing market trends using big data, or creating algorithms for predicting economic indicators.

The experience of implementing a competency-based approach in combination with STEM education demonstrates significant positive results. Studies by leading universities show that students who study according to this method show a higher level of assimilation of the material and better preparedness for professional challenges. In particular, they can adapt faster to new technologies, work more efficiently with data, and make informed decisions. For example, graduates of programs that integrate economics with computer science find jobs in fintech companies, analytical departments of large corporations, or international organizations where their skills are highly valued.

The competence approach contributes to the development of critical thinking and creativity, which are integral parts of the professional competence of a modern economist. With markets becoming increasingly dynamic and unpredictable, the ability to analyze information, identify key trends, and offer innovative solutions is becoming a leading success factor. Competency-based STEM education provides students with the necessary tools to develop these qualities through practical tasks and cooperation with industry.

An important aspect is also the social responsibility of higher education, which consists of training specialists who can respond to the challenges of the modern world. A competency-based approach combined with STEM education allows you to develop technical skills and an understanding of the ethical and social aspects of the use of technology in the economy. For example, students learn to analyze the impact of algorithmic trading on financial markets or assess automation's effects on employment.

Therefore, a competency-based approach to developing professional competence for future bachelors of economics based on STEM education is necessary in response to the challenges of the digital age. It provides a high level of professional training and develops the ability to learn throughout life, which is key in the face of constant change. The results of the implementation of this approach indicate its effectiveness in training competitive specialists who are ready to work in the conditions of the fourth industrial revolution and will contribute to the development of an innovative economy.

Substantiation of the Activity Approach to the Development of Professional Competence of Future Bachelors of Economics based on STEM Education

Modern requirements for economic education have been significantly transformed under the influence of digitalization and technological progress. Under these conditions, the activity approach is particularly important as a methodological basis for forming professional competence of future bachelors of economics [7]. This approach, integrated with the principles of STEM education, creates a powerful mechanism for training specialists who can function effectively in a dynamically changing economic environment.

The activity approach is based on the principle of "learning through action", where the student acts as an active subject of the educational process [21]. In economic education, theoretical knowledge is mastered not in isolation but through its direct application to solve real professional problems. STEM education provides a sufficient basis for this, as it naturally combines theoretical foundations with practical tools for their implementation. For example, the study of econometrics ceases to be an abstract discipline when students immediately apply statistical methods to analyze actual economic data using specialized software.

Implementing the activity approach in economic education based on STEM involves the creation of conditions for the imitation of professional activity. This is achieved by developing comprehensive educational projects that are as close as possible to the actual working conditions of an economist. Students can model financial markets, analyze business processes using data analytics, or develop economic strategies using artificial intelligence. Such forms of work consolidate theoretical knowledge and develop critical thinking and the ability to quickly adapt and work in a team - qualities that are especially important for the modern economist.

An important aspect of the activity approach is its focus on specific results. Unlike traditional forms of education, where the leading indicator is the assimilation of information, the emphasis is on creating a specific product - an analytical report, an economic model, a software solution, or a business project. This gives students a sense of responsibility for the result and an understanding of the practical value of the knowledge gained. The STEM component further enhances this effect, as technological tools allow you to demonstrate the connection between theoretical knowledge and its practical application.

The experience of implementing an activity approach in combination with STEM education demonstrates significant positive results. Studies show that students who study according to this method demonstrate a higher level of assimilation of the material, a better ability to apply knowledge in practice and feel more confident in a professional environment. In particular, they adapt faster to work with new technologies, use analytical tools more efficiently, and demonstrate a more creative approach to solving professional problems. Graduates of such programs are successfully employed in analytical departments of large corporations and international organizations, where their practical skills are highly valued.

It is especially worth noting the influence of the activity approach on the development of the professional identity of future economists. Students form an idea of their future profession, its requirements, and prospects through constant practical work. This allows them to build their career trajectory more consciously and develop the skills in demand in the labor market. The STEM component plays a key role in this process since technological skills become a decisive factor in the competitiveness of a modern economist.

An essential result of implementing the activity approach is an increase in students' motivation to learn. Practice-oriented tasks with a real professional context are perceived as more interesting and valuable than abstract theoretical exercises. This is especially important in economic education, where many traditional disciplines may seem detached from reality to students. STEM elements add a new, modern dimension to these disciplines, making their study more engaging and understandable.

Thus, the activity approach, combined with the principles of STEM education, creates a powerful mechanism for forming professional competence for future bachelors of economics. It allows not only the transfer of knowledge effectively but also the formation of practical skills, professional thinking, and the ability to continuously improve oneself. The results of the introduction of this approach indicate its high efficiency in training specialists who meet the requirements of the modern labor market and can become drivers of innovative development of the economy.

Substantiation of an interdisciplinary approach to the development of professional competence of future bachelors of economics based on STEM education

The modern economic landscape requires specialists to integrate knowledge from different disciplines to solve professional problems effectively. In this context, an interdisciplinary approach is becoming desirable and an obligatory element of the training of future bachelors of economics, especially when combined with the principles of STEM education. Such integration allows you to create a holistic system of knowledge and skills that meets the actual requirements of the digital economy.

The interdisciplinary approach in economic education based on STEM involves a systematic combination of traditional economic disciplines with exact sciences and technologies [18]. This is not a simple mechanical addition of various subjects to the curriculum but the creation of a fundamentally new educational environment where mathematical methods, computer technologies, and engineering approaches become organic tools of economic analysis. For example, the study of macroeconomics is enhanced by mathematical modeling, and courses in corporate finance are complemented by practical classes in financial informatics and working with analytical platforms.

The unique value of the interdisciplinary approach lies in the fact that it allows you to bridge the traditional gap between theoretical economics and its practical application. Students who simultaneously study economic theories and technological tools for implementation form a fundamentally different understanding of professional activity. They learn not only to apply ready-made methods but also to develop the ability to create new approaches to solving economic problems, which is especially important in the context of rapid technological changes. The STEM component in this process acts as a catalyst that transforms abstract knowledge into concrete, practical solutions.

Implementing an interdisciplinary approach in economic education based on STEM involves a fundamental change in the organization of the educational process. Traditional linear programs, where subjects are taught in isolation, can be replaced by integrated courses demonstrating the interconnectedness of different disciplines. For example, the Data Economics course can combine elements of econometrics, Python programming, and machine learning fundamentals, showing how these various fields of knowledge interact when solving real-world analytical problems. Such training increases students' motivation and forms the systematic thinking necessary to work in modern economic conditions.

The experience of implementing an interdisciplinary approach in combination with STEM education demonstrates significant positive results. Studies show that graduates of such programs have a higher level of professional adaptation, better solve complex problems, and move up the career ladder faster. In particular, they demonstrate the ability to work effectively at the intersection of various professional fields - for example, in fintech, where you need to understand economic processes simultaneously and have technological tools for analyzing them. Employers especially note the ability of such specialists to see the problem as a whole and find non-standard solutions, which is a direct result of interdisciplinary training.

An essential aspect of the interdisciplinary approach is its impact on developing students' innovation potential. Constant work at the intersection of different disciplines stimulates creative thinking and contributes to generating new ideas. The STEM component reinforces this effect, as technology provides specific tools for implementing innovative solutions. Many graduates of such programs become initiators of startups or authors of new approaches in traditional economic fields, which is direct evidence of the effectiveness of interdisciplinary training.

The social effect of introducing an interdisciplinary approach to economic education based on STEM also improves the quality of financial decision-making at all levels. Specialists who integrate knowledge from different fields can better analyze complex socio-economic phenomena and offer more informed solutions. This is especially important in the face of global challenges, such as climate change or digital transformation, which require a comprehensive, interdisciplinary approach.

Thus, an interdisciplinary approach to developing professional competence of future bachelors of economics based on STEM education is a response to the challenges of the modern economy, which is constantly becoming more complicated. It allows you to train specialists of a new type who have not only deep

economic knowledge but also the ability to apply the tools of exact sciences and technologies to analyze and solve complex professional problems. The results of the implementation of this approach indicate its high efficiency in the formation of competitive specialists who can become drivers of innovative development of the economy in the digital age.

Conclusions. Integrating competency-based, activity-oriented, and interdisciplinary approaches in economic education is essential for preparing graduates. Implementing these approaches within STEM can lead to improved learning experiences and increased job readiness. As the economy evolves, educational practices must adapt accordingly and ensure that future graduates have the necessary skills and knowledge to succeed. By using innovative approaches to training economics professionals, universities can improve their students' educational experience and promote the development of a skilled workforce capable of navigating the intricacies of the global economy.

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