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НАЦІОНАЛЬНА АКАДЕМІЯ МИСТЕЦТВ УКРАЇНИ
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С29 **STEAM**-освіта: від теорії до практики : матеріали ІІ Міжнародної науково-практичної онлайн-конференції (Київ, 20–26 травня 2026 року) / Упоряд.: В. М. Шульга, Г. В. Онопченко. – Київ : Інститут обдарованої дитини НАПН України, 2026. – 1592 с.

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До збірника увійшли статті й тези учасників ІІ Міжнародної науково-практичної онлайн-конференції «STEAM-освіта: від теорії до практики», у яких автори висвітлюють питання: розвитку STEAM-освіти в сучасному освітньому просторі, еволюції концепції від STEM до STEAM, її філософських, психологічних і педагогічних засад, а також ролі мистецтва та креативних практик у міждисциплінарному навчанні. Розглянуто інноваційні методи та технології STEAM-освіти, зокрема дизайн-мислення, проєктне навчання, використання цифрових платформ і можливості застосування штучного інтелекту в освітньому процесі. Висвітлено український і світовий досвід упровадження STEAM-освіти, сучасні підходи до освітньої політики, розвитку партнерства та професійного зростання педагогів, а також актуальні виклики й перспективи розвитку цієї галузі.

Видання рекомендовано для науковців, керівників і представників закладів освіти, інститутів післядипломної освіти, педагогічних працівників усіх ланок системи освіти.

Статті подано в авторській редакції (збережено авторські мову й граматику). Автори опублікованих матеріалів несуть відповідальність за точність наведених фактів, цитат, посилань на джерела тощо.

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MATHEMATICS FOR ECONOMISTS: ARTIFICIAL INTELLIGENCE IN STEAM EDUCATION FORMAT

Summary. Due to the growing attention to the development of creative thinking in the formation of mathematical competencies, there is a need to develop teaching technologies that would contribute to the growth of creative skills of students of economic specialties and increase their inclination to research activities. The paper presents the results of the experience of teaching mathematical disciplines using STEAM technologies in combination with the in-depth application of artificial intelligence. Examples of interactive classes are provided, during which these technologies were used to solve real economic problems, mathematical models were built and their analysis was carried out taking into account alternative approaches.

Keywords: economics, mathematical modeling, distance learning, creativity, interactive technologies, artificial intelligence, AI prompt.

Анотація. У зв'язку із зростанням уваги до розвитку креативного мислення при формуванні математичних компетентностей виникає потреба у розробці технологій викладання, які б сприяли зростанню творчих навиків студентів економічних спеціальностей, підвищували б їх схильність до дослідницької діяльності. У роботі представлено результати досвіду викладання дисциплін математичного спрямування з використанням STEAM-технологій у поєднанні із поглибленим застосуванням штучного інтелекту. Наведено приклади інтерактивних занять, при проведенні яких ці технології використовувались для розв'язання реальних економічних задач, здійснювалась побудова математичних моделей та проводився їх аналіз з урахуванням альтернативних підходів.

Ключові слова: економіка, математичне моделювання, дистанційне навчання, креативність, інтерактивні технології, штучний інтелект, промт.

The current stage of society's development is defined as the Knowledge Economy. At this stage, innovative technologies and intellectual products become strategic resources and the main commodity, and human capital becomes the main factor of production. Education has always been and is the main tool and fundamental source of reproducing human potential, and now its importance is growing significantly. We are not talking only about secondary and higher education, when

training is carried out for a certain limited period of time. The concept of LLL, or Lifelong Learning, is currently being implemented. It is education that transforms a person's natural abilities into professional competencies and contributes to the further transformation of human potential into human capital, which becomes an economic value and a strategic resource for society. Statistical studies on the example of different countries of the world prove the existence of a significant correlation between human cognitive skills and GDP growth rates. A particularly close connection between these factors is observed for underdeveloped and poor countries [1]. Accordingly, in modern conditions, the requirements for the quality of education are increasing.

Classical education, which is based on traditional teaching methods, is no longer keeping up with the needs of society. The current stage of production development, defined by the 4th Industrial Revolution, consists of the massive introduction of digital technologies into industry, complete automation of processes, and the creation of "smart factories". Thus, specialists are required not so much to have a certain amount of knowledge, but rather the ability to think creatively and be ready for constant self-improvement. Therefore, there is a need for a significant transformation of education, which involves the development of a new methodology, a new approach to the formation of educational resources. First of all, this applies to technical and mathematical disciplines, since they are the key to innovative development [2]. And such a methodology already exists. STEAM Education, which combines Science (S), Technology (T), Engineering (E), Arts (A) and Mathematics (M), fully meets these requirements. The feasibility of applying the principles of STEAM education in the study of disciplines of various directions has been proven both at the level of secondary and pre-university education [3] and at the level of higher education [4], in particular on the example of mathematical disciplines [5].

This paper examines the features of applying the principles of STEAM education in teaching mathematical disciplines for students of economic specialties. The article is a generalization of the experience of using interactive methods used by teachers of the Department of Economic and Mathematical Modeling of the S. Kuznets KhNUE to activate the educational process in distance learning conditions and develop creative thinking in future specialists in economics and management.

According to the curriculum, within the framework of training students in economic specialties, it is envisaged to teach such mathematical disciplines as higher mathematics, probability theory and mathematical statistics, operations research and optimization methods, econometrics. The purpose of studying these disciplines is not simply to master theoretical concepts, but to acquire practical skills in applying them to solving real economic problems using modern software. It should be noted that the general approach to teaching mathematical disciplines to future economists and managers fully complies with the principles of STEAM education, that is, it

implements a combination of theoretical foundations of mathematics and economics (S) with solving real economic problems (T) and using software (E), and the Arts component (A) involves the use of interactive technologies for students to acquire mathematical competencies (M). This approach is implemented starting from the first semester of study, and there are all opportunities for this. Although students do not yet have deep economic knowledge, their awareness of economics at the household level is sufficient to understand the economic formulation of the problem. In turn, to develop mathematical models of economic processes, perform calculations and construct graphs illustrating the results obtained, during practical classes, the use of such open-source software products as MS Excel and Octave is envisaged. Therefore, the mathematical disciplines taught by the Department of Economic and Mathematical Modeling of the S. Kuznets KhNUE are actually a combination of three areas: mathematics, economics and programming.

According to the syllabus for each discipline, in addition to lectures and usual practical classes, laboratory work is also carried out, when practical tasks are solved on a computer, and during the semester, students' complete homework assignments, tests and theoretical colloquiums, as well as an independent creative task. And this combination of different methods and forms of learning gives a synergistic effect - students better understand the possibilities of mathematical methods in their application to solving a particular class of economic problems and can independently determine the algorithm for solving them. It should be noted that the transition to performing practical tasks using such accessible software as MS Excel, which most students have been able to use since school, has significantly increased students' interest in performing practical tasks. Using built-in functions and add-ins of MS Excel allows you to reduce the time spent on routine calculations, and when building a mathematical model, you can also obtain empirical values of criteria for checking the statistical significance of model parameters. Due to the fact that most of the learning in Ukraine takes place remotely and can take place not only in online but also correspondence education, the question arises about the need to further improve the efficiency of learning mathematics.

One of the new opportunities to make the learning process more attractive for students is the use of artificial intelligence. It makes it easier to master the theoretical provisions of mathematical disciplines and acquire practical skills at any stage of learning. When considering this issue, the interests of both participants in this process must be taken into account. For the teacher, AI makes it possible to create interactive content that makes lectures more interesting and informative, and allows you to visualize examples. In the process of forming tasks for practical classes, AI helps by taking on the routine work of compiling tasks of the same type, different in terms of conditions, but the same in topic and level of complexity. The same applies to preparing

exam questions, developing tests for practical classes and colloquiums. In addition, AI helps to teach lecture material in English, preserving context and complex terminology. This is important, because many foreigners study at Ukrainian universities, in particular at the S. Kuznets KhNUE, and the teaching for them is carried out in English. Some foreigners study in Ukrainian, and here the AI becomes an assistant to the student, translating the material into his native language.

For students, the use of artificial intelligence also has significant advantages. A student can always use various AI sites to obtain reference information on any issue. This is especially important in distance learning, since communication with the teacher is either limited or even impossible due to power and Internet outages during classes as a result of military actions by the aggressor. In such conditions, when independently working through the material provided by the teacher on the Personal Learning Systems website in the form of presentations and recording of the class in Zoom, artificial intelligence chats come in handy.

The simplest and most accessible is ChatGPT. It is the most popular basic tool, and it is also free to use. His main advantage is that he is able to explain any complex topic in mathematics in simple language and with the help of visual examples. During communication, which takes place in the form of a conversation, the student is required to correctly and consistently formulate his questions that would help to reveal the topic. ChatGPT is able to answer the same question several times, changing the approaches to the explanation. Another advantage is that when communicating with ChatGPT, it is appropriate not only to ask him questions, but also to ask him to ask you. This allows you to identify weaknesses in your own argument construction scheme.

Separately, we should dwell on the possibilities provided by the use of prompts during a dialogue with ChatGPT. When we simply write a question in the chat, for AI it means: "Give an answer". It is another matter when we put a certain prompt before the question. Then AI looks for information that correlates with additional conditions that the prompt defines. So, if you enter the META prompt at the beginning of the question, then this prompt forces ChatGPT to generate instructions for evaluating those AI tools that are appropriate to use when studying mathematical disciplines. For example, it can offer a step-by-step analysis of the definition of integrals, finding a partial solution to differential equations, calculations the extremum of a function of many variables, or visualizing three-dimensional graphs. To minimize errors in mathematics, you can add the phrase: "Chain of Thought" (CoT) to queries. Then the AI will first build mathematical logic, and only then respond.

Let’s pay attention to another useful prompt that is advisable to use when using ChatGPT. If you type IQ 200 before a question, which means brilliant, maximally professional, then such a prompt forces the neural network to work at the limit of its technological capabilities and produce results of the highest quality. For example, let’s

ask the question in probability theory and mathematical statistics: "What level of significance is appropriate to use to test a statistical hypothesis? ". And ChatGPT gives a detailed but simple answer (fig. 1).

The selection of a significance level (α) depends on balancing the risk of false positives against the risk of missing a real effect.

Standard Significance Levels

- **$\alpha = 0.05$ (5%):** Standard default for most scientific research, psychology, and general business A/B testing.
- **$\alpha = 0.01$ (1%):** Used when high certainty is required, such as clinical trials or manufacturing quality control.
- **$\alpha = 0.10$ (10%):** Applied in exploratory or pilot studies where missing a potential trend is costly.
- **$\alpha = 0.0000003$ (5σ):** Required in particle physics (e.g., CERN) to claim a definitive new discovery.

Figure 1. ChatGPT response to a question if it is asked in the normal form

If we put the prompt IQ 200 in front, then to the same question we will get the answer that the choice of the significance level is influenced by the size of the sample population, as well as the number of statistical hypotheses that we are testing. First, the chat tells us that in order to answer this question at a complex, high level (IQ 200), we must abandon arbitrary thresholds $\alpha = 0.05$ or $\alpha = 0.01$ and consider the choice of significance level as a formal decision theory optimization problem. To do this, he suggests constructing a cost function, as shown in Fig. 2, where $\beta(\alpha)$ is the Type II error rate, which is a function of α, sample size n, and effect size.

In real-world applications (like quantitative finance, tech A/B testing, or deep tech R&D), choosing α requires mapping the decision to a loss function. Let:

- L_1 = The financial/recreational cost of a **Type I Error** (False Positive).
- L_2 = The financial/recreational cost of a **Type II Error** (False Negative).
- π_0 = The prior probability that the null hypothesis (H_0) is true.

The optimal significance level α^* is the one that minimizes the Expected Total Risk (R):

$$R = \pi_0 \cdot \alpha \cdot L_1 + (1 - \pi_0) \cdot \beta(\alpha) \cdot L_2$$

Figure 2. Answer to the question if it is preceded by IQ 200 (Step I)

In the second step, ChatGPT generates the Dynamic Rule of Thumb (Fig. 3). This allows us to use the Leamer-Mudge approach, which sets α such that the sum of errors $\alpha + \beta$ or their weighted combination is minimized for a given sample size.

- **Asymmetric Costs ($L_1 \gg L_2$):** If a Type I error is catastrophic (e.g., launching a drug with fatal side effects), L_1 is near infinity. α must approach zero ($\alpha = 0.001$ or lower).
- **Asymmetric Costs ($L_2 \gg L_1$):** If a Type II error is catastrophic (e.g., missing a security breach or failing to detect a rare cancer in a preliminary screening), L_2 is massive. You aggressively increase α (e.g., $\alpha = 0.15$ or 0.20) to maximize statistical power ($1 - \beta$).
- **Big Data Paradox ($n \to \infty$):** If your sample size is in the millions (e.g., big data click-through rates), statistical power approaches 100%. At $\alpha = 0.05$, even a completely trivial, economically meaningless effect will return a $p < 0.05$. Therefore, with massive datasets, **α must be shrunk dynamically** (e.g., to $\alpha = 0.0001$) to protect against over-detecting noise.

Figure 3. Answer to the question if it is preceded by IQ 200 (Step II)

The X 10 THINK level prompt instructs the AI: "Analyze the problem from 10 different angles, find your own mistakes, refute your first ideas, conduct deep deduction, and only then write a solution". Having asked the same question regarding the level of significance of a statistical criterion, in this case we first of all receive the following information in response: "The traditional approach advises choosing $\alpha = 0.05$, but this is a methodological error that leads to a crisis in the reproducibility of scientific results. The choice α in the X10 THINK paradigm is not the choice of a constant, but a dynamic optimization of the loss function". And then there is advice on how to ensure high accuracy of conclusions while limiting research costs. For example, iIn deep-tech R&D or clinical engineering, data collection is a continuous flow. So, instead of fixing the sample size n and significance level α in advance, two limits are set based on acceptable risk tolerances. If the current likelihood ratio reaches the upper bound, then accept the hypothesis H_1 and no more money is spent on data collection. If it reaches the lower bound, then there is no reason to reject the hypothesis H_0. If it remains within the confidence interval, then it is necessary to continue forming the sample population.

From the above example, it is clear that with the help of AI chat prompts we can get much deeper information than by turning to a classic textbook. And to take advantage of these opportunities, you need to have creative thinking and a penchant for analysis.

It should be noted that the total number of users of chatbots with artificial intelligence in the world has now exceeded 1.1 billion people [6]. The number of users of artificial intelligence in Ukraine has almost doubled: from 28% in 2024 to 49% in 2026. About 27%

of Ukrainians use AI at least once a week. ChatGPT accounts for 85% of Ukrainians who have heard of or used it [7]. That is why we focused on the features of working with ChatGPT. However, there are quite a few other AI chatbots (according to rough estimates, there are millions of individual AI chatbots, and this number is growing every day), of which 20 are the main players, and ChatGPT's share among them is approximately 76%. So, there is a large selection of AI chatbots that can be used in the training process. Each of them has its own characteristics, its own direction of application, but most of them are more difficult to use, and some of them are not free. However, there are no restrictions on their use by the teacher. Students have the opportunity to independently choose which artificial intelligence chat they will use.

So, as can be seen from the examples given, in the process of personal learning, artificial intelligence is an effective tool for ensuring modern requirements for the quality of education. However, it is also advisable to use it as a teaching tool when conducting classes in an interactive mode, which involve active interaction of all participants (student-student, student-teacher) in a dialogue mode. Such an activity could be a business game. In this case, such a component of STEAM education as Art becomes very significant. The topic of the business game is chosen in accordance with the program of the mathematical discipline studied by students, and this topic must have a real economic focus. For example, when studying Higher Mathematics, the topic of a business game may be determining the extremum of a function of several variables in its applied aspect to those economic problems that are understandable to first-year students.

We usually offer several project topics for consideration so that students can choose the one they like best. This topic is common to the entire academic group. Let's assume that students have chosen the project topic "Production Plan Optimization". The task is formulated as follows. The enterprise has a certain amount of technical and material resources to produce several types of products. For each type of product, the cost price of a unit of production and its market price are known, as well as the requirements for material and technical resources for its production. It is necessary to draw up a production plan, that is, to determine the number of products of each type that the enterprise should produce in order to obtain maximum profit from its sale. To provide an element of Art, an enterprise of a certain type is considered: a confectionery factory, a designer clothing sewing workshop, a smartphone manufacturing company, etc. To implement the project, the academic group of students is divided into three subgroups. The division into subgroups is carried out entirely at the request of the students. Two of these groups are equal in the number of participants. Each of these subgroups is a union of developers who propose their own project for consideration. They perform this role from the stage of working on the project to its defense. By the way, their work on the project begins with the fact that they come up with the name of their company. Both at the stage of project development and

preparation for the presentation, they can use artificial intelligence as a consultant. The third subgroup (2-3 students) play the role of arbitrators who analyze the finished projects, ask questions to their developers and express their opinion on which of the projects becomes the winner. The teacher acts as a random listener who can ask questions, provide comments, but the opinion of the arbitrators is decisive. Both groups of developers make a presentation of their projects, using the capabilities of AI for this. The defense of the projects is carried out in front of the entire academic group. Such a game can be played both in the classroom and during distance learning, when communication takes place in ZOOM. Since working on the project takes a lot of time, the business game is played at the last practical lesson of the semester. The atmosphere of the game helps to relieve the tension that lasted throughout the semester. It is such a "cherry on the cake".

As can be seen from the examples given, the use of artificial intelligence as part of any of the teaching methods in combination with the implementation of the STEAM education concept creates conditions for a significant improvement in the quality of mathematical education, the formation of economists and managers of a new type who meet the requirements of the modern stage of society's development. It should be emphasized that we are talking about creating conditions for obtaining quality education. In order to realize these possibilities, a person must want to learn. But since AI allows you to receive ready-made answers, there is a temptation to simply pass them off as your own solution. Therefore, problems arise when evaluating such works. A possible approach to its solution is to evaluate not the answers, but the process of obtaining them, the solution algorithm and the analysis of the results obtained. And this is possible only in the process of discussion. Thus, testing, which is currently used to assess knowledge, should be used only for self-testing and training, and to assess the success of education seekers, written exams should be abandoned and oral exams should be switched to. Thanks to ZOOM, this possibility exists even with distance learning. Since at the S. Kuznets KhNUE, classes for the first year are held in the classroom, the discussion of the results is already used when accepting laboratory works in mathematical disciplines. At the exam, testing is carried out in an essay format and the answers must be accompanied by a detailed explanation of the solution algorithm and analysis of the results.

Therefore, artificial intelligence combined with STEAM technologies is a powerful tool that transforms education, making it learner-centered, i.e., personalized, while changing the role of the teacher to that of a mentor. It helps develop creative thinking, a tendency to analyze problems and ways to solve them. Ensuring the synergy of qualitative knowledge and creative thinking plays an important role in the study of mathematical disciplines by future specialists in the field of economics and management. Although the use of AI in the learning process is associated with certain

ethical issues, they should not be considered significant, since employers pay attention not so much to grades in the diploma when hiring, but to the results of the interview, which determine the level of professional training of the applicant.

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STEAM У РОЗВИТКУ КРЕАТИВНОСТІ МАЙБУТНЬОГО ПСИХОЛОГА

У статті розглянуто можливості використання STEAM-підходу у розвитку креативності майбутніх психологів у системі вищої освіти. Проаналізовано сутність понять «креативність», «STEAM-освіта», «професійна підготовка психолога». Визначено, що сучасний психолог повинен володіти не лише професійними знаннями та навичками, а й здатністю до творчого мислення, міждисциплінарного аналізу, інноваційного вирішення проблем та емоційного інтелекту. Обґрунтовано, що STEAM-підхід забезпечує інтеграцію науки, технологій, інженерії, мистецтва та математики, сприяючи формуванню творчої особистості майбутнього фахівця. Особливу увагу