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E. Telagussova, c.e.s., associate professor

A. Issaeva*, c.e.s., associate professor

A. Saparbayeva, master, senior lecturer

D. Tastan, master's student

Abai Kazakh National Pedagogical University,
Almaty, Kazakhstan

*— main author (author for correspondence)
e-mail: issaeva_ainur@mail.ru

GENERATIVE ARTIFICIAL INTELLIGENCE IN THE DIGITALIZATION OF TAX EDUCATION

The article examines the possibilities of applying generative artificial intelligence in tax education in the context of the modernization of the tax legislation of the Republic of Kazakhstan. The empirical basis of the study was the official set of questions and answers on the application of the new Tax Code, prepared by the State Revenue Committee of the Ministry of Finance of the Republic of Kazakhstan. A total of 108 «question - official answer» pairs were analyzed. Content analysis, thematic grouping, an author-developed typology, and a comparative-analytical approach were applied. Quantitative processing of the material was carried out by calculating the frequency distribution and the shares of the identified categories. The study found that a considerable portion of tax queries relates not to the reproduction of individual concepts but to the application of norms to practical situations. Four types of educational tax operations were identified: informational-reference, procedural-algorithmic, computational-scenario, and interpretive-situational. Based on the identified types of tax study operations, possible directions for the use of generative AI and the risks associated with them have been determined. These provisions are conceptual and analytical in nature and are not the result of an experimental evaluation of specific generative models. Based on the results of the content analysis, a conceptual matrix of potential directions for the application of generative AI has been developed, and a model for its controlled integration into the teaching of tax disciplines has been proposed.

Keywords: generative artificial intelligence, tax education, digitalization of education, Tax Code, tax disciplines, tax literacy, digital competence, content analysis.

Кілт сөздер: генеративті жасанды интеллект, салықтық білім беру, білім беруді цифрландыру, Салық кодексі, салық пәндері, салық сауаттылығы, цифрлық құзыреттілік, контентті талдау.

Ключевые слова: генеративный искусственный интеллект, налоговое образование, цифровизация образования, Налоговый кодекс, налоговые дисциплины, налоговая грамотность, цифровая компетентность, контент-анализ.

Introduction. Generative artificial intelligence (AI) is gradually changing the ways of working with professional information. This is particularly noticeable in tax education. Here, finding a norm or restating a definition is not enough; it is necessary to determine the tax period, take into account the taxpayer's status, select the applicable rule, and verify the conclusion against the legislation in force.

This specificity makes the use of generative AI both promising and risky at the same time. On the one hand, it can explain complex rules, structure educational cases, form action algorithms, and model various tax situations. On the other hand, an automatically generated answer does not always correspond to the current version of a regulatory act. An error may be stated in a confident manner. It is for this reason that the use of AI in tax education requires not blanket approval or prohibition, but a methodologically substantiated delineation of its scope of application.

The scientific problem of the study is related to the insufficient development of approaches that allow distinguishing tax study tasks according to the nature of the operation performed and identifying possible scenarios for the use of generative AI for different types of tasks. In current practice, such tools are often viewed either as a universal digital assistant or as a source of threat to the quality of education. However, a reference question, a computational task, and a situation requiring the interpretation of several conditions are of different methodological natures. Consequently, the potential of AI should be assessed not in the abstract but through the content of specific tax tasks.

The purpose of the study is to develop an original approach to the classification of tax study operations and to identify potential directions for the use of generative artificial intelligence in the teaching of tax

disciplines, based on the analysis of official questions related to the new Tax Code of the Republic of Kazakhstan. To achieve this aim, the following objectives were set:

- to identify the thematic structure of official tax questions; to classify them according to the nature of the educational operation;
- to identify the possible functions of generative AI and the potential risks of its use in relation to the identified types of study operations;
- to develop a conceptual matrix of potential directions for the application of generative AI and to propose a model for its controlled integration into the teaching of tax disciplines.

The research materials comprised the official set of questions and answers on the application of the new Tax Code, prepared by the State Revenue Committee (SRC) of the Ministry of Finance of the Republic of Kazakhstan, as well as the provisions of the Tax Code of the Republic of Kazakhstan No. 214-VIII ZRK dated 18 July 2025. The methodological framework of the study comprised content analysis, thematic grouping, an author-developed typology, and a comparative-analytical approach. Quantitative processing of the question set was carried out by calculating frequencies and determining the shares of thematic and operational groups.

Each “question–official answer” pair was classified according to two criteria: thematic affiliation and the type of operation required to obtain the answer. The thematic category was determined by the type of tax, tax regime, or administrative procedure addressed in the question. Classification by operation was based on the main action required: reproducing a legal provision, determining a sequence of actions, performing a calculation, or interpreting a situation involving multiple conditions. Based on this criterion, all 108 questions were assigned to one of four types: informational-reference, procedural-algorithmic, computational-scenario, or interpretive-situational.

If a question contained features of more than one type, it was classified according to the operation without which the final answer could not be obtained. For example, a direct question about the applicable tax rate was classified as informational-reference. If the choice of rate depended on the tax period, taxpayer status, or the nature of the transaction, the question was classified as interpretive-situational. Stating an established threshold was treated as an informational-reference operation, whereas using that threshold to calculate the tax liability was classified as computational-scenario. Borderline cases were discussed by the authors until agreement was reached on the final category. No formal assessment of inter-rater agreement was conducted, as the final coding was determined through consensus among the authors in cases of disagreement. This limitation was taken into account when interpreting the resulting classification.

The study employed a comparative analysis, contrasting the characteristics of specific tax-related tasks with research findings on the application of generative AI in the fields of tax, accounting, and legal practice. The comparison focused on the nature of the tasks themselves, the dependence of outputs on initial conditions and the regulatory legal environment, and the limitations of generative models identified in prior research.

Literature Review. The application of generative artificial intelligence in higher education has attracted considerable attention in international scholarly literature in recent years. In a systematic review, J. Batista, A. Mesquita, and G. Carnaz synthesized empirical studies on the use of generative AI in the university environment. The authors distinguish several lines of analysis: the impact of AI on teaching and learning, the perception of the technology by students and instructors, and the institutional conditions for its implementation [1]. The significance of this work lies in the fact that it reflects a shift from discussing the technological capabilities of AI to assessing its pedagogical applicability. At the same time, the review is broadly interdisciplinary in nature and does not address the specificity of disciplines whose content depends on the legislation in force. An approach closer to the subject of this article is presented in the work of D.A. Wood and co-authors. Using accounting assessment tasks, the authors compared ChatGPT's answers with students' results and showed that the quality of the model's answers depends on the type of question, the assessment format, and the subject content [2]. F. A. Stott and D. M. Stott focus on the context of teaching taxation. The authors view ChatGPT as a tool that complements instruction on tax-related topics and discuss ways to integrate it into established teaching methods, while emphasizing the role of the instructor and the importance of professional judgment. The study is primarily conceptual in nature and does not offer a classification of tax assignments based on the type of specific educational task [3]. In a study by M. Tharapos et al., ChatGPT's capabilities were evaluated based on 18 tasks spanning six subject areas within an undergraduate accounting program. The authors compared the results against the levels of Bloom's Revised Taxonomy. ChatGPT performed better on low- and mid-level tasks, whereas its

capabilities were limited when handling more complex tasks. The study demonstrates that the nature of the academic task influences the outcomes of using generative AI; however, this classification is based on levels of cognitive learning and is not specifically tailored to tax transactions governed by legal regulations [4]. This conclusion is important for tax education. It confirms that generative AI cannot be assessed as a single universal tool: its effectiveness varies depending on the nature of the educational operation. The study by J.J. Nay and co-authors on the application of large language models (LLMs) in tax law is of particular importance. The authors showed that providing legal context and using more advanced models improve the quality of answers, although even in such cases LLMs do not reach the level of an expert in tax law [5]. This result is of fundamental importance to the present study. It underscores the necessity of normatively verifying AI responses, particularly for tasks involving jurisdiction, tax periods, and the interpretation of legal provisions.

In Kazakhstani scholarly literature, the application of artificial intelligence in education is considered mainly through the prism of the digital transformation of the educational process. N.T. Shyndaliev, A.S. Serikkazy, and G.F. Nurbekova, analyzing the use of big data and AI in the educational environment, highlight the personalization of learning, adaptive systems, performance monitoring, and decision-making support [6]. The work demonstrates the relevance of AI for the modernization of education in Kazakhstan, but does not address the specificity of tax disciplines or the issue of verifying the regulatory accuracy of automatically generated answers. A separate line of research concerns the digitalization of tax administration. K.K. Mamutova, L.M. Peshenova, and A.N. Aitymbetova examine modern technologies of tax administration in Kazakhstan, including electronic taxation, electronic invoices, online cash registers, and the prospects for applying artificial intelligence in the tax sphere [7]. This work is important for understanding the professional environment in which future specialists will work. However, the link between the digitalization of tax administration and changes in the methodology of teaching tax disciplines remains insufficiently explored.

Recent studies have examined the use of generative AI in accounting and tax education and have shown that its performance depends on the content and complexity of the learning task. Existing approaches, however, mainly classify tasks by their format or cognitive level. Tax-related tasks have an additional feature: the correct answer may depend on the applicable legal provision, tax period, taxpayer status, and other jurisdiction-specific conditions. In this study, such tasks are classified according to the operation required to obtain the answer: informational-reference, procedural-algorithmic, computational-scenario, and interpretive-situational. Unlike classifications based on subject area or cognitive level, the proposed typology focuses on the action that must be performed to reach a correct conclusion in a specific tax situation.

The main part. The empirical basis for the study consists of the official collection of questions and answers regarding the application of the new Tax Code, issued by the State Revenue Committee of the Ministry of Finance of the Republic of Kazakhstan. Although published as "Top 100 Questions and Answers," the material actually comprises 108 numbered question-and-answer pairs. It was posted on April 21, 2026, and updated on June 3, 2026 [8]. The regulatory framework for the analysis is the Tax Code of the Republic of Kazakhstan (Law No. 214-VIII of July 18, 2025), which entered into force on January 1, 2026 [9].

This dataset was selected based on its official source and its direct relevance to the implementation of the new tax legislation in the Republic of Kazakhstan. The materials released by the SRC of Kazakhstan cover various aspects of tax regulations, encompassing issues that differ in both content and the nature of the required responses. However, the source does not provide information regarding the total volume of original inquiries, the frequency of specific issues, or the criteria used for selecting items for publication. Consequently, this dataset is regarded as an official thematic corpus of the SRC rather than a representative sample of tax-related inquiries.

Table – 1

Thematic structure of the official set of tax questions

Thematic block	Question numbers	Number of questions	Share, %
Corporate Income Tax	1-7	7	6,5
Value Added Tax	8-21	14	13,0
Personal Income and Social Taxes	22-37	16	14,8
Special Tax Regimes	38-51	14	13,0

Universal Declaration	52-64	13	12,0
Taxation of Subsoil Users	65-75	11	10,2
Taxation of Non-residents	76	1	0,9
Tax Administration	77-95	19	17,6
Miscellaneous Tax Issues	96-104	9	8,3
Taxation of High-Value Property	105-108	4	3,7
Total	1-108	108	100,0

**calculated by the authors based on source [8].*

In the published material, questions related to tax administration make up the largest part - 17.6%. In addition, a significant part of the questions concern personal income tax and social security tax, value added tax, special tax systems and general tax declaration. This data reflects the thematic structure of the SRC question bank, but is not sufficient to determine the prevalence of these challenging questions among taxpayers. Moreover, the exact content of the questions varies depending on the nature of the requested answers: in addition to introductory questions, some require the identification of certain steps, the performance of calculations or the consideration of several factors in certain circumstances.

The VAT block is illustrative. It contains questions about rates, the offsetting of tax, transactions with non-residents, electronic invoices, and transitional provisions. For example, if goods and services were purchased in the fourth quarter of 2025 and the electronic invoice was issued in 2026, the applicable rate is determined not by the date of issuing the document but by the period in which the turnover occurred [8]. Such a task requires not merely restating a norm but interpreting it.

Similar complexity is also observed in questions on individual income tax. Where there are several sources of income, it is necessary to take into account the individual's aggregate income, the functions of the tax agent, and the taxpayer's own obligation. An error may arise not only in choosing the rate but also in incorrectly identifying the subject of the tax obligation. In order to identify differences in the nature of the actions required to solve tax problems, the questions were additionally classified by type of study operation. This classification differs from grouping by tax type, since a single tax block may contain reference, procedural, computational, and interpretive tasks.

The four-component classification of the questions was formed on the basis of the predominant educational operation required to obtain a correct answer: restating a norm, determining a course of action, performing a calculation, or interpreting a multi-condition situation. The three-component scheme was found to be insufficient, since it combined procedural and computational tasks that presupposed different actions on the part of the learner and different ways of constructing an answer. A more detailed division, on the contrary, would have complicated the interpretation of the results and their further use (see Table - 2).

Table – 2

Conceptual Matrix of Potential Directions for the Application of Generative AI by Types of Tax Study Operations

Type of learning activity	Number of questions	Share, %	Potential function of AI	Potential risk
Informational-reference	34	31,5	explaining the standard, comparing rates, preparing self-assessment questions	outdated or incomplete information
Procedural-algorithmic	31	28,7	establishing the procedure for the actions of the taxpayer or tax agent	missing a deadline or a condition
Computational-scenario	18	16,7	displaying calculations, modifying initial conditions, generating cases	making an error in a rate, limit, or calculation
Interpretive-situational	25	23,1	defining key conditions, comparing solution options	a confident but incorrect conclusion
Total	108	100		

**Compiled and calculated by the authors based on the analysis results [8]. The potential functions of generative AI and the risks of its use are determined by comparing the characteristics of the identified types of operations with the results of previous studies [2-5].*

The presented matrix is conceptual in nature and links the distinguished types of educational tax operations with the possible functions of generative AI and the potential risks of its use. In information-reference and procedural-algorithmic tasks, AI can be considered as an auxiliary tool for the primary explanation of the norm and the structuring of the sequence of actions. At the same time, the response generated must be verified against the current regulatory source.

Computational-scenario and interpretive-situational tasks impose higher requirements regarding the consideration of initial conditions, because the final conclusion may depend on the rate, threshold, tax period, status of the person, or a combination of several factors. In such cases, AI may be used to present the logic of the solution and to highlight significant conditions, but the final conclusion must be verified in accordance with the legislation. The functions and risks indicated within the framework of this study have not been experimentally evaluated and require subsequent validation.

Based on the analysis conducted, a model for the controlled integration of generative AI into tax education was proposed (see Figure - 1).

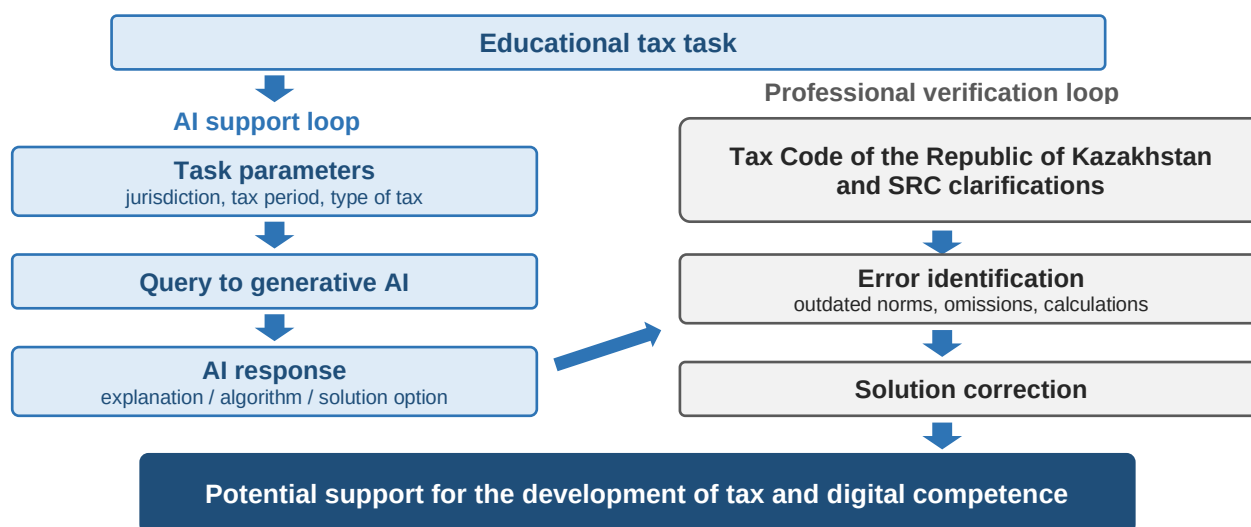


Figure – 1. **Model for the controlled integration of generative AI into tax education.**

**compiled by the authors*

This model was developed specifically for disciplines where the content is based on current regulatory requirements. Generative artificial intelligence serves as an aid within the model; the responses it generates are treated as intermediate results subject to verification against regulatory standards and correction where necessary. The time sensitivity of tax information is of particular importance. The new Tax Code of the Republic of Kazakhstan has been in effect since 1 January 2026 [9], while the official SRC question set was updated after its entry into force [8]. Therefore, an educational query submitted to AI should include the tax period, the jurisdiction, the type of tax, and the initial conditions of the situation. Without this, the risk increases of confusing the norms of different years or of relying on general tax rules that have no relation to the legislation of the Republic of Kazakhstan.

The limitations of the empirical framework arise from the principles used to compile the official SRC data. The published source does not indicate the number of original applications, the frequency of receipt of individual questions, or the selection criteria used. Therefore, the results obtained only describe the structure of the set of 108 analyzed questions and cannot be used to assess the prevalence of tax difficulties among taxpayers. In addition, the study was carried out on the material of the Republic of Kazakhstan and does not imply the direct transfer of its conclusions to the tax systems of other countries. A specific methodological limitation concerns the absence of a formal assessment of inter-rater agreement; borderline cases in the coding process were resolved through consensus among the authors regarding the final category. Generative AI models were not directly tested in this study; therefore, the proposed AI functions and associated risks should be regarded as analytically derived possibilities rather than as results of experimental evaluation. Changes in students' tax and digital competence were also not measured.

Conclusion. This analysis examines the structure of the official SRC question set and classifies tax-related educational tasks into four groups. Based on this, the study proposes a categorized approach to identifying potential areas for applying generative AI in tax education. The study does not aim to evaluate the capabilities of specific generative models or to measure the educational outcomes resulting from their use.

Content analysis of the official SRC question set showed that the questions differ in the type of operation required to obtain an answer, ranging from reproducing a legal provision to performing calculations and interpreting situations involving multiple conditions. Four types of educational tax operations were identified: informational-reference, procedural-algorithmic, computational-scenario, and interpretive-situational. For each group, the possible functions of AI and the main risks were identified analytically.

The results obtained do not claim universality and reflect the specific features of the SRC question set; however, the proposed approach can be adapted to the analysis of other professional disciplines based on regulatory frameworks. Future research may focus on the experimental evaluation of the quality of the answers given by various generative models to tax tasks and on the development of criteria for assessing the AI literacy of students in economics programs.

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Телагузова Э.О., Исаева А.Т., Сапарбаева А.М., Тастан Д.Ж.

САЛЫҚТЫҚ БІЛІМ БЕРУДІ ЦИФРАНДЫРУДАҒЫ ГЕНЕРАТИВТІ ЖАСАНДЫ ИНТЕЛЛЕКТ

Аңдатпа

Мақалада Қазақстан Республикасының салық заңнамасын жаңғырту аясында салық білімінде генеративті жасанды интеллектті қолдану мүмкіндіктері қарастырылады. Зерттеудің эмпирикалық негізі Қазақстан Республикасы Қаржы министрлігінің Мемлекеттік кіріс комитеті дайындаған жаңа Салық кодексін қолдану бойынша ресми сұрақтар мен жауаптар жиынтығы болды. Барлығы 108 «сұрақ - ресми жауап» жұбы талданды. Мазмұнды талдау, тақырыптық топтастыру, автор әзірлеген типология және салыстырмалы-талдау тәсілі қолданылды. Материалды сандық өңдеу жиілік таралуын және анықталған санаттардың үлестерін есептеу арқылы жүзеге асырылды. Зерттеу салық сұрауларының айтарлықтай бөлігі жеке ұғымдарды қайталауға емес, нормаларды практикалық жағдайларға қолдануға қатысты екенін анықтады. Білім беру салық операцияларының төрт түрі анықталды: ақпараттық-анықтамалық, процедуралық-алгоритмдік, есептеу-сценарийлік және түсіндірмелік-жағдайлық. Салықты зерттеу операцияларының анықталған түрлеріне сүйене отырып, генеративті жасанды интеллектті пайдаланудың мүмкін бағыттары және олармен байланысты тәуекелдер анықталды. Бұл ережелер тұжырымдамалық және аналитикалық сипатта болады және нақты генеративті модельдерді эксперименттік бағалаудың нәтижесі емес. Мазмұнды талдау нәтижелеріне сүйене отырып, генеративті жасанды интеллектті қолданудың ықтимал бағыттарының тұжырымдамалық матрицасы әзірленді және оны салық пәндерін оқытуға басқарылатын интеграциялау моделі ұсынылды.

Телагузова Э.О., Исаева А.Т., Сапарбаева А.М., Тастан Д.Ж.

ГЕНЕРАТИВНЫЙ ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В ЦИФРОВИЗАЦИИ НАЛОГОВОГО ОБРАЗОВАНИЯ

Аннотация

В статье рассматриваются возможности применения генеративного искусственного интеллекта в налоговом образовании в контексте модернизации налогового законодательства Республики Казахстан. Эмпирической основой исследования послужил официальный набор вопросов и ответов по применению нового Налогового кодекса, подготовленный Комитетом государственных доходов Министерства финансов Республики Казахстан. Всего было проанализировано 108 пар «вопрос – официальный ответ». Применялись контент-анализ, тематическая группировка, авторская типология и сравнительно-аналитический подход. Количественная обработка материала проводилась путем расчета частотного распределения и долей выявленных категорий. Исследование показало, что значительная часть налоговых вопросов связана не с воспроизведением отдельных понятий, а с применением норм к практическим ситуациям. Были выделены четыре типа налоговых учебных операций: информационно-справочные, процедурно-алгоритмические, вычислительно-сценарные и интерпретативно-ситуационные. На основе выявленных типов налоговых учебных операций определены возможные направления использования генеративного ИИ и связанные с ними риски. Данные положения носят концептуальный и аналитический характер и не являются результатом экспериментальной оценки конкретных генеративных моделей. На основе результатов контент-анализа была разработана концептуальная матрица потенциальных направлений применения генеративного ИИ и предложена модель его контролируемой интеграции в преподавание налоговых дисциплин.

