Abstract Book

INTERNATIONAL CONFERENCE INTERSCI 2025 : GLOBAL INNOVATIONS IN MODERN SCIENCE (JURAJ DOBRILA UNIVERSITY OF PULA, CROATIA)

17-19 NOVEMBER, 2025

2025
Volume 2 (5)

Science Communication International
https://sciconf.ho.ua

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UDC 061.3:001.89(06.3)

Abstract Book of the II International Scientific Conference: «InterSci 2025: Global innovations in modern science», Juraj Dobrila University of Pula

Pula, Croatia 17-19 November, 2025

First Published: 20 November, 2025

This book is available on the Science Communication International website: www.sciconf.ho.ua

Conference schedule

Meet Link https://meet.google.com/aoh-xgvf-nuc

18 November, 2025

10:00 Eastern European Summer Time (EEST)

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10:05	Snjezana Babić	USABILITY AND USER EXPERIENCE RELATED PERCEPTIONS OF UNIVERSITY STUDENTS REGARDING THE USE OF BING CHAT SEARCH ENGINE AND AI CHATBOT: PRELIMINARY EVALUATION OF ASSESSMENT SCALES
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GEOSPATIAL PATTERN OF TOPSOIL POLLUTION AND MULTI-ENDPOINT TOXICITY IN THE PETROCHEMICAL AREA OF AUGUSTA-PRIOLO (EASTERN SICILY, ITALY)

Petra Burić, Assistant professor, Juraj Dobrila University of Pula, Croatia

The operation of the petrochemical industry continues to draw scrutiny due to its potential contribution to pollutant releases and subsequent adverse effects on human and environmental health, particularly because industrial facilities are often located in close proximity to population centers [1]. The global reliance on fossil fuels complicates the transition to cleaner energy, making the rigorous monitoring of health in communities near industrial sites essential [1].

Epidemiological research provides strong evidence linking residence near petrochemical complexes to increased health risks. For example, studies in Asia have revealed a significantly greater incidence of cancers and an overall elevated risk of leukemia for residents living within a few kilometers of major complexes [2, 3].

Furthermore, negative impacts are also documented in occupational settings, with exposures linked to increased concentrations of various metals in workers' urine and elevated risks of specific conditions like miscarriage [4, 5]. In the Italian context, workers in the petrochemical sector have been reported to experience significantly higher incidences of malignant tumors and respiratory system diseases compared to other industries [6].

In Sicily, public health surveillance programs have consistently documented adverse health outcomes. Analysis of congenital anomalies in the industrial area of Gela showed a highly concerning 236% increased incidence of genital defects in newborns during the 2006–2010 period [7].

Similarly, the Augusta-Priolo-Melilli conurbation, a site hosting three major oil refineries and related facilities—representing one of Europe's largest industrial footprints—also recorded high rates, including a 154% increased incidence of genital defects and a 165% increase in digestive system anomalies in newborns relative to national baseline values during the same period [7].

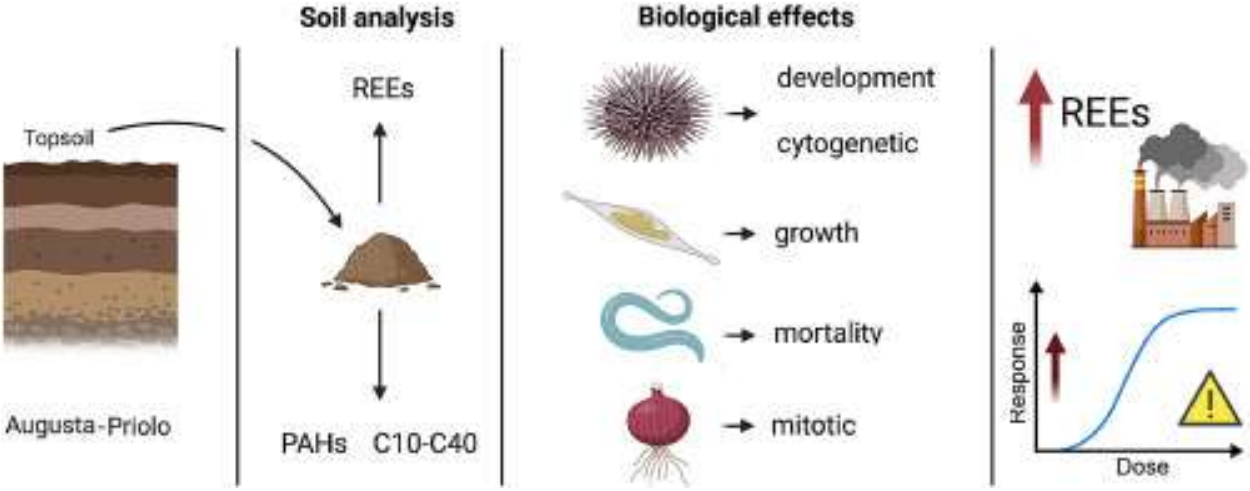

Fig 1. Soil analysis and biological effects

These elevated rates of negative health outcomes are hypothesized to be driven by industrial emissions [8]. Recognizing the clear evidence of contamination and health concerns in the region, an ad hoc investigation was crucial to evaluate the environmental effects of topsoil contamination near the Augusta-Priolo facilities, building upon previous work conducted in other heavily industrialized zones [9].

This study aimed to identify the geospatial patterns of pollutants and their complex, mixture-related toxicity in topsoil samples collected near the heavily industrialized Augusta-Priolo area. Topsoil was collected across the conurbation, which supports a population of approximately 50,000 inhabitants. The chemical characterization was comprehensive: elemental

analysis was conducted via Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for 23 metals and 16 Rare Earth Elements (REEs), while organic analyses focused on 16 polycyclic aromatic hydrocarbons (PAHs) and total aliphatic hydrocarbons (C_{10} – C_{40}).

Analysis revealed that organic pollutants varied spatially; PAHs displayed the highest concentrations at specific sites (#8 and #12), with total C_{10} – C_{40} hydrocarbons peaking at other locations (#3 and #13).To provide a robust toxicity assessment, a multi-endpoint approach using four distinct bioassays was implemented, which is necessary given that the results can be model-organism dependent.

Topsoil samples were tested for toxicity using:

1) the evaluation of developmental defects and cytogenetic anomalies in the early life stages of the sea urchin Sphaerechinus granularis;

2) the assessment of growth inhibition in the diatom Phaeodactylum tricornutum;

3) the determination of mortality in the nematode Caenorhabditis elegans; and

4) the induction of mitotic abnormalities in the onion Allium cepa [10].

The integration of chemical and biological data established a clear link between contaminant levels and biological effects. Samples collected closest to the defined petrochemical facilities consistently showed the highest levels of select inorganic and organic pollutants, which directly correlated with adverse biological effects across multiple toxicity endpoints. Significantly, the study identified increased levels of total REEs in sites nearest to the industrial complexes. This finding is noteworthy because REEs can serve as valuable signatures, aiding in the identification of petrochemical sources contributing to environmental pollution. In conclusion, the consistent data

on soil toxicity, metal, and REE contamination observed across the Augusta-Priolo sampling sites provides a crucial geospatial assessment of risk.

This information establishes a reliable baseline for epidemiological studies concerning the high incidences of congenital birth defects reported in the area, facilitating the targeted identification of specific at-risk localities.

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THE EFFECT OF BLACK SOLDIER FLY LARVAE FRASS ON ULTISOL SOIL PROPERTIES, CHLOROPHYLL CONTENT, AND YIELD OF UPLAND RICE (ORYZA SATIVA L.)

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Ultisol soils, prevalent in many agricultural regions, pose significant challenges to crop production due to inherent problems such as high acidity, high aluminum (Al) saturation, and critically low levels of essential nutrients and organic matter [10]. These soils are also highly sensitive to erosion,

necessitating innovative and sustainable remediation strategies. One promising alternative effort involves the application of Frass fertilizer, a bioconversion byproduct derived from the rearing of Hermetia illucens L., commonly known as the Black Soldier Fly (BSF) larvae [5]. Frass is rich in beneficial nutrients that not only support plant growth but also actively work to ameliorate the chemical and physical limitations of Ultisol soil [5].

This study aimed to investigate the effect of BSF Frass application and to determine the extent to which this organic fertilizer can replace the need for conventional NPK chemical fertilizer in the cultivation of upland rice (Oryza sativa L.) on Ultisol soil [5]. The experiment, conducted between April and August 2021, employed a Factorial Completely Randomized Design (CRD) with three replications [5, 6]. The experimental treatments involved two main factors: Factor A, the total dose of Frass (0, 10 percent, 20 percent, and 30 percent), and Factor B, the dose of NPK fertilizer (100 percent, 75 percent, 50 percent, and 25 percent of the recommended amount) [5, 6]. The Frass material was sourced locally from BUMNAG Lubuk Alung Padang and a West Java Maggot Manager [6].

Initial analysis of the Frass content confirmed that it contained macroelements nitrogen (N), phosphorus (P), and potassium (K) that met the domestic organic waste compost specification standard (SNI 19-7030-2004), indicating its high nutrient potential for plant growth [5, 6]. Further analysis of the Ultisol soil after treatment with Frass demonstrated that increasing Frass doses led to improved soil conditions. The soil pH increased towards a more neutral state, which is vital for improving nutrient availability in acidic Ultisols [10]. This increase is likely due to the humic acid content in Frass, which possesses functional groups capable of reducing hydrogen ion hydrolysis [9]. The highest Frass dose of 30 percent resulted in

the greatest increase in total N, available P, K, magnesium (Mg), and organic carbon (C-Organic) in the soil compared to other doses [5]. The improvement in nutrient content and soil structure by organic fertilizer, including Frass, is consistent with prior research on rice cultivation in other soil types [12].

The main plant response variables studied were chlorophyll content and grain yield. Measurement of chlorophyll content (chlorophyll a, chlorophyll b, and total chlorophyll) was performed during the vegetative phase (less than sixty days after planting) using the Arnon method, involving spectrophotometric analysis at wavelengths of 663 and 645 nanometers [6]. Statistical analysis (ANOVA and DNMRT at the five percent level) revealed that the dose of Frass and the combined dose of Frass with NPK fertilizer had a significantly different effect on the chlorophyll content [5]. The single application of Frass showed that higher doses increased chlorophyll content, likely due to the higher presence of key elements such as N, P, K, Mg, and sulfur (S) [11, 14]. Magnesium, in particular, is a central component of the chlorophyll molecule, and its higher content (one point two zero one milliequivalents per 100 grams) in the 30 percent Frass treatment likely encouraged chlorophyll formation, counteracting the potential negative effect of high aluminum on phosphorus fixation [13, 14].

Crucially, the combination treatment demonstrated that applying 30 percent Frass with 25 percent NPK had a significant effect on increasing the total chlorophyll content of upland rice, making it comparable to the control treatment that received a full 100 percent NPK dose or 75 percent NPK dose [5]. This suggests that the nutrient profile in Frass, particularly its nitrogen content, plays an important role in supporting chlorophyll formation, which is key for photosynthesis [15].

Table 1. Grain Weight of 100 Seeds (g) Upland rice plants applied with Frass and NPK

	Fertilizer				
Treatment	NPK Dose*				
Frass Dose (%)	100%	75%	50%	25%	Average Factor A
0	2.43±0.04 abed	2.34±0.04 ab	2.37±0.05 abc	2.35±0.04 abc	2.37±0.04 A
10	2.31±0.06a	2.34±0.03 ab	2.33±0.02 ab	2.35±0.03 abc	2.33±0.03 A
20	2.33±0.07 ab	2.40±0.03 abed	2.43±0.05 abed	2.34±0.05 ab	2.37±0.05 A
30	2.53±0.02 cd	2.44±0.02 abed	2.51±0.08 bed	2.57±0.09 d	2.51±0.05 B
Average factor B	2.40±0.048 A	2.38±0.03 A	2.41±0.05 A	2.40±0.05 A	

Regarding the yield component, the grain weight of 100 seeds was significantly different only for the Frass dose factor [5]. The 30 percent Frass treatment resulted in a significantly higher 100-seed grain weight compared to all lower doses and the control [5]. This positive yield response is attributed to the Frass's ability to boost nutrient uptake, particularly phosphorus, and enhance soil fertility by increasing microbial activity and reducing soil acidity [7, 8]. The combination of 30 percent Frass with 25 percent NPK achieved the highest 100-seed grain weight, and this result was not significantly different from the 30 percent Frass combined with 50 percent, 75 percent, or 100 percent NPK [5].

In conclusion, the research successfully demonstrated that applying Frass from Hermetia illucens L. larvae is an effective strategy for improving the physical and chemical properties of challenging Ultisol soil [5]. The

application of 30 percent Frass combined with 25 percent NPK fertilizer significantly improved the chlorophyll content of upland rice and enhanced the grain weight of 100 seeds [5]. Most importantly, this finding indicates the strong potential of Frass to reduce the required dosage of conventional chemical NPK fertilizer by 75 percent without compromising the physiological health or yield of upland rice [5].

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USABILITY AND USER EXPERIENCE RELATED PERCEPTIONS OF UNIVERSITY STUDENTS REGARDING THE USE OF BING CHAT SEARCH ENGINE AND AI CHATBOT: PRELIMINARY EVALUATION OF ASSESSMENT SCALES

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Since the introduction of the artificial intelligence (AI) chatbot ChatGPT in November 2022, followed by the much more powerful GPT-4 in March 2023, the academic community has engaged in a continuous debate regarding their potential negative and positive impacts on education [1]. Research is rapidly accumulating on user perspectives related to the use of Large Language Models (LLM) in higher education [2].

Bing Chat (now Microsoft Copilot), a GPT-based AI chatbot integrated with the Microsoft Bing search engine, represents a crucial tool in this landscape, presenting both significant challenges and opportunities for academic instruction [3]. Focusing on the potential benefits of Bing Chat, this preliminary investigation assessed specific variables broadly related to the usability and user experience (UX) of the service among university students [4].

The study utilized a survey administered to two convenience samples of students from different Croatian higher education institutions (N=30 and N=43). The survey included assessment scales for several key variables relevant to technology perception, specifically: Perceived Usefulness, General Usability, Learnability, System Reliability, Visual Design and Navigation, Information Quality, Information Display, Cognitive Involvement, Design Appeal, Trust, Risk Perception, and Intenti1on to Use [5]. An acceptable Cronbach alpha coefficient, indicating sufficient internal

consistency, was revealed for most of these assessment scales, confirming their reliability for continued use [6].

Data analysis revealed that the variables with the highest correlation to the ultimate Intention to Use Bing Chat (or a similar service like GPT-4) were Cognitive Involvement, Design Appeal, and Trust. This finding suggests that affective and cognitive factors, along with the user's confidence in the AI tool, are more potent predictors of technology adoption among students than purely functional or technical metrics [7, 8]. Overall, students' responses to specific survey items provided a positive evaluation of various usability and UX characteristics of Bing Chat. Existing literature already supports the potential benefits of LLM in specific areas, such as language education [9] and medical education [10].

Extended Discussion of Study Results: User Perception Impact on AI Integration in Higher EducationThe preliminary findings, which report an overall positive evaluation of the usability and user experience (UX) of Bing Chat by students, must be rigorously discussed within the framework of established technology adoption models [5].

Traditional models like the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT) primarily identify Perceived Usefulness and Perceived Ease of Use as the central predictors of a user's intention to use a new technology [5].

This study validates that these classic factors remain pertinent, but critically reveals that for contemporary AI chatbots like Bing Chat, which are powered by Large Language Models (LLM) such as GPT-4, additional and more subjective variables are becoming paramount in predicting the Intention to Use. Specifically, the variables of Cognitive Involvement, Design Appeal, and Trust showed the highest correlation with students'

intention to adopt the service. This correlation shift suggests that for AI technologies offering a more conversational and interactive experience, the adoption model must be expanded.

The significance of Trust underscores that because the AI generates information rather than merely processing static data, a student's confidence in its reliability, accuracy, and ethical operation is a prerequisite for sustained reliance. High trust levels directly translate into a greater willingness to utilize the tool for academic assignments.

Cognitive Involvement highlights that Bing Chat is not perceived as a passive utility but as a learning partner; students who find the interaction intellectually stimulating and reflective of active learning are more likely to integrate it into their study habits. Lastly, Design Appeal moves beyond mere aesthetics; in the competitive digital landscape of educational tools, a clean, intuitive interface and positive overall aesthetic experience are now essential for maintaining user engagement and ensuring long-term adoption. These results collectively emphasize that successful AI integration is contingent not only on the technology's technical capabilities but, more importantly, on subjective user perceptions and the human factor.

These study conclusions have direct and significant implications for pedagogical design and curriculum development in higher education institutions. Since AI chatbots like Bing Chat are recognized as an inevitable force to be integrated into educational practices, educators must transition away from restrictive approaches toward strategies that promote competent and critical utilization. For ensuring successful and sustainable implementation, tasks must be redesigned to prioritize complex interaction over simple fact retrieval.

Given that Trust is a crucial factor, students must be explicitly trained to critically evaluate AI outputs, particularly regarding common LLM issues like "hallucinations." Learning activities should demand information verification against established academic sources, thereby fostering information literacy in the age of AI. To enhance Cognitive Involvement, assignments should shift from rote memorization to demanding complex, multi-step problem-solving where the AI serves as a co-pilot or brainstorming tool, compelling students to critically reflect on the AI-generated responses and apply deep critical thinking. Furthermore, maintaining Academic Integrity is vital, requiring clear establishment of ethical and procedural guidelines detailing when, how, and for which specific components of coursework AI tools are permissible.

This directly contributes to establishing a consistent institutional framework of Trust. Finally, to leverage Design Appeal, educational platforms must prioritize seamless, aesthetic, and intuitive integration of AI tools within existing Learning Management Systems (LMS). In summary, the findings indicate that the greatest risk to AI adoption lies not in the technology itself, but in the failure to understand the user's psychological and cognitive interaction with it. Sustainable integration of AI chatbots necessitates a transition toward a user-centric pedagogy where the student's subjective perception, trust, and quality of cognitive experience are the primary design priorities.

The results of this preliminary study are discussed in the context of AI technology adoption models and the essential design of learning activities for students in higher education. The findings emphasize that while AI chatbots like Bing Chat are likely to be integrated into educational practices, understanding the subjective user perceptions—especially factors like trust

and cognitive engagement—is critical for ensuring successful and sustainable implementation.

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METHODOLOGICAL FEATURES OF USING ROBOTICS IN PHYSICS AND COMPUTER SCIENCE LESSONS FOR DEVELOPING STUDENTS' ENGINEERING THINKING

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The methodological features of integrating robotics into the educational process of physics and computer science for the targeted development of engineering thinking in profile-oriented high school students are investigated. Robotics serves as an interdisciplinary proving ground that allows students to apply theoretical knowledge of physical laws to solve applied design and programming tasks. The structure of a pedagogical experiment is proposed to verify the effectiveness of this practically oriented approach.

The contemporary educational paradigm demands a shift from the theoretical acquisition of knowledge to the formation of practical skills, particularly engineering thinking, which is critically important for the technological development of society. Traditional physics and computer science lessons often fail to provide sufficient space for applying laws and algorithms in real design and project tasks. The relevance of the study lies in the necessity of developing and substantiating a methodology that utilizes the potential of robotics as a proving ground for developing profile-oriented high school students' ability for systemic design, optimization, and the realization of physical models in a digital environment.

In the course of the research, the role of robotics as a means of interdisciplinary integration of physics and computer science was theoretically substantiated. The key components of engineering thinking developed during work with robotic construction kits were identified and systematized. Specific practical scenarios for using robotic complexes in profile-oriented high schools were developed and proposed. The structure of a pedagogical experiment necessary for the empirical verification of the new methodology's effectiveness was also designed.

The methodological feature of using robotics lies in its ability to organically combine abstract physical laws with applied programming, which is an ideal basis for developing engineering thinking.

This topic is actively researched in scientific and pedagogical literature.

D. Pidhirnyi, N. Seriuzhenko, Ya. Brateiko, and I. Chyzh investigate robotics as a universal tool for implementing STEM education in the context of the New Ukrainian School, which creates prerequisites for socialization and continuous technical education. The authors substantiate that educational robotics allows for the early detection and development of engineering thinking, creativity, and communication skills in students, yet they emphasize the lack of a systemic approach to its implementation in the Ukrainian educational process. The research highlights the high effectiveness of this form of educational activity in knowledge acquisition and the formation of positive personal qualities [2].

O. O. Hrybiuk examines variable models of research-based learning for natural science and mathematics subjects with a pedagogically balanced use of computer-oriented methodological systems. The author conducts a thorough analysis of ways to introduce educational robotics and electronic laboratory complexes for organizing students' cognitive activity,

emphasizing the continuity of education and the integration of educational, scientific, and research activities. The study is fundamental in nature and dedicated to developing a new concept for developing students' intellect during research-based learning [3].

V. V. Sipii analyzes the potential of robotics as an effective tool for implementing STEM education in schools, demonstrating how knowledge from physics, mathematics, and computer science can be integrated into the project activities of students in grades 5–9. The author emphasizes the career guidance potential of the course and the importance of practical learning and the engineering approach for developing key 21st-century competencies. The article also presents examples of applying robotics in natural science courses and outlines prospects for the further development of STEM education in Ukraine [1].

In profile-oriented high schools, robotic complexes serve as learning models that allow students not just to study a phenomenon, but to design devices that are controlled by that phenomenon. For example, when studying the "Dynamics" and "Fundamentals of Algorithmization" sections, students can implement a specific application: creating an autonomous acceleration measurement system consisting of a microcontroller, an accelerometer, and a wheeled platform. In this project, students first calculate the physical parameters of motion, friction forces, and inertia (Physics), and then write code for the microcontroller that collects data, processes it, and controls the motors to achieve a predetermined trajectory (Computer Science). This approach stimulates engineering thinking because it requires students to have a systemic vision, break down a large problem into modules (structure, electronics, code), and constantly optimize both the physical design and the software to achieve the desired result. Robotics

transforms the student from a passive observer into an active designer and inventor, which is key to their further professional orientation.

Let us consider a specific project example: "Autonomous Speed Regulator on an Inclined Plane." This interdisciplinary project is ideal for profile-oriented high schools and serves as a powerful tool for developing engineering thinking, as it requires students to comprehensively apply knowledge. Students are tasked with designing a mechanism that will move along an inclined plane at a constant or specified variable speed, despite the forces of gravity and friction. This requires them to perform accurate mathematical modeling—calculating all force vectors, determining the angle of inclination, and calculating the necessary control force that the electric motor must provide. The calculations involve applying Newton's second law and formulas for uniformly accelerated motion.

Students take a robotic construction kit (for example, based on Arduino or LEGO Mindstorms), design, and assemble a mobile platform with wheels and a motor. Next, they use their knowledge of computer science to write the control program. The key element is the implementation of a feedback algorithm (e.g., a simple PID controller). For this purpose, the platform is equipped with a speed sensor (encoder), which constantly measures the actual speed of movement. The code written by the students compares the actual speed with the speed set by the teacher and, in case of deviation, automatically adjusts the voltage supplied to the motor. This is a direct embodiment of the engineering cycle: analysis → design → programming → testing → optimization.

During this project, students develop engineering thinking in several key aspects. Firstly, they learn systemic analysis, breaking down a complex task into separate subsystems (mechanical structure, electrical power,

software algorithm). Secondly, they master the skill of prototyping, quickly assembling and testing various mechanical solutions. Thirdly, they form optimization and debugging skills, as no initial code or construction works perfectly, and iterative adjustments must be made. Thus, robotics serves as a practical proving ground where abstract physical theory and algorithmics are transformed into a real, functioning device that solves a specific technical problem.

For the empirical verification of the methodology's effectiveness, which is based on the active use of robotics, a pedagogical experiment is planned, including the following stages:

Preparatory Stage: Development of teaching and methodological support, including a set of robotic projects for both subjects, and the formation of control (CG) and experimental (EG) groups of students.

Stating Stage: Diagnosis of the initial level of formation of key engineering skills, including systemic analysis and design skills, in students of both groups.

Formative Stage: Teaching the EG according to the developed methodology with the active application of robotics, while the CG is taught using the traditional methodology without the involvement of robotic complexes.

Control Stage: Conducting final diagnostics and a comparative analysis of the results in the CG and EG to confirm the hypothesis about the effectiveness of the proposed method in developing engineering thinking.

The proposed methodology for using robotics is an effective and innovative tool for developing students' engineering thinking, effectively combining theoretical knowledge of physics and practical programming skills from computer science, which fully corresponds to the goal of the

study. The outlined theoretical provisions and the developed methodology form the basis for my master's thesis. At the moment, the master's thesis plan is fully ready, and pilot attempts have already been made to use robotic complexes for modeling physical processes, which confirmed the expediency of a full-scale pedagogical experiment.

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THE LACUNA AND LATENCY OF FILIPINO MARITIME ANTHROPOLOGY

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The Philippines, an archipelagic nation comprising over seven thousand islands, faces compelling, market-driven pressures on its extensive marine resources, including issues of overfishing, resource degradation, pollution, and ineffective regulation. Despite the significant demographic reality that over sixty percent of its population of more than one hundred million resides in coastal areas, making the fisheries sector a critical component of national life, anthropological studies focusing on this maritime aspect are surprisingly scarce. As early as 1998, Filipino anthropologist Ponciano Bennagen noted the ironical poverty and youth of maritime anthropology in the Philippines relative to the well-established upland and lowland ethnographies. The prevalence of this yawning gap in Philippine social science is starkly evident in the publication record, where non-Filipino authors surpass local scholars in books and academic journals on coastal fishing communities. This disparity prompts a crucial question: given the nation's reliance on aquatic resources, why has the surrounding sea not played a larger, more central role in the development of Philippine anthropology?

Current conservation efforts, such як establishing marine protected area networks, highlight this deficit, as far more information exists regarding fish biology and marine species behavior than the social identities, subsistence strategies, exchange networks, and cultural knowledge of the human inhabitants who depend on these environments. Intensification and decline in Philippine fisheries were already apparent in the 1930s [3], and today, fishers routinely report having to travel farther out to sea for greatly

diminished catches, raising the urgent research question of why fishing persists as a livelihood option despite demonstrably uneconomic returns. Foreign scholars have recently called for ethnography to better understand the social complexity of these Philippine coastal settings [4, 6].

A substantial amount of well-written, theoretically framed, and sensitively nuanced ethnographic material on Filipino coastal communities already exists, but it remains largely unpublished. This body of work, referred to as "gray literature," comprises Master's theses, PhD dissertations, and technical research reports from long-term initiatives like Coastal Resource Management (CRM) projects. These hidden resources offer rich insights into social aspects such as sharing behavior among fishers, mobility, access to marine resources, local knowledge related to fishing gear, and cultures of resource use and abuse. Though spanning over a century, this significant research on fisherfolk is often inaccessible and unknown. The reasons for this latent body of knowledge are multifaceted, relating to the shifting prominence of anthropology against other disciplines, compartmentalization between the social and natural sciences, and the thematic priorities and advocacy within Filipino anthropology.

Early formative experiences, such as the extended anthropology field school in the 1980s that required research papers to be written in Filipino, were instrumental in thrusting some Filipino students toward coastal resource management and, subsequently, maritime anthropology. This early push was consistent with a deliberate nationalistic drive toward social science indigenization by pioneers such as Poncilio Bennagen and Virgilio Enriquez. The subsequent employment of anthropology graduates in projects like the first CRM Project in Lingayen Gulf further contributed to this unpublished ethnographic material. The work of Cynthia Neri Zayas,

who established a sea-oriented anthropology program after receiving graduate training in an Asian context (Japan), is specifically highlighted as a major recent development in establishing a publication-oriented focus in this field. The knowledge being surfaced through this new emphasis on maritime contexts reveals a conscious intention to indigenize ideas, privilege local knowledge, and claim one's own grounded practice in Filipino anthropology, echoing broader themes of counter-hegemonic discourse that have recurrently stimulated Filipino scholarship [1, 2, 7, 8, 9, 10]. Until Philippine universities commit to the digitization and open online reference of these theses and dissertations, a significant volume of valuable ethnographic material will remain underutilized and out of sight.

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METHODOLOGICAL ASPECTS OF USING A 3D PRINTER IN TECHNOLOGY LESSONS IN SENIOR GRADES

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In modern Ukrainian education, the implementation of 3D technologies is crucial for the development of STEM skills (Science, Technology,

Engineering, Mathematics), as they contribute to the formation of practical abilities, creativity, and readiness for professional activity in the digital world. According to the Ministry of Education and Science of Ukraine, the integration of additive technologies, such as 3D printing, into the school curriculum allows for increased student motivation to study technology, making lessons more interactive and focused on real-world projects. A survey of 100 senior grade students (25 from each class: 10-A, 10-B, 11-A, 11-B) showed that 80% of respondents express high interest in 3D printing, but only 12% have practical experience, which underscores the need for methodological developments to implement this technology in the school environment. The relevance is also confirmed by global trends: according to UNESCO research, 3D printing in schools contributes to the development of critical thinking and innovativeness, especially in the context of digital transformation in education. In Ukraine, where access to modern equipment is limited, do-it-yourself or affordable 3D printers can become an effective tool for overcoming this barrier, making education more inclusive and practical.

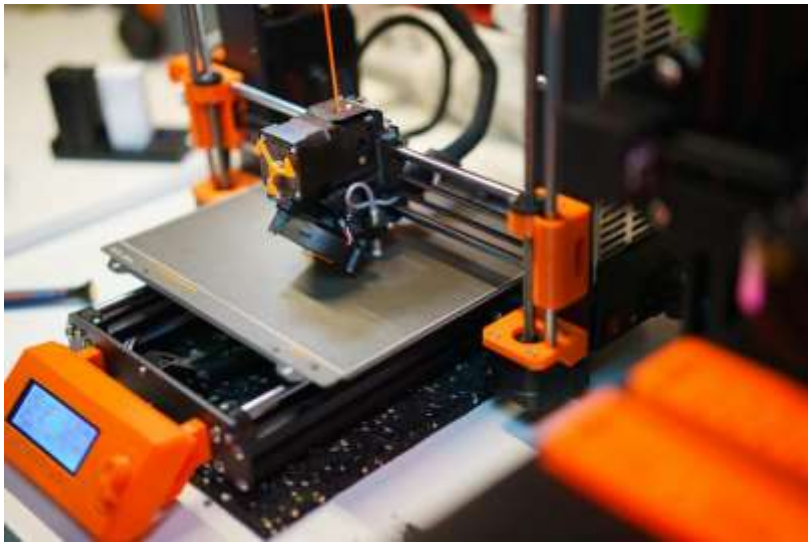

Figure 1. Example photo of 3D printer usage

The goal of the research is to develop a differentiated methodology for using the Tinkercad and FreeCAD programs for modeling and 3D printing in technology lessons in senior grades, aiming to increase student motivation and develop practical skills. The objectives include: analyzing scientific literature on additive technologies in education (with a focus on Ukrainian sources, such as the journal "Informatyka ta Osvita"); conducting a survey to determine students' interests and needs; developing step-by-step guides for projects ("Key Holder" for 10th grade in Tinkercad and "Gear" for 11th grade in FreeCAD); creating assessment criteria, technological maps, economic calculations, and environmental justification; and summarizing the results for recommendations on implementation into school practice. The methodology is based on empirical methods (survey, statistical analysis in Excel) and theoretical synthesis (comparative analysis of modeling software). The object of the study is the process of teaching technology in senior grades; the subject is the methodological aspects of using a 3D printer.

The theoretical basis of the research is grounded in the works of Ukrainian and foreign educators who emphasize the role of 3D printing in competency development. According to the journal "Informatyka ta Osvita" (2025), 3D printing increases student motivation by 40-50%, facilitating the transition from theory to practice. Tolmachov V. S.'s monograph, Additive Technologies in Pedagogical Education (HNPU named after O. Dovzhenko, 2024), focuses on the accessibility of Tinkercad for beginners and FreeCAD for advanced users, which allows for differentiated instruction. Petrenko O. M.'s study (The Use of 3D Modeling in School Education, 2025) shows that the integration of 3D technologies improves the understanding of three-dimensional space and engineering principles. The theoretical analysis also includes environmental aspects (Sydorenko T. P., Environmental Aspects of

Additive Manufacturing, 2025), where PLA plastic is highlighted as a biodegradable material, and economic calculations (Bondarenko V. Yu., Economic Calculations in 3D Printing for Education, 2024), which confirm the technology's accessibility for schools with limited budgets.

The survey of 100 senior grade students revealed that: 68% have a general idea of 3D printing, but only 12% have experience; 65% want to learn, and 5% are not interested. Motivation: 42% are attracted by creating unique objects, and 32% by creating useful things. Project priorities: 38% prefer creative projects, 35% prefer engineering projects. Learning methods: 45% prefer technology lessons, 25% prefer extracurricular clubs. Usefulness for a profession: 55% consider it very useful, 35% partially useful. Difficulties: 40% cite software complexity, and 30% cite computer requirements. This data, processed in Excel (mean values, correlations, charts), confirms the need for simple tools like Tinkercad for 10th grade and FreeCAD for 11th grade, with a focus on creative projects for motivation.

The developed methodology includes descriptions of the Tinkercad interface (intuitive for beginners) and FreeCAD (parametric for advanced users), and a comparative analysis (a table with 15 parameters: complexity, functionality, etc.). Step-by-step guides were created: for the "Key Holder" project in Tinkercad (25 steps: adding shapes, grouping, STL export); and for the "Gear" project in FreeCAD (30 steps: sketching, extrusion, chamfers). Additional projects (a table with 8 options: keychain, molecule model, etc.) were outlined. The Technological Map details the stages: preparation, settings in Cura, printing on Ender-3, and post-processing. Assessment rubrics (12 points: technical complexity – 4, functionality – 3, etc.) were established. Economic calculations show an estimated cost of 11 UAH for the "Key Holder" project (using PLA plastic at 500 UAH/kg). The

Environmental Rationale highlights PLA as biodegradable and provides recommendations for recycling.

The developed methodology is effective for senior grades, allowing for differentiated instruction: Tinkercad for basic skills in 10th grade, and FreeCAD for complex projects in 11th grade. The survey results confirm high student motivation (85% are ready to learn), economic accessibility (10-20 UAH per model), and environmental safety. It is recommended for implementation in Hlukhiv schools and other institutions in the Sumy region, with adaptation based on budget. The novelty lies in its integration with Ukrainian educational standards; future prospects include expanding to Blender for higher levels. This contributes to the formation of competencies for future specialists in technological education.

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THE INFLUENCE OF PRICE, QUALITY, PROMOTION, AND SERVICE ON CONSUMER BEHAVIOR IN HOME APPLIANCE PURCHASES

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This academic paper examines the influence of key marketing factors—Price, Quality, Promotion, and Service—on Consumer Behavior related to the purchase of Panasonic Home Appliances at PT. Sumber Karya Asia [5]. Understanding the mechanisms through which these variables shape purchasing decisions is crucial for management and entrepreneurial strategy in the competitive home appliances sector. The research employed a quantitative, descriptive approach, utilizing primary data collected from consumers via questionnaires, with the resulting analysis performed using the multiple linear regression method and processed with the SPSS 20 program [5].

Consumer behavior is defined as the actions displayed by individuals when seeking, buying, using, evaluating, and disposing of products, services, and ideas [2]. This behavior forms the core dependent variable of the study. The independent variables are analyzed based on established marketing literature. Price, according to Kotler and Amstrong (2008), is the amount of money exchanged for a product or service, or more broadly, the value consumers exchange for the benefits of owning or using a good [1]. Price remains a critical focus point for consumers during the purchase process, often serving as an identifier of overall value. Product Quality, as described in the literature, refers to a product's capacity to perform its functions, encompassing attributes such as durability, reliability, accuracy, ease of operation, and repair [1]. A product that successfully executes its functions is typically deemed to possess good quality.

Promotion represents an essential activity within the marketing mix, designed to stimulate demand [3]. Promotion is characterized as a one-way flow of information or persuasion aimed at directing an individual or organization towards actions that facilitate market exchange [3]. Lastly, Service requires a company to determine how best to offer post-sale support, including maintenance, repair services, and customer training, to enhance the overall customer experience [4]. Given these established relationships, the study hypothesized that each of these four factors—Price, Quality, Promotion, and Service—would individually exhibit a positive and significant effect on Consumer Behavior. Furthermore, the combined, simultaneous effect of all four factors was hypothesized to significantly influence consumer behavior [5].

The research methodology involved gathering data from consumers of PT. Sumber Karya Asia using accidental sampling, selecting respondents based on convenience and availability [5]. The subsequent data analysis confirmed the hypotheses. Based on partial analysis, the findings demonstrate that all independent variables—Price, Quality, Promotion, Promotion, and Service—have a positive and significant effect on Consumer Behavior in the purchase of home appliance products [5]. This suggests that consumers consider all four factors highly important in influencing their purchasing decisions at PT. Sumber Karya Asia. Moreover, simultaneous testing further reinforced these results, proving that the variables of Price, Quality, Promotion, and Service collectively and significantly influence consumer behavior [5].

In conclusion, the findings confirm that price, quality, promotion, and service all exert a positive and significant influence on consumer purchasing behavior for Panasonic home appliances at PT. Sumber Karya Asia.

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ECONOMIC ESSENCE AND STRUCTURAL FEATURES OF ENTERPRISE FINANCIAL STABILITY

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Theses are dedicated to the analysis of the economic essence and structural features of enterprise financial stability. Financial stability is defined as a key aspect of economic activity, characterizing an enterprise's ability to maintain stable functioning, fulfill its financial obligations, and secure long-term development. The structure of financial stability analysis, key indicators, and the influence of internal and external factors are outlined.

Economic Essence and Significance Financial stability of an enterprise is a key aspect of its economic activity, determining the enterprise's ability to function and develop stably. It reflects the enterprise's capacity to ensure

the timely fulfillment of financial obligations to creditors, suppliers, and employees. Financial stability is characterized by the availability of sufficient financial resources to cover costs and invest in development.

Financial stability is the ability of an organization to maintain a stable financial position and ensure its operation in the long term. It is expressed through the effective management of financial resources and the enterprise's ability to respond to internal and external economic challenges. Financial stability is defined as the balance between equity and borrowed funds, which enables the enterprise to meet its financial obligations on time.

Key indicators of financial stability include: Autonomy ratio (or equity ratio), which reflects the share of equity in the total structure of funding sources.

Solvency ratio, which indicates the enterprise's ability to pay off its debts. The important aspect is also asset liquidity, which determines how quickly the enterprise can convert its assets into cash to cover urgent needs. A lack of financial stability can lead to bankruptcy, which will negatively affect the economy and the labor market.

Maintaining financial stability requires effective cash flow management and cost control. The development of strategic financial plans helps the enterprise adapt to changing market conditions and avoid crisis situations. A high level of financial stability contributes to increased confidence among investors and partners, which opens up opportunities for attracting additional financial resources. Thus, the financial stability of an enterprise is the foundation of its stability, development, and successful operation in the market.

The financial condition of an enterprise is a comprehensive characteristic that involves the implementation of several research areas:

Horizontal and vertical analysis of enterprise assets and their formation sources.

- Analysis of liquidity and solvency indicators.
- Analysis of financial stability.
- Analysis of business activity indicators.
- Analysis of financial results formation and profitability indicators.

Assessment of financial stability is a component of the financial condition analysis that characterizes the features of enterprise capital formation, its structure, and dynamics. A sufficient level of financial stability is a kind of indicator for forming the enterprise's image, and consequently, for attracting investments, obtaining bank loans, and cooperating with reliable counterparties. Therefore, studying the methods and approaches to ensuring enterprise financial stability is an important component of financial work in the enterprise, which indicates the enterprise's possession of financial resources to ensure further financial and economic development [1].

The external and internal factors influencing the financial stability of an enterprise differ in the mechanism of enterprise response to them.

External factors are beyond the enterprise's control, as they do not depend on the enterprise's activities but are related to the nature of state regulation and the development of the economy as a whole. Therefore, more attention must be paid to them to ensure timely response and adaptation to changes.

Internal factors are within the enterprise's regulatory zone and are important from the perspective of forming the enterprise's activity strategy.

Among many internal factors, the most important, in our opinion, are the composition and structure of the enterprise's assets and financial resources.

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USING CLOUD SERVICES IN TEACHING PHYSICS AND COMPUTER SCIENCE IN PROFILED HIGH SCHOOLS

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The modern profile-oriented educational process requires effective interdisciplinary integration of physics and computer science to develop students' key digital and research competencies. This research is dedicated to the theoretical substantiation and development of a methodology for using Google Classroom and Google Colab as the main cloud tools to ensure personalized and practically oriented learning in high school. The proposed methodology involves creating an adaptive educational environment, the effectiveness of which will be verified within the framework of a pedagogical experiment.

In the context of rapid digitalization and the requirements of the competency-based approach, traditional methods of teaching physics and computer science often fail to provide the necessary level of practical training for profile-oriented high school students in working with Big Data, modeling, and programming. There is an urgent need to implement cloud services that would not only support the distance format but also foster

students' skills in collaboration, critical thinking, and the application of IT tools to solve complex scientific and applied problems. The relevance of the study lies in the necessity of developing a comprehensive methodology for integrating cloud platforms to achieve these educational goals.

In the course of the research, a theoretical substantiation of the pedagogical capabilities of Google cloud services was carried out in the context of forming key competencies of high school students, and their role in interdisciplinary integration was determined. Based on this analysis, which included a study of foreign and domestic practices, specific scenarios for using Google Classroom and Google Colab in teaching physics and computer science were proposed. Furthermore, the structure and stages of a pedagogical experiment necessary for the empirical verification of the proposed methodology's effectiveness were developed.

The topic of using cloud services in teaching physics and computer science is relevant because it ensures the continuity and flexibility of the educational process, allowing for interdisciplinary integration for Big Data processing and the formation of key digital competencies in students.

O. M. Tryfonova and H. L. Kurnat explore the capabilities of the Google Classroom platform as an effective means of intensifying the educational process in distance learning, particularly in teaching physics. The authors substantiate that this service is a suitable tool for ensuring non-contact information interaction and activating students' cognitive activity. The article provides a specific example of creating and filling a didactic platform for studying the "Electric Field" section in the 10th grade, demonstrating Classroom's potential in physics education [4].

N. Ostapchuk and N. Poliukhovych analyze the use of cloud technologies, specifically the G Suite for Education package, for

implementing a blended learning model and intensifying computer science lessons. The authors developed and graphically presented the structure of a virtual class in the Google Classroom service, paying special attention to organizing a single computer science lesson. The study demonstrates practical solutions for the effective application of this platform in secondary education institutions [2].

O. I. Chub and M. V. Novozhylova explore and classify the possibilities of cloud services for studying the mathematical tools of Data Science in an online learning environment. The authors propose using Google Colab as the main element of the cloud environment, demonstrating its potential in cooperation with Python scientific libraries and solvers to simplify the coding process. The application of this approach allows students to focus directly on the modeling stage of Data Science problems [3].

M. Yu. Zhylin compares the capabilities of two powerful interactive environments—Jupyter and Google Colab—for solving Machine Learning (ML) and Artificial Intelligence (AI) problems in the context of increasing data volumes. The author notes that Jupyter is fully open-source software under the BSD license, allowing free use and modification, while Google Colab, though based on the open Jupyter Notebooks, is governed by Google's terms and policies, offering a free service with an optional paid subscription [1].

Google cloud services offer unique opportunities for transforming the educational process in profile-oriented high schools. Google Classroom acts as a centralized cloud environment that develops students' organizational competence and self-regulation skills through effective management of learning content, assignments, deadlines, and feedback. It supports a

blended learning model and simplifies the exchange of didactic materials, increasing the transparency and accessibility of the educational process.

The key tool for developing scientific, research, and digital competencies is Google Colab. This cloud-based Jupyter Notebook allows students to perform complex computational tasks, integrating knowledge from both subjects without installing software. For example, in physics, when studying "Kinematics" or "Electric Circuits," students can use Google Colab to write Python code that models the motion of objects or calculates circuit parameters, as well as to visualize the results in the form of interactive graphs. Computer science lessons, in turn, use Colab to master Data Science and Machine Learning, applying these skills to analyze real physical data. This approach creates a powerful space for project activities where students learn not only to code but also to critically interpret results obtained using cloud computing.

A specific example of integrating physics and computer science in the profile school can be realized on the interdisciplinary topic "Designing and Analyzing the Trajectory of a Body Thrown at an Angle to the Horizon," using Google Colab. At the beginning of the work, students receive a physics problem: to model the flight of a projectile, considering realistic conditions, including air resistance, which depends on the body's speed, requiring a deep understanding of the laws of classical mechanics. To implement this model, students use the interactive Google Colab notebook. In this cloud environment, they write or adapt Python code, utilizing the NumPy library for numerical calculations and Matplotlib for graphics. They implement a physical model that uses a numerical integration method to dynamically calculate the body's coordinates at every moment in time, which forms their programming skills and algorithmic thinking (computer science).

Thanks to the cloud nature of Colab, students can work on the document collaboratively, discussing physical parameters and making changes to the code in real-time, which develops communicative competence. After running the code, Google Colab instantly generates an interactive flight trajectory graph. Students can quickly change initial conditions, such as the angle of throw or the drag coefficient, and visually compare the idealized flight with the realistic one. Based on the resulting graphs, students conduct a critical analysis, explaining the effect of air resistance on the flight range and height, which is key to developing research competence and scientific understanding. Thus, Google Colab serves as a powerful bridge that transforms theoretical physical knowledge into practical programming and data analysis.

For the empirical verification of the methodology's effectiveness, which is based on the active use of Google Classroom and Google Colab, a pedagogical experiment is planned, including the following stages:

Preparatory Stage: Development of teaching and methodological support, including integrated tasks and laboratory work in Google Colab, and the formation of control (CG) and experimental (EG) groups of students.

Stating Stage: Diagnosis of the initial level of formation of key competencies (digital, research, organizational) of students in both groups.

Formative Stage: Teaching the EG according to the developed methodology with the active use of cloud services, while the CG is taught using the traditional methodology.

Control Stage: Conducting final diagnostics and a comparative analysis of the results in the CG and EG to confirm or refute the hypothesis about the effectiveness of the proposed method.

The proposed methodology for using the cloud services Google Classroom and Google Colab is appropriate and effective for organizing the educational process in profile-oriented high schools. It allows for interdisciplinary integration of physics and computer science at a qualitatively new level, ensuring the development of necessary key competencies in students, particularly the skills of scientific modeling, data processing, and critical work with cloud computing resources, which fully corresponds to the stated goal.

The outlined theoretical provisions and the developed methodology form the basis for my master's thesis. Currently, the master's thesis plan is fully ready, and pilot attempts to use integrated assignments in Google Colab have already been made, confirming the feasibility of a full-scale pedagogical experiment.

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MEDIATION AS A MEANS OF RESOLVING CONFLICTS IN ORGANIZATIONS

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In the process of human interaction, certain discrepancies inevitably arise, related to differences in opinions, varying understandings of production functions and responsibilities, goals and objectives, as well as the diversity of personal qualities, values, attitudes, interests, and views on problems that emerge during joint activities. As a result of such differences, the likelihood of conflict situations and conflicts increases. The presence of similar problems is an inherent element of any organization's activity. To steer conflicts into a constructive channel, it is necessary to be able to analyze them, understand the causes of their occurrence and potential consequences, and apply effective mechanisms for conflict resolution. One such mechanism is mediation. Its implementation can significantly improve an organization's corporate culture.

Today, mediation is one of the most promising technologies for the constructive resolution of conflicts. It involves the participation of a third party, the mediator, who maintains a neutral position toward the parties [2, p. 127]. Ukrainian legislation defines mediation as an out-of-court voluntary, confidential, structured procedure during which the parties, with the help of a mediator(s), attempt to prevent the occurrence of or settle a conflict

(dispute) through negotiations [1]. It is an effective dispute resolution mechanism based on the principles of voluntariness, confidentiality, neutrality, independence, impartiality of the mediator, self-determination, and equality of rights of the parties to mediation. The Law also establishes the legal status of the mediator, their functions, and responsibilities. The mediator is obligated to act neutrally and without hindrance, assisting the parties in finding a mutually beneficial solution, and has no right to provide legal consultations or impose their own decisions. The Law also sets rules for confidentiality, according to which information obtained during the mediation process is confidential and cannot be disclosed without the consent of the parties and the mediator.

Since mediation is a conflict resolution tool that has long been developed worldwide and is rapidly evolving in Ukraine, having proven its effectiveness and offering a number of advantages over other methods of resolving conflict situations, the implementation of internal mediation procedures within an organization can be an effective mechanism. This may include creating an internal mediation department or engaging external mediators. Such a department can handle the settlement of internal or external disputes before the dispute is submitted to court [2, p. 138]. Such procedures provide employees with the opportunity to turn to a mediator for resolving conflict situations, which should contribute to the optimization of the corporate culture, creating an atmosphere of trust and cooperation in the organization.

Mediation can also be implemented through the introduction of an official mediation program (developing a policy that provides for the use of mediation to resolve labor conflicts and defines the procedures, conditions, and rights of the parties involved in the mediation process), training

employees in mediation skills (providing mediation training for the entire staff, which will make employees more competent in conflict resolution), creating a culture of support for mediation (management support and dissemination of information about the positive impact of mediation), and encouraging employees to use mediation by establishing a system of rewards or recognition for those who successfully use mediation to resolve conflicts. Implementing mediation into the corporate culture is not only a constructive way to resolve conflicts and improve communication but also the creation of an environment where every employee feels heard and valued, where conflicts are transformed into opportunities for growth and innovation, leading to the unity of production interests, improvement of morale and mood, lower staff turnover, and increased work productivity.

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INTERDISCIPLINARY INTEGRATION OF COMPUTER SCIENCE AND PHYSICS BASED ON NEURAL NETWORK TECHNOLOGIES FOR VISUALIZATION AND ANALYSIS OF EXPERIMENTAL DATA IN PROFILED HIGH SCHOOLS

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The development of neural network technologies opens new perspectives for the interdisciplinary integration of school subjects, particularly computer science and physics. The necessity of implementing Deep Learning methods into the practice of physics experiments in profiled high schools is substantiated to improve the quality of visualization, automate processing, and analyze experimental data. Specific examples of applying neural networks in laboratory work are proposed, and a plan for a pedagogical experiment to assess the effectiveness of this approach is presented.

Modern profile-oriented education requires the formation of complex skills and digital competence in students that meet the challenges of Industry 4.0. Traditional methods of conducting physics experiments are often labor-intensive in terms of the manual processing of large data arrays, which reduces the time available for in-depth analysis and limits the possibilities for high-quality visualization of complex processes. There is an urgent need to develop and implement innovative didactic approaches that effectively combine fundamental knowledge in physics with the latest tools of information technology, particularly neural networks.

In the course of the research, the pedagogical expediency of interdisciplinary integration was substantiated, potential scenarios for using Convolutional Neural Networks (CNN) and Recurrent Neural Networks

(RNN) in educational physics experiments were identified, specific methodological recommendations for laboratory work were proposed, and the structure of a pedagogical experiment to verify the methodology's effectiveness was developed.

The interdisciplinary integration of physics and computer science in profiled high schools is not merely desirable but critically necessary for forming a holistic scientific worldview in students and practical skills demanded by the modern technological market. This connection is realized through three main areas: data collection and processing, modeling and visualization, and research automation.

The traditional physics experiment, enriched by computer science, transforms into modern research. Students use digital sensors and microcontrollers (e.g., Arduino, Raspberry Pi), which is a direct implementation of hardware and software. Computer science acts here as a tool for programming data collection (recording temperature, pressure, speed), as well as for its primary processing—sorting, filtering, and statistical analysis. In the context of your article, this connection is deepened by using programming libraries (e.g., Python, NumPy) to work with large data arrays obtained in the physics practical work.

Computer science provides powerful tools for mathematical modeling of complex physical phenomena that are impossible or difficult to reproduce in a school laboratory setting. Students can create computer models of trajectories of motion, wave propagation, and thermal processes, applying knowledge of algorithms and data structures. A key point here is the visualization of results: transforming numerical data into graphs, 3D models, and animations. This allows students to qualitatively interpret physical laws. The application of neural network technologies, as you noted

in the abstract, elevates modeling to the level of automatic pattern recognition (e.g., optical spectra or diffraction patterns), which is the integration of deep learning directly into the physical content.

The deepest level of integration is achieved through the automation of experiments and the introduction of Artificial Intelligence (AI) elements [3]. The physics experiment ceases to be just about manual measurements and becomes a Machine Learning (ML) task. For instance, instead of manually measuring the width of interference fringes, students train a neural network (computer science) to recognize these fringes in an image (optics/physics) and automatically calculate key parameters. Thus, computer science provides the methodology for creating a "smart" assistant in the physics laboratory, teaching students to work with Big Data and apply deep learning algorithms to increase the accuracy and speed of research work. This approach not only reinforces knowledge but also forms the research competence of a new generation [2].

Consequently, computer science transitions from the role of a simple "calculator" to the role of a key methodological tool for scientific research in physics.

Neural Networks (NNs) act as a powerful tool for automating and increasing data processing accuracy. Their application in profile-oriented education allows students not only to take measurements but also to model complex physical phenomena, predict results, and automatically classify experimental data, elevating the educational experiment to a qualitatively new level.

S. Velychko and Yu. Kovalyov consider the idea of automatic recognition of optical spectra using artificial neural networks (ANNs), integrating artificial intelligence into the educational practical work on the

basics of spectral analysis. The main idea is to use ANNs as a powerful modern tool for analyzing data obtained with traditional spectral equipment. The authors pay special attention to the logic of constructing neural network structures oriented towards isolating differential features of optical spectra of various chemical elements. The study involves checking the effectiveness of the proposed structures by training them using the gradient descent method [1].

Specifically, a laboratory work is proposed dedicated to the automatic classification of experimental data on the concrete example of recognizing the optical spectra of helium and neon. This gives students an understanding of the structure and function of the ANN model and its application in studying spectroscopic patterns.

In the context of laboratory work in profiled high schools, it is proposed to integrate NNs as follows:

When studying oscillations and waves in the relevant section, it is expedient to use Recurrent Neural Networks (RNNs) or CNNs for the recognition and classification of audio signals. Students can record sound (e.g., a tuning fork or a string) via the computer's microphone input. The neural network, pre-trained on similar samples, will be able to automatically determine the oscillation frequency, their amplitude, and analyze the decay rate, allowing students to focus on the physical interpretation of the phenomenon rather than routine measurements.

In the Optics section, particularly when studying interference, diffraction, and spectral analysis, the application of Convolutional Neural Networks (CNNs) is especially effective. The NN can be used for the automatic recognition and analysis of complex diffraction patterns (from gratings) or interference fringes (from thin films) in images obtained from a

digital camera. By analyzing the pattern, the neural network is capable of determining the wavelength or the grating period with high accuracy, which is often unattainable using traditional measurement tools. Additionally, NNs can be involved in the automatic classification of spectra (emission or absorption) for the purpose of identifying elements, which is an important element of interdisciplinary integration with chemistry.

Such use of NNs allows a shift from simple result recording to an in-depth analysis of large data arrays, visualization of hidden patterns, and training in the principles of machine vision, significantly enhancing the quality of preparation for future engineers and scientists.

To verify the effectiveness of the proposed methodology, a pedagogical experiment will be conducted, consisting of the following stages:

Preparatory Stage: Educational modules, learning materials, and software based on neural networks are developed. Control (CG) and experimental (EG) groups of students are formed, ensuring identical starting conditions.

Stating Stage: Initial testing is conducted to assess the baseline knowledge of physics and computer science, as well as the level of data processing skills in both groups.

Formative Stage: The control group is taught according to the traditional methodology, while the experimental group is taught using laboratory work integrated with neural network tools for automatic analysis and visualization of experimental data.

Control Stage: Final testing and completion of complex practical tasks are conducted to evaluate the depth of assimilation of physical concepts, and the level of formation of research and digital skills. The results are compared to assess the effectiveness of the implemented methodology.

The proposed interdisciplinary integration of computer science and physics based on neural network technologies is a promising didactic approach for the profiled high school. The use of NNs in the physics experiment allows for the automation of complex calculations and analysis, ensures high-quality visualization of processes, and contributes to the deep assimilation of both physical laws and modern technological tools by students. The implementation of this methodology strengthens the practical orientation of learning and forms critically important skills for working with Big Data.

The outlined theoretical provisions and the proposed methodology form the basis for my master's thesis. At the moment, the master's thesis plan is fully ready, and pilot attempts have already been conducted to apply simple convolutional neural networks for recognizing diffraction patterns. These attempts confirmed the high accuracy and pedagogical expediency of further full-scale implementation.

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SLEEP DISORDERS IN ADOLESCENT AGE

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The theses are devoted to the problem of the peculiarities of sleep disorders in a person in adolescence, as well as to the study of factors affecting the occurrence of sleep disorders in adolescents, in particular, chronotype, sleepiness, character accentuations, stress, and others.

Adolescence is a time when the ability for abstract thinking, analysis, and independent problem-solving forms. However, during this period, the adolescent may feel a strong need to define their identity and find their place in society. The adolescent period is important for identity formation and establishing relationships with peers and adults. At this time, the individual begins to master various roles and skills, as well as the ability to form personal values and a worldview.

Sleep is an integral part of an adolescent's life, representing a special state of the body that occurs regularly and occupies about one-third of their time. Brain structures such as the medulla oblongata, midbrain, pons, and cerebellum perform a number of critically important functions, including the control of sleep and wakefulness [1]. The circadian rhythm determines the cycle of sleep and wakefulness over a day, and the ultradian rhythm, consisting of slow-wave and rapid eye movement (REM) sleep phases, is a sequence of functional brain states [2]. Sleep duration in different people,

including adolescents, can vary. For adolescents aged 13 to 18, the total duration of nocturnal sleep is recommended to be 8 to 10 hours per day [3].

Sleep disorders in adolescents are a common occurrence and can have serious consequences for physical and mental health. The causes of these disorders can be diverse, ranging from changes in schedule and parenting style to stress, fatigue, and physical problems. Delayed Sleep Phase Syndrome occurs due to irregular circadian rhythms and can lead to problems with falling asleep and waking up. Sleepwalking and night terrors are forms of parasomnias and can be caused by various factors, such as insufficient sleep or traumatic events. Diagnosing and treating these disorders can be complex and requires an individualized approach. Physical factors, such as active growth and the menstrual cycle, can negatively affect sleep in adolescents.

An adolescent's chronotype can be associated with the risk of developing sleep problems. The use of medications, internet addiction, and constant use of gadgets can also disrupt sleep. Psychological factors, such as stress, anxiety, and depression, affect the quality and duration of sleep. Repetitive thinking and sleep-related attitudes, social pressure, school demands, weather factors, noise, and unfavorable sleeping conditions can also be causes of sleep problems in adolescents.

Research Methodology

Various methods were chosen to study sleep disorders in adolescents:

H. Schmieschek's Questionnaire Test (adapted for children by E. I. Rogov): A psychological tool designed to identify personality characteristics in children and adolescents. It helps in assessing the level of character accentuations and can be used for the early diagnosis of the risk of mental disorders.

Epworth Sleepiness Scale (ESS): A psychological tool for measuring sleepiness in everyday situations. It is based on how likely one is to fall asleep in various situations, such as watching television, reading, or riding in a vehicle.

Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ): A psychological tool used to determine an individual's chronotype (sleep and wakefulness rhythm). This test helps determine whether a person is more active in the morning (morning lark), in the evening (night owl), or has an intermediate chronotype.

Questionnaire determining the predisposition to stress development (by A. Nimchin and J. Taylor): Designed to determine a person's predisposition to stress development. This tool helps identify which factors or situations can cause stress in a specific person and evaluates the overall stress level they may be experiencing.

The research results revealed the following:

Insomnia symptoms in adolescents strongly correlate with symptoms of other sleep disorders, confirming the idea that insomnia can be both a separate mental disorder and a symptom of other sleep disorders.

Character accentuations such as Anxious, Dysthymic, Pedantic, and Excitatory are closely correlated with sleep disorders of the type Insomnia, night terrors, sleepwalking, and social jetlag.

The Cyclothymic accentuation type correlates with Circadian disorders and cataplexy.

The study also showed that in younger adolescents, disorders such as sleepwalking and night terrors are most often encountered, which corresponds to the age-related distribution of the frequency of occurrence of specific sleep disorders.

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USING ARTIFICIAL INTELLIGENCE TOOLS IN FORMING STUDENTS' KEY COMPETENCIES IN THE PROCESS OF STUDYING PHYSICS AND COMPUTER SCIENCE

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The development of Artificial Intelligence (AI) technologies necessitates a review of traditional methods of teaching physics and computer science in profile-oriented high schools. The expediency of integrating AI tools for forming students' key competencies, particularly digital and research competencies, is substantiated in this abstract. Specific mechanisms for

using generative and adaptive AI models in the educational process are proposed, and the structure of a pedagogical experiment to evaluate the effectiveness of this approach is presented.

The contemporary educational paradigm, focused on the competency-based approach, requires the formation of not only subject knowledge but also readiness for life amidst technological changes in high school students. AI tools are becoming an integral part of professional activity, and thus ignoring them in the educational process leads to educational outcomes lagging behind societal demands. The relevance of the research lies in the need to develop a methodology for the interdisciplinary integration of physics and computer science that utilizes AI to develop students' critical thinking, problem-solving skills, and digital competence.

In the course of the research, the pedagogical expediency of applying AI to form key competencies in profiled high schools was substantiated, and the spectrum of AI tools and their potential functions in studying physics and computer science were defined. Specific scenarios for integrating AI into laboratory work and project activities were also proposed, and the structure of a pedagogical experiment was designed to verify the effectiveness of the proposed methodology.

AI tools act as personal educational assistants that can adapt content, automate routine tasks, and provide instant feedback. As is known from materials, such as the Google report "100 ways to apply AI in education," AI technologies can be used for the automatic generation of tests, personalization of tasks, and analysis of material assimilation levels [1]. In the context of the interdisciplinary integration of physics and computer science, AI is used as a research tool that allows students to transition from

simply assimilating facts to practical work with data and algorithmic thinking [3].

This problem has been actively discussed in the literature in recent years. M. Soroka and V. Shamonya investigate the strategic role of physics and computer science teachers in the formation of information and digital competence (IDC) in students, conducting a comparative analysis of global educational practices. The authors find that physics teachers provide interactive experience for developing critical thinking and applying scientific methods through IT tools, while computer science teachers focus on programming, digital security, and data analysis. The study confirms the complementary role of both educators, reveals significant gaps in IDC, and emphasizes the transformative potential of IT in education [3].

M. Ya. Khomyak researches and develops a methodology for implementing Artificial Intelligence (AI) tools for the personalization of computer science education in general secondary education institutions, substantiating the creation of an adaptive and effective educational environment. The proposed methodology is based on diagnosing students' individual needs through adaptive testing and educational analytics, which allows for the formation of individual educational trajectories and the generation of personalized tasks. Experimental verification confirmed that the use of intelligent learning systems and AI-based chatbots increases learning outcomes, student motivation, and optimizes the computer science teacher's work [4].

The use of Artificial Intelligence (AI) in education opens up significant opportunities but also carries a number of important ethical aspects that require attention. These issues concern fairness, transparency, and the impact of technologies on the subjectivity of the student and teacher. One of

the main challenges is algorithmic bias. If the data on which AI systems are trained (e.g., for adaptive testing or assessment) reflect historical or social inequality, the AI can unintentionally solidify and reinforce discrimination by offering different educational trajectories for various social or gender groups. This directly relates to the fairness and equality of access to quality education. The next critical aspect is confidentiality and data protection. AI systems collect vast amounts of personal data about students' academic performance, behavior, emotional state, and progress. Improper storage, use, or transfer of this sensitive data creates risks for children's privacy and security. There is also the problem of transparency: educational decisions made based on the AI "black box" may be incomprehensible to students, parents, and teachers, undermining trust in the system. Furthermore, the impact on autonomy and skill development must be considered. Excessive reliance on AI for answers or task completion (especially generative AI) can reduce motivation, hinder the development of critical thinking, and inhibit skills in independent information search and processing. The ethical use of AI implies that the technology should be a tool that enhances, rather than replaces, human interaction and cognitive development [2].

Finally, there is the question of the teacher's professional role. Ethical responsibility requires that AI be used to support the educator and optimize their work, not to replace them. Teachers must maintain control over the educational process and have the right to question or correct the recommendations provided by the AI system, ensuring a human-centered approach to learning.

To form digital competence, it is proposed to use generative AI (e.g., text models). Students can apply these models to generate hypotheses or initial texts for scientific reviews in physics. The student's key task becomes

the critical evaluation, editing, and verification of the generated content, which directly develops the skill of working with digital information and its verification.

For forming research competence, it is appropriate to integrate AI for data visualization and analysis into the study of physics. For example, when studying thermodynamics or mechanics, students, using computer science knowledge, can apply neural network models to predict changes in system parameters or optimize a physics experiment, minimizing errors. AI can automatically classify and visualize large data arrays concerning temperature, pressure, and volume in real-time. Additionally, adaptive AI systems can personalize learning routes in physics, automatically offering supplementary problems or explanations for topics where the student demonstrates knowledge gaps.

A specific example of forming students' key competencies through the interdisciplinary integration of physics and computer science can be realized in the project "Optimizing a Heat Exchange Model using Generative AI." This project aims to develop digital competence, critical thinking, and problem-solving skills. In the first stage, within the physics course, students are tasked with modeling the cooling process of a body based on the laws of thermodynamics, specifically the Newton-Richmann law. This requires deep scientific understanding. In the second stage, using a generative AI tool (corresponding to one of the ways AI is applied, as described, for example, in the well-known Google document for education [1]), students enter a technical specification and receive basic program code for modeling. In this process, AI acts as a coding assistant, automating routine parts, which forms digital competence and the ability to interact effectively with advanced technologies in students. In the third, crucial stage, students must critically

analyze the AI-generated code: check its physical correctness and efficiency. They independently make corrections, add functions for result visualization (cooling graphs), and use AI for data analysis. This develops critical thinking and research competence, as students do not blindly trust the technology but substantiate its advantages and disadvantages, completing the cycle of scientific work. Thus, AI acts as a tool that enhances learning, helping students focus on the complex physical essence rather than mechanical coding.

To verify the effectiveness of the proposed methodology, a pedagogical experiment will be conducted, consisting of the following stages:

Preparatory Stage: Development of educational modules that integrate AI tools (accessible code generators, online platforms with AI modeling). Formation of control (CG) and experimental (EG) groups of students.

Stating Stage: Conducting initial testing to assess the baseline level of formation of key competencies (digital, research) in both groups.

Formative Stage: The CG is taught using the traditional methodology, while the EG is taught using laboratory work and projects integrated with AI tools. Emphasis is placed on critical interaction with AI.

Control Stage: Conducting final testing and complex task completion, where students' ability to effectively use AI to solve physics problems and analyze data is assessed.

The application of Artificial Intelligence tools in the process of studying physics and computer science in profiled high schools is an effective mechanism for forming students' key competencies, especially digital and research competencies. The integration of AI allows for the personalization of learning, increases motivation, and teaches students to critically work with the newest technologies, which fully aligns with the research goal.

The outlined theoretical provisions and the proposed methodology form the basis for my master's thesis. At the moment, the master's thesis plan is fully ready, and pilot attempts have already been made to use generative models for creating educational materials and automatically checking their correctness, which confirmed the expediency of a full-scale pedagogical experiment.

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INFLUENCE OF CONFLICTS ON SEXUAL DYNAMICS IN A COUPLE

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Theses analyze the impact of conflicts on sexual relations between partners, with an emphasis on the importance of emotional connection for maintaining a healthy intimate life. Destructive patterns of behavior that lead to conflicts are considered, and effective strategies for solving them are proposed in order to restore closeness and stability in relationships.

Relationships are a complex and multifaceted phenomenon influenced by many factors, including conflict. Sexual dynamics is one of the main elements of a relationship and is often used as an indicator of the overall health of the couple. Conflict, regardless of its origin, can lead to changes in the sexual sphere, which can negatively affect the emotional state of the couple and the quality of their life together [1]. Understanding the impact of conflict on sexual dynamics is important, as it can disrupt the harmony and stability of the relationship, leading to emotional alienation, reduced intimacy, and other negative consequences. Without proper intervention, these processes can have long-term effects on the couple and their environment. Therefore, it is important to identify the mechanisms of conflict and develop strategies to overcome and prevent them. This issue concerns not only researchers but also practical psychologists, family therapists, and other specialists working with couples, as the general level of happiness and well-being depends on the quality of a couple's relationship.

The research of American psychologist John Gottman, one of the leading experts in marital and family psychology, shows that conflict can affect a couple's sexual dynamics in different ways, depending on how it is

resolved. John Gottman identified four patterns of behavior that he called the "Four Horsemen of the Apocalypse": criticism, contempt, stonewalling, and defensiveness. When these factors are present in a relationship, it can lead to emotional alienation, reduced intimacy, and even relationship breakdown. For example, criticism directed at the partner's personality rather than their behavior can harm self-esteem and lead to alienation. Contempt, expressed through sarcasm or humiliating gestures, can create a hostile atmosphere that can negatively affect sexual intimacy. Defensiveness can complicate conflict resolution when partners respond to criticism with excuses or counter-accusations. Gottman emphasizes that if these patterns are not addressed, they can lead to long-term alienation and a loss of sexual interest. He also suggests an alternative approach that includes open communication, empathy, and a willingness to accept mutual mistakes, which can restore emotional connection and improve sexual dynamics in the couple. Gottman proposes strategies such as "softened start-up," where a conflict begins with positive elements, and "repair attempts," which help mitigate tension during conflicts, allowing partners to maintain an emotional connection even in difficult situations. To overcome the negative impact of conflicts on sexual dynamics in a couple, it is necessary to ensure an open dialogue between partners, discuss sexual needs and expectations, and work to strengthen emotional closeness [2].

The emotional connection in a relationship directly affects the sexual dynamic between partners. Gary Chapman, author of The Five Love Languages, states: "Sexual problems almost always start where emotional needs are not met; they have nothing to do with physiology" [3, p. 19]. This indicates that when partners feel emotionally alienated or their emotional needs remain unresolved, it can lead to reduced intimacy and sexual desire.

Conflicts that are not properly resolved, or deficiencies in communication regarding emotional and sexual needs, can have a negative impact on a couple's sexual dynamics. To restore harmony in the relationship, it is necessary to implement effective communication, demonstrate empathy, and work to strengthen the emotional bond. Open dialogue and mutual support allow couples to overcome conflicts and maintain a healthy sexual relationship.

In conclusion, conflicts in relationships can significantly affect sexual dynamics, leading to reduced intimacy and sexual desire. Destructive patterns such as criticism, contempt, stonewalling, and defensiveness can lead to emotional detachment, which exacerbates the negative consequences. To minimize these consequences, it is necessary to implement effective conflict resolution strategies, including "softened start-up" and "repair attempts," which promote open communication, empathy, and mutual support. Strengthening the emotional connection between partners helps maintain a stable sexual dynamic, which positively affects the overall well-being of the couple.

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MODERN APPROACHES TO TEACHING FOREIGN LANGUAGES, LANGUAGES OF NATIONAL MINORITIES, AND INDIGENOUS PEOPLES IN GENERAL SECONDARY EDUCATION INSTITUTIONS

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No school subject demonstrates such a diverse palette of different teaching methods as foreign languages. While the teaching methodology of some subjects remains unchanged for decades, language teachers demonstrate true wonders of ingenuity and creativity in their lessons. Language learning is a complex and comprehensive cognitive process, and if the desired outcome is not professionals who master the language at the "read and write with a dictionary" level, but speakers who are difficult to distinguish from native speakers—because they, too, are language users, albeit of a non-native language—then we need to supplement the classical method of memorizing words and rules with many other techniques. The tighter we connect traditional language material with new knowledge about psychology and neurobiology, the more effective our learning process will be.

Keywords: multilingualism, foreign language learning, audiolingual method, grammar-translation method, natural approach, cooperative language learning, direct method, communicative language teaching, task-

based language teaching, content and language integrated learning, total physical response.

The Growing Importance of Foreign Languages in Modern Education

Nowadays, foreign languages have become "soft skill No. 1" not only for those who link their plans with working abroad but also for entire sectors of science, production, and technology. Language proficiency is becoming a necessity for everyone who wants to keep up with the world. Moreover, the general level of foreign language proficiency has already become the key to the progress of an entire state, an unstated condition for Ukraine's accession to NATO and the EU. Furthermore, this general level contributes to our Victory, helping our defenders master modern standards of military equipment and combat operations. It is no wonder that the enemies were so surprised by the English language textbooks seized in the basements of "Azovstal." After all, those textbooks also share a great deal of credit for every tank burned by a "Javelin." It is quite simple to prove the growing interest in foreign language learning in Ukraine—it is enough to visit any bookstore (online or offline) and find several shelves, or even entire racks, of foreign language literature. Despite the state of war, publishing houses and editorial offices continue to operate, and textbooks and manuals are published in various languages.

And, of course, let's not forget that the early study of languages, started in primary and secondary school, is an important basis for their further mastery and use.

At the same time, we should not forget about schoolchildren whose native language is not Ukrainian. The use of their native language in school allows them to learn effectively, integrate into the general educational process, and also improves their psychological state and confidence.

Schoolchildren who have the opportunity to study in their native language show better success and faster mastery of the state language.

The main difficulty in language learning is the large volume of material that needs not only to be learned but also to be mastered in the right context and immediately put into practice. That is why such a diversity of methodologies and approaches has arisen, which we will consider below.

Key Methodological Approaches to Language Teaching

1. Grammar-Translation Method

This is a traditional teaching approach that favors translation from the native language to the foreign language and vice versa. Students are required to memorize long lists of vocabulary and grammatical forms and rules.

This approach prioritizes accuracy over fluency and typically promotes the development of reading and writing skills rather than speaking skills. A disadvantage of this approach is that it does not prepare students for spontaneous communication. Therefore, classroom activities usually include grammar exercises, vocabulary tests, and the use of new grammatical concepts in standard written assignments.

2. Audiolingual Method

This method was developed as a supplement to the Grammar-Translation Method and began to be applied with the development of technical teaching aids. Lessons are conducted in the target language, as this approach is aimed at developing speaking and listening skills.

Students repeat the teacher's words (aloud or in headphones in a language lab) until they achieve the correct pronunciation.

3. Natural Approach

Adherents of this method rely on the difference between studying (learning) and acquiring (acquisition) a language. In their opinion, studying a language requires structure, textbooks, resources, and memorizing grammatical rules and vocabulary. In contrast, language acquisition only requires the teacher to create a language environment into which the participants of the educational process are immersed.

This approach is intended for beginner students; teachers emphasize interesting, comprehensible input and create low-anxiety situations. Thus, lessons conducted using the Natural Approach focus on understanding messages in the foreign language and give little importance to error correction, drills, or the conscious assimilation of grammatical rules.

4. Cooperative Language Learning (CLL)

Cooperative Language Learning is part of a broader teaching approach known as collaborative or community learning. CLL seeks to maximize collaborative activities involving pairs and small groups of students in the classroom. Thus, this language teaching approach is student-centered rather than teacher-centered.

In a CLL classroom, all language learning activities are specifically designed to maximize opportunities for social interaction. Students must complete tasks by interacting with each other and working together. The teacher in CLL acts as a facilitator and a participant in the completion of learning tasks.

5. Direct Method

In this language teaching method, all instruction takes place in the foreign language, forcing the student to think and speak in it. The student does not use their native language in the classroom at all.

As a result, students process key grammatical concepts by practicing the language and building their experience communicating in it. Standard classroom techniques for this approach include question-and-answer, conversations, reading aloud, written assignments, and student self-correction.

6. Communicative Language Teaching (CLT)

This approach is the most popular model for teaching foreign languages today. This is partly because it aims to place students in a variety of real-life situations where they can learn to use their language skills for communication. The teacher focuses on fluency rather than grammatical and lexical accuracy, and lessons are more practical than theoretical.

CLT is characterized by interactive classroom activities and the use of authentic materials instead of didactic ones (discussing an article from a magazine, not a textbook). Teachers provide students with as many opportunities as possible for meaningful communication. The use of personal experience is also encouraged in CLT.

The CLT method is applied to give students the skills to help them communicate in various circumstances. Thus, it pays less attention to learning grammatical rules and more to the skills of fluency and pronunciation, like native speakers. Students are assessed based on their level of communicative competence, not their level of knowledge. This method emerged in the USA when there was a need for the rapid adaptation of a large number of migrants who urgently needed to start communicating today, not after mastering all the grammatical and lexical subtleties.

After all, the main goal of language learning is communication, and CLT methods involve students in the communication process from the very first

minutes. And only later, with time and experience, does this process become grammatically correct and lexically enriched.

CLT is more like a philosophy than a clearly structured methodology. The goal of the method is to teach communicative competencies.

According to Richards, communicative competence includes the following aspects of language knowledge:

Knowledge of how to use the language for various purposes and tasks.

Knowledge of how to vary the use of language according to the situation and participants (e.g., knowing when to use formal and informal speech or when language use is appropriate for written versus oral communication).

The ability to create and understand different types of texts (e.g., narratives, reports, interviews, conversations, discussions).

The ability to maintain communication despite limitations in language knowledge (e.g., by using various types of communicative strategies) [3, 3].

7. Task-Based Language Teaching (TBLT)

This methodology emerged from CLT and is based on its principles. CLT focuses on language fluency, while TBLT focuses on using language as a tool to complete tasks and encourages problem-solving and critical thinking skills. Students use the language skills they already possess to complete a task.

For example, students might be asked to prepare a presentation on an important social issue. To do this, they will need to find sources, conduct research online, and prepare the presentation itself. Research shows that students in TBLT classes gain more opportunities and motivation because they "own" the language and can control the nature of the response to the task.

David Nunan listed six key elements of this approach:

An approach to content selection based on the needs of the students.

Emphasis on learning to communicate through interaction in the target language.

Implementing authentic texts in the learning situation.

Providing students with the opportunity to focus not only on the language but also on the learning process itself.

Enhancing the influence of the student's personal experience.

Combining language study in the classroom with language use outside the classroom [2, 1].

8. Content and Language Integrated Learning (CLIL)

The CLIL approach involves studying school subjects in combination with the simultaneous study of a foreign language.

Language instruction is built around the requirements of the main subject, not the language. Therefore, it is crucial to ensure that the integration is clear and that students are engaged in it. The CLIL method creates significant opportunities for interdisciplinary work. In CLIL language lessons, teachers teach all material in the target language and focus instruction on a specific subject.

CLIL teachers design tasks that allow students to use the foreign language while working with the subject material. Teachers are encouraged to see themselves as experts in their subject teaching a group of language users, without the need to translate or explain at every stage.

Fluency is more important than accuracy in CLIL lessons, emphasizing that errors are a natural part of language learning.

Lessons within the CLIL methodology are closely linked to real-life scenarios or problems. They typically engage students and increase their

learning motivation; they are focused on language acquisition, rather than forced learning or rote memorization methods.

CLIL materials often feature a large number of visual resources and teaching aids to provide context and clarify meaning. This allows those studying the language at a lower level to access the content of higher-level learning material.

9. Total Physical Response (TPR)

"Total Physical Response" was created by Dr. James J. Asher. It is based on how children learn their native language. Parents give children instructions, and the child physically responds to them. Parents say, "Look at me" or "Give me your hand," and the child performs the action [1, 9]. TPR attempts to replicate this effect in the classroom.

In the classroom, the teacher acts as one of the parents. They begin by uttering a word or phrase and demonstrating the action or movement. Then the teacher gives the command, and all students perform the action.

TPR can be used to teach and practice many things, including verb vocabulary, commands, and instructions.

None of these approaches can be considered "the best," as every student is unique, with their individual abilities and needs. And given that every class consists of many such unique individuals, the teacher often has no other option but to combine these methods, adapting them to the specific context and analyzing their impact according to different students and educational process conditions.

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МАГІЧНЕ МИСЛЕННЯ ЯК ЧИННИК ПСИХОЛОГІЧНОЇ АДАПТАЦІЇ СТУДЕНТСЬКОЇ МОЛОДІ В УМОВАХ ВІЙНИ

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Актуальність проблеми. Сучасний соціокультурний контекст України, що характеризується тривалою військовою агресією, соціальною нестабільністю та економічною кризою, створив безпрецедентні умови для психіки молоді. Неконтрольований стрес – стан, коли індивід не має можливості впливати на джерело загрози або передбачити розвиток подій – став рутинним фоном життя. У таких умовах традиційні механізми психологічного захисту та адаптації часто виявляються неефективними, що призводить до активізації нетрадиційних, зокрема ірраціональних, форм світосприйняття [2].

Особливої уваги в цьому контексті заслуговує магічне мислення – психологічний феномен, який полягає у вірі в існування надприродних причинно-наслідкових зв'язків, здатності думок, слів або символічних дій безпосередньо впливати на фізичну реальність. Парадоксальним є те, що цей феномен набуває значного поширення серед здобувачів вищої освіти – молоді, яка за своїм статусом та навчальною діяльністю має бути орієнтована на раціональність, критичне мислення та наукову картину світу [4].

Здобувачі вищої освіти перебувають на особливому етапі життєвого циклу – ранньої дорослості (за Д. Арнеттом), для якого характерні ідентифікаційна криза, інтенсивне становлення особистості, пошук свого місця у світі та засвоєння професійних компетентностей. Накладення цих нормативних криз на умови макросоціального стресу створює підвищену вразливість і може сприяти пошуку альтернативних, у тому числі магічних, способів відновлення відчуття контролю та безпеки [4].

Мета дослідження полягала у комплексному вивченні впливу магічного мислення на адаптаційні механізми здобувачів вищої освіти в умовах неконтрольованого стресу, а також у виявленні взаємозв'язків між рівнем магічного мислення, тривожністю та типами темпераменту.

Теоретичні засади дослідження. Магічне мислення є багатогранним психологічним феноменом, корені якого сягають у найдавніші шари людської свідомості. У психології магічне мислення визначається як віра в те, що власні думки можуть безпосередньо впливати на зовнішній світ або що мислення про щось еквівалентне виконанню певної дії [6].

З. Фрейд у концепції "омніпотентності думки" розглядав магічне мислення як форму первинного процесу мислення, що керується принципом задоволення [6]. К.Г. Юнг інтерпретував магічні уявлення як проекцію архетипів колективного несвідомого. Ж. Піаже вважав магічне мислення стадією когнітивного розвитку, характерною для доопераційного періоду [9].

Сучасні когнітивні та еволюційні підходи пропонують нове розуміння цього феномену. Д. Канеман у двопроцесній теорії мислення асоціює магічне мислення з інтуїтивною, швидкою Системою 1 [7]. З еволюційної точки зору, магічне мислення можна розглядати як адаптивний механізм, що виник для виживання в непередбачуваному середовищі [11].

Методологія дослідження. Для реалізації поставлених завдань було обрано комплексний підхід, що поєднував теоретичні та емпіричні методи. Емпіричне дослідження базувалося на використанні трьох психодіагностичних методик:

Спеціально розроблений «Опитувальник на магічне мислення», що включав 10 тверджень, орієнтованих на різні аспекти магічного мислення (віра в астрологію, передбачення снами, ритуали, карму тощо). Відповіді оцінювалися за 4-бальною шкалою Лайкерта.

Адаптована «Шкала тривожності Спілбергера», що містила 10 питань для оцінки рівня особистісної та ситуативної тривожності.

Модифікована методика визначення типу темпераменту на основі підходу Г. Айзенка, що включала 20 питань для оцінки екстраверсії/інтроверсії та емоційної стабільності/неврівноваженості.

Вибірку дослідження склали 85 здобувачів вищої освіти віком від 18 до 49 років, переважно мешканці різних регіонів України (Київ,

Черкаси, Суми, Глухів тощо). Вибірка є цілеспрямованою та дозволяє вивчати специфіку явища в умовах соціальної нестабільності.

Для обробки даних застосовувалися методи математико-статистичного аналізу: дескриптивна статистика, кореляційний аналіз за Пірсоном, t-критерій Стьюдента.

Результати та обговорення.

Загальна характеристика рівня магічного мислення. Загальний рівень магічного мислення у вибірці склав M = 24,3 ± 5,1 бала з можливого діапазону від 10 до 40 балів. Розподіл показників має наступну структуру: низький рівень – 18%, середній – 52%, високий – 30% вибірки (рис. 1).

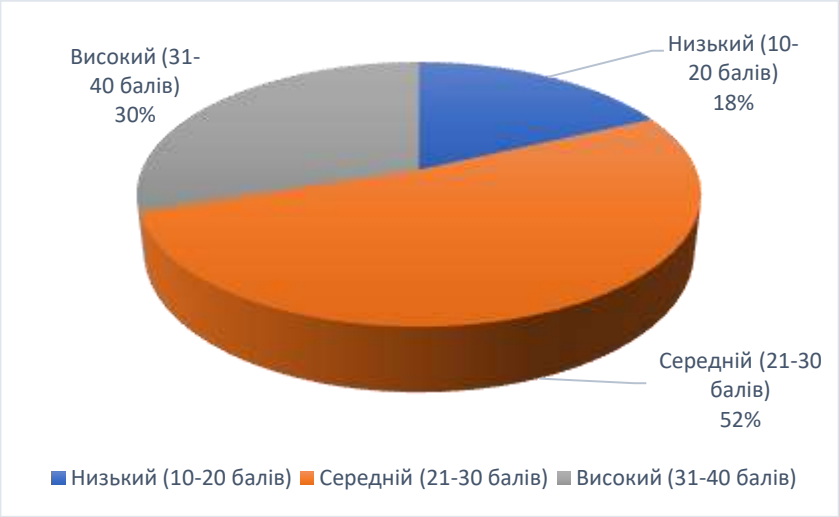

Рис. 1. Розподіл рівнів магічного мислення у вибірки/

Найбільш вираженими аспектами магічного мислення виявилися:

Віра в знаки долі (M = 2,9 ± 0,8)

Переконання про вплив думок на реальність (M = 2,7 ± 0,9)

Віра в екстрасенсорні здібності (M = 2,6 ± 0,9)

Ці дані свідчать про те, що магічне мислення є досить поширеним явищем серед здобувачів вищої освіти, особливо в умовах стресу.

Рівень тривожності. Середній показник тривожності склав M = 28,4 ± 6,2 бала. Розподіл за рівнями: низька тривожність – 12%, середня – 45%, висока – 43%. Високий відсоток осіб з підвищеною тривожністю може бути пов'язаний з загальною соціальною ситуацією в країні.

Взаємозв'язок магічного мислення та тривожності. Кореляційний аналіз виявив помірний позитивний зв'язок між рівнем тривожності та схильністю до магічного мислення ($r = +0,42$, $p < 0,01$). Це підтверджує гіпотезу про компенсаторну функцію магічного мислення в умовах стресу, згідно з якою особи з високою тривожністю демонструють інтенсивніші прояви магічного мислення з метою відновлення відчуття контролю та зменшення невизначеності [12]. Цей результат узгоджується з дослідженнями Уїтсона та Галінскі (2008), які довели, що в умовах втрати контролю індивіди схильні шукати альтернативні способи відновлення відчуття упорядкованості світу.

Вплив темпераменту на магічне мислення. Тип темпераменту суттєво впливає на прояви магічного мислення. Найсильніший зв'язок виявлено з меланхолічним типом ($r = +0,38$, $p < 0,01$) та холеричним типом ($r = +0,31$, $p < 0,05$). Найнижчу схильність демонстрували флегматики ($r = -0,24$, $p < 0,05$) (рис. 2).

Рис. 2. Зв'язок між типом темпераменту та рівнем магічного мислення

Це підтверджує гіпотезу про значний вплив індивідуально-психологічних особливостей на формування ірраціональних переконань. Поєднання інтровертованості та емоційної нестійкості у меланхоліків обумовлює схильність до рефлексії, самоспоглядання та пошуку глибинних смислів у звичайних подіях. Екстравертованість та емоційна нестійкість холериків сприяють імпульсивному пошуку швидких рішень та пояснень.

Типологія сприйнятливості до магічного мислення. На основі отриманих результатів було виділено типологію сприйнятливості до магічного мислення:

«Тривожно-рефлексивний» тип (меланхоліки): найбільш схильні, використовують магічні практики для зменшення внутрішньої напруги, схильні до систематизації магічних уявлень.

«Імпульсивно-пошуковий» тип (холерики): періодичне звернення до магічних практик в стресових ситуаціях, епізодичний характер магічного мислення, прагнення до швидких результатів.

«Соціально-адаптивний» тип (сангвініки): незначна схильність до магічного мислення, соціальна активність як основний механізм адаптації, перевага раціональних стратегій подолання стресу.

«Стабільно-раціональний» тип (флегматики): мінімальна схильність до магічного мислення, перевага раціональних стратегій подолання стресу, внутрішня самодостатність та емоційна стійкість.

Вплив стресових факторів. Особи, які зазнали стресових подій за останні 3 місяці (67% вибірки), демонструють достовірно вищі показники як за тривожністю ($M = 30,2$ vs $24,8$; $p < 0,01$), так і за магічним

мисленням (M = 26,1 vs 21,4; p < 0,01). Це підтверджує роль неконтрольованого стресу як потужного каталізатора ірраціональних переконань.

Гендерні та вікові особливості. Статистично значущі відмінності за t-критерієм Стьюдента показали, що жінки демонструють вищий рівень магічного мислення (M = 25,8) порівняно з чоловіками (M = 21,9; p < 0,05). Найвищі показники магічного мислення спостерігаються у віковій групі 18-22 роки (M = 25,9), що може бути пов'язано з кризою ідентичності та пошуком себе характерним для цього періоду.

Висновки.

Магічне мислення є досить поширеним явищем серед здобувачів вищої освіти, особливо в умовах стресу. 30% вибірки демонструють високий рівень схильності до магічного мислення.

Виявлено статистично значущий позитивний зв'язок між рівнем тривожності та схильністю до магічного мислення (r = +0,42, p < 0,01), що підтверджує його роль як компенсаторного механізму, спрямованого на зменшення негативних емоційних станів у умовах стресу.

Тип темпераменту суттєво впливає на прояви магічного мислення. Найбільш схильними виявилися меланхоліки (r = +0,38) та холерики (r = +0,31), тоді як флегматики демонстрували найнижчу схильність (r = -0,24).

Умови неконтрольованого стресу виступають потужним каталізатором магічного мислення. Особи, які зазнали стресових подій, демонстрували достовірно вищі показники як за тривожністю, так і за магічним мисленням.

На основі отриманих результатів було виділено типологію сприйнятливості до магічного мислення, що включає чотири типи: "тривожно-рефлексивний", "імпульсивно-пошуковий", "соціально-адаптивний" та "стабільно-раціональний".

Практичні рекомендації. З огляду на виявлені закономірності, можна запропонувати наступні заходи психологічної підтримки:

Для осіб «тривожно-рефлексивного» типу (меланхоліки) ефективними будуть методи когнітивно-поведінкової терапії, спрямовані на розвиток раціональних установок та навичок емоційної регуляції.

Для «імпульсивно-пошукового» типу (холерики) важливо навчання стратегіям планування та контролю імпульсів, перенаправлення їхньої енергії в конструктивне русло.

В освітньому процесі необхідно інтенсифікувати розвиток критичного мислення, медіаграмотності та навичок протидії маніпуляціям, особливо в цифровому середовищі.

Розробка програм психологічної підтримки для студентів з підвищеною тривожністю може сприяти зменшенню схильності до дезадаптивних форм магічного мислення.

Отримані результати підтверджують, що магічне мислення у здобувачів вищої освіти в умовах неконтрольованого стресу є складним, багатофакторним явищем, яке виступає не стільки як симптомом незрілості чи патології, скільки як функціональний психологічний механізм адаптації до екстремальних умов. Його активізація детермінована поєднанням високої тривожності, індивідуально-типологічних особливостей (темпераменту) та соціокультурного контексту. Розуміння цих закономірностей є ключем

до розробки ефективних інтервенцій, спрямованих не на боротьбу з магічним мисленням як таким, а на розвиток у молоді більш адаптивних, ресурсних стратегій подолання стресу та відновлення відчуття особистісного контролю в умовах невизначеності.

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EXPLORATION OF SOLITON SOLUTIONS FOR THE KAUP–NEWELL MODEL USING TWO INTEGRATION SCHEMES IN MATHEMATICAL PHYSICS

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The study of nonlinear wave phenomena is fundamental across numerous branches of physics and engineering, with applications spanning from fluid dynamics to fiber optics [1, 10].

A critical component of this research involves identifying exact solutions to nonlinear partial differential equations (NPDEs), which often reveal the presence of stable, localized wave structures known as solitons [2, 7].

These solitons maintain their shape and speed after interacting with other waves, offering profound insight into the mechanics of energy propagation in physical systems [5].

The Kaup–Newell (KN) model is a significant NPDE that falls under the class of nonlinear Schrödinger equations, finding crucial applications in both plasma physics and nonlinear optics. Its capability to accurately describe the behavior of subpicosecond pulses makes it an indispensable tool for analyzing signal propagation in nonlinear optical fibers and understanding wave dynamics in complex plasma environments.

The typical form for the integrable Kaup–Newell equation, describing the evolution of the complex envelope q(x,t), is (though it may vary slightly depending on the specific model context). The (G'/G^2) method is a variation of the fundamental (G'/G)-expansion method, which uses the solution to a second-order linear ordinary differential equation (ODE) to construct solutions to the NPDE. The underlying auxiliary equation is:

$$\frac{d^2G}{d\xi^2} + \lambda\frac{dG}{d\xi} + \mu G = 0, \quad (1)$$

where x_i is the wave variable, λ and μ are constants, and the solution to this ODE.

Analyzing the soliton solutions of the KN model is thus essential for a comprehensive understanding of nonlinear wave behaviors within these diverse physical contexts. The equation itself can be considered a modification of the standard nonlinear Schrödinger equation (NLSE), often involving higher-order dispersion or nonlinear terms, reflecting more complex physical scenarios [5]. In its most common form, the KN equation describes the evolution of a complex envelope function *q(x, t)* and is characterized by a specific coupling between the dispersive and nonlinear terms. This coupling is what makes the KN model integrable and allows for the existence of its characteristic soliton solutions.

In this research, a focus is placed on using novel and robust analytical techniques to derive a rich variety of exact solutions for the Kaup–Newell model. Specifically, the authors employed a new version of the generalized exponential rational function method (GERFM) and the (G'/G^2)-expansion function method. These integration schemes are particularly effective for tackling complex NPDEs by transforming the problem into a solvable system of algebraic equations [4, 9].

The GERFM demonstrates remarkable versatility by yielding a broad spectrum of solutions, including singular, shock, singular periodic, exponential, combo trigonometric, and hyperbolic solutions in mixed forms

In contrast, the $4(G'/G^2)$-expansion function method provides solutions categorized as trigonometric, hyperbolic, and rational.

These distinct solution types reflect the diverse physical behaviors that the KN model can exhibit, from localized traveling waves (hyperbolic solutions, e.g., the solitary wave profile) to complex periodic oscillations or abrupt changes in wave profile (shock and singular solutions).

Furthermore, the study rigorously examined the modulation instability (MI) of the proposed model. Modulation instability is a crucial nonlinear phenomenon where small perturbations in a continuous wave (CW) background grow exponentially, leading to the formation of localized wave structures, such as solitons. Analyzing the conditions under which MI occurs provides a theoretical check on the physical relevance of the derived solutions, ensuring that the analytical results are complemented by an understanding of the solutions' dynamic behavior through numerical simulations.

This dual approach—analytical derivation complemented by numerical validation—ensures that the results are not only accurate but also offer practical insights for future research. The methodologies employed are considered robust and practicable for a wide range of NPDEs, and their specific application to the Kaup–Newell model represents a novel and previously unexplored avenue of investigation. The computational software Maple was used to verify the accuracy of all derived solutions.

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ROBUST CLINICAL QUERYING WITH LOCAL LLMS: LEXICAL CHALLENGES IN NL2SQL AND RETRIEVAL-AUGMENTED QA ON EHRS

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Electronic health records (EHRs) serve as crucial digital repositories for patient data, including histories, results, and medications, enabling data-driven care [1]. However, the intrinsic complexity of EHR data—its vast volume, heterogeneity, and ambiguity—complicates interpretation and the extraction of actionable insights, particularly for nontechnical clinical users [2]. Furthermore, the data are typically housed in relational databases, requiring specialized SQL knowledge for any substantial query. The application of advanced Natural Language Processing (NLP) tools, such as Large Language Models (LLMs), in healthcare is heavily regulated by concerns regarding reliability, safety, and, most critically, data privacy and compliance [3, 4]. These privacy requirements motivate the evaluation and deployment of locally hosted LLMs. This study systematically evaluates nine LLMs across two core clinical NLP workflows: natural language to SQL (NL2SQL) for EHR querying and retrieval-augmented generation for clinical question answering (RAG-QA), with an explicit focus on practical, privacy-preserving deployment strategies.

Nine distinct LLMs were benchmarked, representing a comprehensive cross-section of architectures, including seven open-weight options (DeepSeek V3/V3.1, Llama-3.3-70B, Qwen2.5-32B, Mixtral-8x22B, BioMistral-7B, and GPT-OSS-20B) and two proprietary APIs (GPT-4o and GPT-5) [5]. The NL2SQL task was evaluated on the MIMICSQL benchmark, involving 27,000 generated queries over three experimental runs for each

model, with execution accuracy (EX) serving as the core evaluation metric. The top performance was secured by the proprietary models, with GPT-4o achieving 66.1% EX and GPT-5 closely following at 64.6%. Among the open-weight models, DeepSeek V3.1 was the leader with 59.8% EX, followed by DeepSeek V3 at 58.8%, and Llama-3.3-70B at 54.5%. The domain-adapted BioMistral-7B significantly underperformed, achieving only 11.8% EX, which highlights a substantial and persistent gap between NL2SQL performance in the specialized biomedical domain and results observed in general benchmarks [8]. Even the peak accuracy observed remains insufficient for high-stakes deployment scenarios in clinical settings.

To move beyond simple accuracy reporting, a deterministic SQL error-classification framework (SQL-EC) was introduced to diagnose the precise failure modes of NL2SQL outputs. The errors were categorized into five classes: schema mismatches, aggregation issues, join errors, condition misinterpretations, and string mismatches. Analysis via SQL-EC revealed that string mismatches were overwhelmingly the most frequent cause of failure, accounting for 86.3% of all errors. Query-join misinterpretations were also a significant bottleneck at 49.7%, while incorrect aggregation-function usage was a minor contributor at only 6.7%. This finding strongly indicates that the critical challenge for robust NL2SQL in the biomedical sphere is not the complexity of query logic or aggregation functions, but rather the fundamental issue of lexical/ontology grounding—the inability to correctly map the heterogeneous and often unnormalized terminology of clinical language to the precise string values and schema elements of the underlying relational database [10].

The RAG-QA task was evaluated on a corpus comprising 100 synthetic patient records and 20 clinical questions, generating 54,000 reference–

generation pairs across three runs. Performance metrics included BLEU, ROUGE-L, and BERTScore. While the lexical similarity scores (BLEU and ROUGE-L) fluctuated across models, BERTScore remained consistently high, particularly for DeepSeek V3.1 and GPT-4o, confirming that the privacy-conscious RAG-QA workflow achieves strong semantic fidelity.

Input: (1) Excel file with generated query execution results. (2) Log file with ground-truth and generated SQL queries per natural question
Output: Error classification report with per-model error distributions

Step 1: Load Failed Queries
FailedQueries ← `LoadFailedQueries(`*Excel file*`)`

Step 2: Parse Log File
Cases ← `ParseLogFile(`*Log file, FailedQueries*`)`

Step 3: Classify Errors
foreach *case* ∈ *Cases* **do**
  foreach *LLM generation* ∈ *case* **do**
    GeneratedSQL, TrueSQL ← extract queries
    `// Apply rule-based error classification:`
    if *tables or columns differ* **then**
      add category `(1) SCHEMA_MISMATCH;`
    if *aggregation logic differs* **then**
      add category `(2) INCORRECT_AGGREGATION;`
    if *number of joins or join structure differs* **then**
      add category `(3) JOIN_ERRORS;`
    if *conditions differ in WHERE/HAVING clauses* **then**
      add category `(4) CONDITION_MISINTERPRETATION;`
    if *string literals differ* **then**
      add category `(5) STRING_MISMATCH;`
    if *no pattern matched* **then**
      add category `(0) OTHER;`
    end
    Store (*error_categories, messages*) for this prediction
  end
end

Step 4: Aggregate Results
Summarize queries (total, failed, classified);
For each LLM: accuracy, failures, error distribution;
Compute overall error distribution

Step 5: Save Report
Export case-level results to CSV;
Export summary

Pairwise t-tests confirmed that differences in NL2SQL performance between the top proprietary and open-source models were statistically

significant, but these differences were less pronounced in RAG-QA, supporting the conclusion that retrieval augmentation acts to stabilize performance across diverse LLMs [4]. A cost–performance analysis based on token usage showed per-query costs ranging from USD 0.000285 to USD 0.005918. The analysis concluded that DeepSeek V3.1 offers the most favorable open-source cost–accuracy trade-off, making it highly relevant for resource-constrained health systems [6].

In conclusion, this systematic evaluation confirms the promise of RAG-QA strategies for clinical summarization and question answering tasks, where semantic accuracy is paramount. However, it also clearly demonstrates that clinical NL2SQL remains inherently brittle due to high lexical variation. The SQL-EC framework provides an essential diagnostic tool, pinpointing string mismatches and join errors as the key actionable failure modes. Future work must therefore prioritize ontology-guided normalization, validation modules, and schema-linked prompting to address these persistent lexical and terminological inconsistencies, which is critical for the safe and responsible adoption of LLMs as trustworthy clinical decision support tools.

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PHYTOMEDICINES IN THE COMPLEX TREATMENT AND MEDICAL REHABILITATION OF PATIENTS WITH BRONCHITIS

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Bronchitis is an inflammatory lesion of the bronchial mucosa. The majority of bronchitis cases are caused by viruses (influenza, parainfluenza, adeno-, rhinoviruses, etc.) and bacteria (pneumococci, Haemophilus influenzae, streptococci, and others). Less frequently, the causes of bronchitis include fungi, contact with allergens, or the inhalation of toxic substances. The main mechanism of infection is airborne transmission—the inhalation of infected droplets of saliva during contact with an ill person (while talking, coughing, or sneezing). Due to the action of etiological factors, the bronchial mucosa swells and becomes covered with exudate, which narrows the bronchial lumen; the exudate may even completely block it, causing atelectasis of the lung tissue. The narrowing and closure of the bronchial lumen reduce the respiratory surface of the lungs, leading to shortness of breath and impaired gas exchange.

In the general structure of respiratory viral infections, bronchitis accounts for about 34%. Yet, it remains one of the most mythologized diseases, often stubbornly treated with antibiotics despite contemporary understandings of its nature. The primary causes of acute bronchitis are recognized as adenoviruses, coronaviruses, coxsackieviruses, enteroviruses,

rhinoviruses, influenza viruses, parainfluenza viruses, and respiratory syncytial (RS) virus. The proportion of specific pathogens varies depending on factors such as the presence of an epidemic, the season, and the population's vaccination coverage. Infections caused by parainfluenza, enterovirus, or rhinovirus most often develop in the autumn. Influenza viruses, RS-virus, and coronaviruses are dominant in winter and spring, but influenza viruses are most frequently associated with acute bronchitis.

Clinical signs include a cough, often fever, a sensation of tightness behind the sternum, and a deterioration of general well-being. Auscultation of the lungs may reveal dry or moist rales (wheezing). General symptoms of an infectious disease may occur concurrently. The disease is typically more severe in the elderly and in debilitated individuals.

Main Directions of Bronchitis Treatment

The main directions for treating bronchitis depend on the severity of the disease and involve three primary approaches: etiotropic, pathogenetic, and symptomatic treatment.

1. Etiotropic Treatment

Etiotropic treatment focuses on eliminating the cause of the disease and supporting the body's defenses.

Restoration of Protective Barriers of the Upper Respiratory Tract (URT): This involves clearing the nose, gargling, and administering curative extracts (aqueous or oil-based) into the nose with anti-inflammatory, antihypoxic, and regenerating effects that stimulate local immunity. This is performed every 2–3 hours in the first few days, then 3–4 times daily.

Immunocorrection: This involves several strategies. Stimulating endogenous interferon can be achieved using plant-derived polysaccharides from Kalanchoe juice, coltsfoot leaf, great plantain leaf, or Icelandic moss.

Once the temperature normalizes, adaptogens such as ginseng, Rhodiola rosea, and Eleutherococcus senticosus are used. Replacement therapy involves the administration of interferons or immunoglobulins. Activation of phagocytosis and interleukin production is supported by medicinal plants containing organosilicon acids (like common agrimony, field horsetail, and lungwort) and those rich in polyphenolic complexes (like St. John's wort species, lemon balm, and beggar-ticks). Plants that concentrate zinc (birch leaf, sage leaf, common knotgrass) are also used. Pharmacological agents include Levamisole and thymus preparations (under immunogram control). Vitamins are also an essential part of immunocorrection.

Fighting the Infection: Phytotherapy involves using herbal compositions containing medicinal plants with antimicrobial, antiviral, and antifungal actions. If phytotherapy shows no results by the 3rd or 4th day, broad-spectrum antibacterial drugs should be administered. In severe cases, broad-spectrum antibacterial drugs are started immediately in the first week, followed by the selection of an optimal drug based on bacteriological test results.

2. Pathogenetic Treatment

Pathogenetic treatment addresses the mechanisms by which the disease develops.

Restoration of Bronchial Drainage Function: Early use of drugs derived from medicinal plants (such as common valerian, heath speedwell, Icelandic moss, and common flax) is beneficial. Acetylcysteine inhalation is used initially, followed by phytotherapy once improvement is noted. This includes mucolytics like inhalations with essential oils and aqueous extracts from plants containing phytoncides, or drugs like ambroxol, bromhexine, or

carbocysteine. Expectorants with a reflex action, such as preparations from wild rosemary, ipecacuanha, Oxycoccus microcarpus (bog cranberry), and Thermopsis lanceolata, are also used.

Anti-inflammatory Therapy: For phytotherapy, medicinal plants such as warty birch leaf, elecampane rhizome and roots, St. John's wort herb, chamomile flower, sage leaf, calendula flower, and coltsfoot leaf are recommended. For pharmacotherapy, nonsteroidal anti-inflammatory drugs (NSAIDs) such as acetylsalicylic acid or mefenamic acid are used for 1–2 days.

Elimination of Hypoxia: This requires synthetic and plant-based antihypoxants and antioxidants.

Detoxification Therapy: This involves consuming a large amount of drinking fluid, using intestinal sorbents (like Enterodesis or Sorbogel), and infusion therapy.

3. Symptomatic Treatment

Symptomatic treatment alleviates uncomfortable symptoms.

Oxygen Therapy: This includes oxygen cocktails and oxygen therapy in an oxygen chamber.

Cardiotonic Agents: Various species of hawthorn and Adonis vernalis are used. Parenteral administration of analeptics like Nikethamide (Cordiamine) and Sulfocamphocaine may be necessary.

Antipyretics: Medicinal plants such as linden flower, chamomile flower, and cornflower flower are used, alongside non-medicinal fever-reducing procedures. If the effect is insufficient, analgesics and antipyretics, such as paracetamol, are administered.

Sleep Normalization: Phytopreparations with a sedative-hypnotic effect are used.

Herbal Formulas for Bronchitis and Broncho-bronchiolitis

The following sections list specific herbal formulas used for different presentations of bronchitis and associated conditions, specifying the constituent herbs by common and Latin names, their proportion in the blend, and the recommended method of consumption.

For Acute and Chronic Bronchitis, Pulmonary Emphysema, and Pneumonia:

The formula combines Marshmallow Root (Althaeae radix, 40.0), Licorice Root (Liguiritiae radix, 25.0), Coltsfoot Leaf (Tussilago farfarae folium, 20.0), and Fennel Fruit (Foeniculi vulgaris fructus, 15.0). This blend is taken as a warm infusion or decoction, 1/3–1/4 of a glass, 3–5 times daily.

For Dry Bronchitis:

A complex blend for dry cough includes Wild Rosemary Herb (Ledi Palustris herba, 10.0), Coltsfoot Leaf (Tussilago farfarae folium, 10.0), Wild Pansy (Violae herba cum flore, 10.0), Great Plantain Leaf (Plantaginis majoris folium, 10.0), Chamomile Flower (Matricariae flos, 10.0), Spring Primrose Herb and Root (Primulae herba et radicis, 10.0), Anise Fruit (Anisi fructus, 10.0), Marshmallow Root (Althaeae radix, 20.0), and Licorice Root (Liguiritiae radix, 10.0). It is consumed as an infusion or decoction, 1/3 of a glass, 3 times a day after meals.

For Moist Bronchitis:

This formula focuses on expectorant and antiseptic actions, combining Elecampane Root (Inulae helenium radix, 10.0), Anise Fruit (Anisi fructus, 10.0), Pine Buds (Pini sylvestris gemmae, 15.0), Calendula Flower (Calendulae flos, 10.0), Sage Leaf (Salviae officinalis folium, 10.0),

Peppermint Leaf (Menthae piperitae folium, 10.0), Coltsfoot Leaf (Tussilago farfarae folium, 10.0), Wild Pansy (Violae herba cum flore, 10.0), and Eucalyptus Leaf (Eucalyptis viminalis folium, 15.0). The infusion or decoction is taken at 1/3–1/4 of a glass, 3 times daily.

For Broncho-Bronchiolitis:

Several formulas are cited for this condition. One involves Sage Leaf (20.0), Thyme Herb (15.0), Chamomile Flower (15.0), Jacob's Ladder Root (15.0), Anise Fruit (15.0), Coltsfoot Leaf (10.0), and Calendula Flower (10.0). Dosage is 1/3–1/4 of a glass of infusion 3–4 times a day after meals.

Another formula for this condition is a simple mix of Marshmallow Root (50.0) and Thyme Herb (50.0), taken as an infusion at 1/3–1/4 of a glass, 3 times a day.

A third formula uses Pine Buds (40.0), Great Plantain Leaf (30.0), and Coltsfoot Leaf (30.0), consumed as a warm infusion at 1/3–1/4 of a glass, 3 times daily.

Further formulas for general respiratory support include:

Anise Fruit (30.0), Fennel Fruit (30.0), Flax Seed (20.0), and Thyme Herb (20.0).

Anise Fruit (20.0), Fennel Fruit (20.0), Thyme Herb (20.0), Licorice Root (20.0), and Pine Buds (20.0).

Thyme Herb (20.0), Coltsfoot Leaf (20.0), Wild Pansy (20.0), Elecampane Root (20.0), and Anise Fruit (20.0).

Marshmallow Root (40.0), Coltsfoot Leaf (40.0), and Oregano Herb (20.0), taken at 0.5 glass 3–4 times a day.

Great Plantain Leaf (30.0), Licorice Root (30.0), and Coltsfoot Leaf (40.0), taken at 0.5 glass every 3 hours.

Other combinations involve Marshmallow Root, Licorice Root, Anise Fruit, Sage Leaf, and Pine Buds; Marshmallow Root, Licorice Root, and Fennel Fruit; Sage Leaf, Anise Fruit, Pine Buds, Marshmallow Root, and Licorice Root; Coltsfoot Leaf, Anise Fruit, Marshmallow Root, and Licorice Root; Marshmallow Root, Licorice Root, and Elecampane Root; and Anise Fruit, Marshmallow Root, and Licorice Root. All are generally administered as infusions or decoctions multiple times per day.

Tonic and Complex Adaptogenic Blend

One final, complex formula provides tonic and adaptogenic support, combining Licorice Root (10.0), Beggar-Ticks Herb (10.0), Manchurian Aralia Root (10.0), Horsetail Stems (10.0), Rosehip Fruit (10.0), Helichrysum Flower (10.0), Elecampane Root (10.0), Alder Fruit (10.0), Dandelion Root (10.0), and Burdock Root (10.0). This preparation is taken as an infusion at 1/3–1/4 of a glass, 3 times a day after meals.

Another blend for general support includes Pine Buds (15.0), Birch Buds (10.0), St. John's Wort Herb (18.0), Wild Pansy (12.0), Licorice Root (16.0), Wild Rosemary Herb (19.0), and Thyme Herb (10.0), taken at 1/3–1/2 of a glass 3 times a day.

These formulas demonstrate the rich tradition of using specific plant combinations to address the multi-faceted nature of bronchitis, offering support for inflammation, mucus clearance, and immune function.

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GENERAL ISSUES OF BIOPOLYMER APPLICATION IN RESTORATIVE DENTISTRY

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Introduction. The possibility of using polymers in medicine is determined by the presence of properties such as non-toxicity, biological inertness, the ability to withstand sterilization, the absence of sensitizing, carcinogenic, mutagenic, or other effects, and in some cases, biocompatibility and physiological activity.

Biomaterials can be natural or synthetic. Dental biomaterials are specifically developed for use in dentistry to restore, replace, or enhance tooth structures and adjacent tissues. They can be classified as: anticaries, antigingivitis, anti-dental (presumably anti-plaque/calculus), whitening, and desensitizing.

Biomaterials can have an artificial origin (metals, ceramics, polymers) or a biological origin (collagen, chitin, etc.). Depending on the nature of the artificial material from which the implant is made, they are classified into: ceramic, metallic, polymeric, or composite materials.

Goal. To highlight the general issues of biopolymer application in dentistry.

Materials and Methods. Review, bibliosemantic, summarizing.

Results and Discussion. A dental biomaterial is a biological material (chitin, silicone, collagen, etc.) or an artificial material (metals, ceramics, or polymers) that is used to manufacture units, parts, and devices.

Materials currently used for tooth filling must possess high strength, durability, good adhesion, and be biocompatible.

The first polymer filling materials (40s–50s of the 20th century) were produced based on acrylic copolymers. They were called "self-curing" plastics or "cold" curing plastics and represented powder–liquid systems (these plastics include: Noracryl-65, Stellon, Portex, Noracryl-100, Redont, Remont-02, Protacryl, Protacryl-M, and others). These materials are still used today for prosthesis repair and for auxiliary purposes.

The next stage in the creation of filling materials is characterized by the development of epoxy-acrylic copolymers—products of the esterification of epoxy oligomers. Filling materials under the names Acryloxid and Carbodent are produced based on them.

Later, composite filling materials were developed in the form of a paste–paste system, containing up to 70–75% of a mineral filler, which allows for a reduction in the content of residual monomer.

By the early 1970s, all restorative dental materials were self-polymerizing. They were supplied as two-component systems: "powder–liquid" or "paste–paste." Newer composite materials are hybrid composites, which contain two types of inorganic fillers: microparticles allow for good material polishing, and macroparticles allow for high load bearing and ensure strength.

Copolymer cements are primarily made from polyacrylic acid and inorganic fillers such as zinc oxide, calcium, magnesium, and aluminofluorosilicate glass. They are used as liners, dental adhesives for crown fixation, and as temporary fillings. They have high adhesion to tooth tissues but low mechanical strength. Copolymer cements based on polyacrylic acid possess an optimal complex of properties.

Currently, glass-ionomer cements, which are a hybrid of organic and inorganic substances, are widely used in restorative dentistry and as filling materials. They contain aluminosilicates—ground glass.

Filling materials based on acrylic copolymers are produced as a "powder–liquid" kit. The liquid component contains a mixture of acrylic monomers, a polymerization activator, a polymerization inhibitor, and, in some cases, a cross-linking agent. Plasticizers are introduced into the composition to impart elasticity and increased resistance to the polymers. Dioctyl phthalate, dibutyl phthalate, and low-molecular-weight polyesters are most frequently used.

Dyes and pigments are introduced into the composition to give the polymers color and shades that resemble the color of natural tissues. One of the new directions in the development of composite materials is the use of bioactive fillers that ensure the creation of a bond between the body tissue and the composite material.

Currently, composites that polymerize under the influence of ultraviolet light are practically not used, as light-curing materials have appeared. In light-curing composites, the process of polymerization and hardening occurs under the influence of halogen lamps. The composition of these materials includes a photoinitiator which decomposes into radicals under the influence of light, carrying out the polymerization process.

The improvement of the working characteristics and physical properties of composites is mainly achieved by changing the main parameters: the concentration and size of the filler particles. The filler is not subject to shrinkage, but one of the most important characteristics of the composite, namely the magnitude of polymerization shrinkage, directly depends on its concentration.

Fibrous polymers (e.g., Flexi Nylon) are increasingly used in the manufacture of flexible prostheses. Fibrous polymers have optimal elasticity and strength, which allows for the manufacture of prostheses without metal clasps. They cause fewer allergic reactions in patients than acrylic or vinyl polymers.

However, despite the development of technologies associated with PVC plastics and nylon, acrylic plastics will remain in demand by dentists for a long time. Such plastics are time-tested and have proven their reliability.

Conclusion. Polymer materials for medical purposes and products made from them must meet higher requirements for quality and purity. Their production and processing must be carried out under special conditions and under stricter control than in the case of manufacturing polymer materials for general-purpose products. A necessary condition for the creation of materials and products harmless to the body is the removal to the required degree of purification of harmful substances (carcinogens, allergens, substances with high acute or long-term toxicity) that can penetrate into surrounding tissues.

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SEPARATING 2-PROPANOL AND WATER: A COMPARATIVE STUDY OF EXTRACTIVE DISTILLATION, SALTING-OUT, AND EXTRACTION

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This experimental study compared extractive distillation (ED), liquid-liquid extraction (LLE), and salting-out methods to address the difficult and costly separation of the 2-propanol–water azeotrope, aiming to provide practical confirmation often missing from modeling literature. Critically, none of the four ED entrainers tested were able to surpass the azeotropic composition threshold in the limited experimental setup.

For LLE, four novel hydrophobic deep eutectic solvents were screened, with those based on menthol or thymol with decanoic acid identified as the most promising. The most successful approach was salting-out, where, out of sixteen tested agents, five induced phase separation, and sodium carbonate emerged as the best candidate among the four effective inorganic salts for promoting 2-propanol separation. Product purity across all successful methods was verified using FTIR and 1H-NMR, and the overall experimental results showed only moderate success when compared to COSMO-RS model predictions.

The research experimentally tested various methods—extractive distillation (ed), liquid-liquid extraction (lle), and salting-out—for separating the challenging ipa-water azeotrope.

For extractive distillation, the experimental results were poor: none of the tested entrainers, including two conventional solvents (glycerol and ethylene glycol) and two hydrophilic deep eutectic solvents (dess), were able to push the system beyond the azeotropic point in the limited experimental setup.

Initial COSMO-RS model predictions for ed suggested that the pure conventional solvents were virtually ineffective, but both dess were predicted to significantly facilitate separation by favoring ipa in the vapor phase, with effectiveness increasing as des amount increased.

In contrast to ed's poor experimental showing, the salting-out method was more successful in inducing the necessary phase change. Out of sixteen agents tested, sodium carbonate emerged as the most promising candidate for promoting 2-propanol separation.

For liquid-liquid extraction using hydrophobic solvents, the dess based on menthol or thymol with decanoic acid were found to be the most promising extraction media.

Overall, the experimental findings for the various techniques showed only moderate agreement with the COSMO-RS model predictions.

This article studied the separation of ipa-water mixtures using dess for extractive distillation and liquid-liquid extraction, alongside various solid compounds for salting-out. Simple distillation and extraction experiments were performed and compared against the COSMO-RS model predictions.

In extractive distillation, neither pure multivalent alcohols like ethylene glycol nor glycerol affected relative volatility, contradicting their reputation as efficient entrainers. Although dess slightly increased separation efficiency, they were ultimately ineffective for ipa-water separation in the tested setup.

Regarding liquid-liquid extraction, four hydrophobic DESS were tested. The thermodynamic model successfully predicted the general phase diagrams but failed to predict the correct order of des efficiencies. The extracted phases were richer in IPA, and nuclear magnetic resonance confirmed the dess did not contaminate the raffinate phases. Issues like extractant reusability and downstream separation remain unsolved.

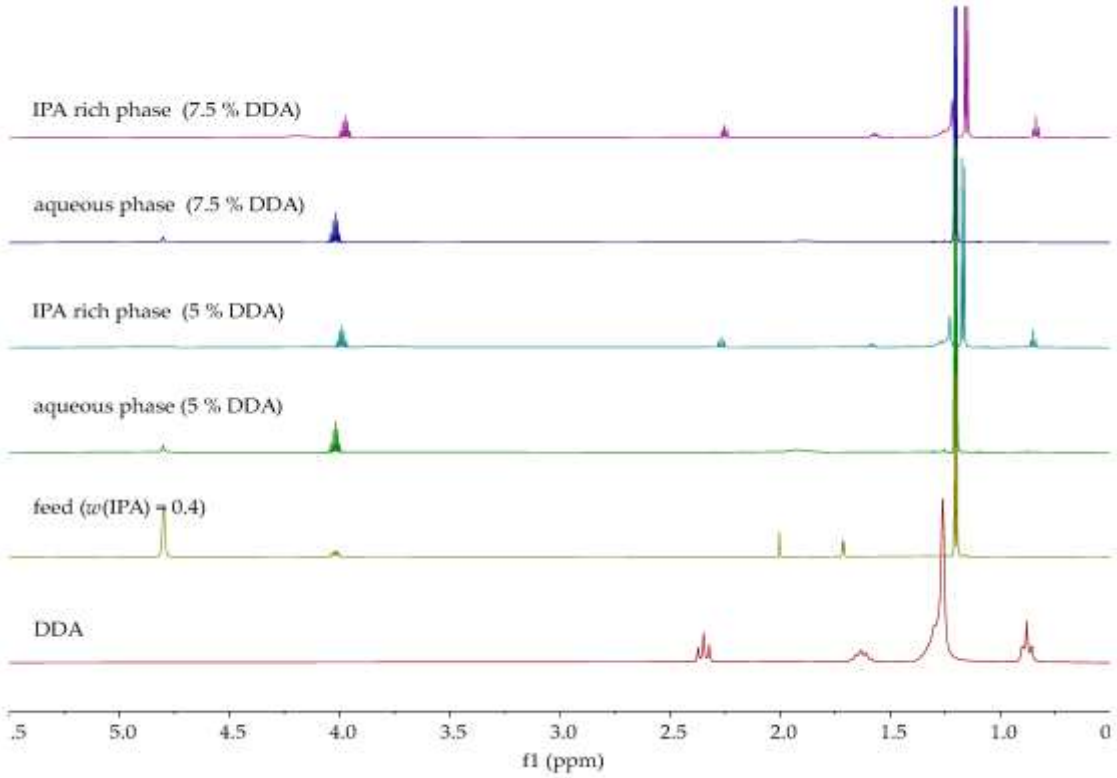

Fig 2. ^{1}H NMR spectra of feed, dodecanoic acid (DDA), aqueous, and 2-propanol (IPA)-rich phases

In salting-out experiments, sixteen candidates were tested. The COSMO-RS model predictions for inorganic salts did not align with experimental results, likely due to inadequate modeling of ion hydration. Five agents induced liquid-liquid phase separation. Among the four effective inorganic salts, sodium carbonate was found to be the best candidate, a conclusion supported by the model. The compositions of the

separated phases were confirmed using infrared and nuclear magnetic resonance analysis.

The potential for using DESS in industrial processes is still unproven, particularly concerning their long-term stability and environmental impact. Further research into different hydrophilic and hydrophobic des combinations is needed to find better separation methods.

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ПРОБЛЕМИ ВИКОРИСТАННЯ БОБОВОЇ СИРОВИНИ В НАТИВНОМУ ВИГЛЯДІ У ХАРЧОВІЙ ПРОМИСЛОВОСТІ

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Бобові — це критично важливе джерело харчування для мільярдів людей, особливо у країнах, що розвиваються. Вони є основним продуктом харчування, часто вживаються в комбінації зі злаками, завдяки високому вмісту білка, мінеральних речовин, вітамінів та фітохімічних речовин. Їхня значущість підкреслюється низьким глікемічним індексом, що робить їх ключовим елементом раціону для значної частини світового населення. [1]

В нативному насінні сої містяться антинутрієнти, зокрема інгібітори протеолітичних ферментів, такі як інгібітор трипсину та гемаглютеніни. Їхній вміст може сягати 6.7-8.4% від загальної кількості білка. Ці сполуки можуть знижувати засвоюваність поживних речовин, однак їхня активність значно зменшується під час термічної обробки, що є важливим технологічним етапом у виробництві соєвих продуктів.

Наявність значної кількості антипоживних факторів у бобових культурах, таких як дубильні речовини, фітинова кислота та лектини, інібіторипротеаз та інгібітори α – амілаз ставить під сумнів їхню поживну якість. Антипоживні фактори насіння гороху спричинені

здатністю утворювати нерозчинні комплекси з мінеральними речовинами, такими як мідь, залізо та цинк, що суттєво знижує їх біодоступність у шлунково-кишковому тракті (ШКТ).

Фітинова кислота зазвичай вважається антипоживним фактором у нативній бобовій сировині. Це пов’язано з утворенням нерозчинних комплексів з мінеральними речовинами (наприклад, міддю, залізом і цинком), що призводить до зниження їх засвоєння людиною. Деякі методи обробки, такі як замочування, смаження, кип’ятіння, варіння під тиском і пророщування, є ефективними для зниження антипоживних факторів, і комбіноване застосування замочування, смаження та приготування під тиском може бути найефективнішим вибором для зменшення вмісту фітинової кислоти

Також у нативному насінні бобових присутні у значній кількості рівень лектинів, які також мають антипоживні фактори. Вони стійкі до дії травних ферментів і можуть зв'язуватися з клітинами, які вистилають травний тракт. Це призводить до ускладнення засвоєння поживних речовин. Лектини можуть перешкоджати повноцінному засвоєнню білків і мінеральних речовин, що знижує біологічну цінність насіння. [2]

З іншого боку, горох також містить інгібітори трипсину, які, очевидно, можуть впливати на активність трипсину та хімотрипсину, а також на подальше перетравлення білка в живих організмах.

Способи зменшення проблем: Замочування: Зменшує вміст фітинової кислоти та лектинів. Пророщування: Збільшує вміст вітамінів і мінеральних речовин, а також покращує засвоюваність білка. Термічна обробка: Руйнує інгібітори трипсину та пом'якшує текстуру бобової сировини. Ферментація: Покращує засвоюваність поживних

речовин і надає бобовій сировині більш приємного смаку. Використання цих методів обробки може зробити бобове насіння більш придатним для широкого застосування в харчовій галузі. ·

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GUIDELINES FOR THE USE AND INTERPRETATION OF ASSAYS FOR MONITORING AUTOPHAGY

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The field of autophagy research has seen rapid growth since the initial guidelines for standardizing research were first published in 2008 [1]. Given the expansion of knowledge and the development of new technologies, regular updates to these guidelines are essential for investigators monitoring

autophagy across different organisms [2]. A persistent challenge remains the confusion surrounding acceptable and reliable methods for evaluating this process, particularly in multicellular eukaryotes.

This review presents a critical discussion of current methods, aiming to assist investigators in selecting and interpreting assays and to help reviewers provide fair critiques of relevant reports. It is important to note that these guidelines are not intended to be a fixed set of rules, as the suitability of any assay depends entirely on the specific scientific question and the biological system under study. No single assay is universally perfect, which necessitates the use of multiple techniques to properly monitor the autophagic process in any given experimental setting.

Moreover, because core components of the autophagy machinery have roles in distinct autophagic processes—both canonical and noncanonical—genetic approaches to block the pathway should ideally involve targeting two or more autophagy-related genes that function at different steps. Similarly, many proteins involved in autophagy also regulate other cellular pathways, such as apoptosis, meaning not all of them can be used as specific markers for a true autophagic response. Our ultimate goal is to foster intellectual and technical innovation within the field.

Methods for Monitoring Autophagy

Autophagy was first detected using transmission electron microscopy (TEM) in the 1950s, observed initially as the focal degradation of cytoplasm by lysosomes [1]. Later work confirmed that autophagy begins with the sequestration of cytoplasmic portions by a double-membrane structure called the phagophore, which then matures into the double-membrane autophagosome. Subsequent fusion events with the lysosome, or the vacuole in fungi and plants, expose the sequestered cargo to enzymatic breakdown.

The importance of TEM lies in its capacity to reveal the morphology of autophagic structures at nanometer resolution, allowing for their exact identification within their natural cellular environment [2]. TEM can monitor both selective and nonselective autophagy. Selective autophagy targets a specific substrate, largely excluding bulk cytoplasm, while nonselective autophagy sequesters disposable cytoplasmic components. While sequestration of very large structures is rare, giant autophagosomes capable of engulfing an entire nucleus have been observed under special circumstances.

In plant cells, structures called provacuoles resemble phagophores but form independently of autophagy [3]. Therefore, when using TEM to detect autophagosomes in plant cells, comparison with an appropriate autophagy-deficient control sample is mandatory.

After sequestration, the contents and the bordering double membrane of the autophagosome remain morphologically unchanged for a period of time. Degradation of the sequestered material begins within the amphisome and the autolysosome following fusion with a late endosome and lysosome, respectively [3]. The sequential morphological changes are continuous and dynamic, which makes discrete classification problematic. For general purposes, the term autophagic vacuole can be used when it is difficult or unnecessary to differentiate between the autophagosomal, amphisomal, and autolysosomal stages. In complex eukaryotic cells, the use of autophagic vacuole is strongly recommended.

Autophagosomes, also called initial autophagic vacuoles, typically show a distinct double membrane visible by TEM [4]. The amphisome may be identified by small intralumenal vesicles. Late or degradative autophagic vacuoles, the autolysosomes, typically possess only a single limiting

membrane and often contain electron-dense, partially degraded cytoplasmic material. These degradative compartments are often difficult to distinguish from late endosomes or lysosomes even for experts [1]. A simple solution is to group all dark-staining structures as degradative compartments; an increase in these structures per cell area indicates enhanced degradation [4].

Unequivocal identification of lysosomes requires immuno-electron microscopy to detect a cathepsin or other lysosomal hydrolase on the limiting membrane. Structural proteins such as lamp1, lamp2, or scarb2/limp-2 can also be used for confirmation. No single protein marker is sufficient to discriminate autolysosomes due to the dynamic fusion and component interchange with other organelles. Rigorous confirmation requires demonstrating the colocalization of a second marker, such as an autophagic substrate like LC3 and CTSD, or confirmation of acidification.

The sequential destruction of cytoplasmic cargo is a key feature for identifying autolysosomes. Degradation progresses from recognizable organelles to vacuoles with heterogeneous density, eventually becoming amorphous and electron dense. In pathological states, it is possible to see double-membrane autophagosomes containing partially digested amorphous substrate, which may result from active autophagy of damaged lysosomes, known as lysophagy. Alternatively, inhibiting the fusion of autophagosomes and lysosomes using bafilomycin a1 allows for the visualization and quantification of cargos being actively sequestered during a short chase period [4].

It must be emphasized that other processes—such as endosomal, phagosomal, and chaperone-mediated mechanisms—also transport cargo to lysosomes [3]. The formation of an amphisome through the direct fusion of an endosome with an autophagosome is particularly common in neuronal

axons. Therefore, a lytic compartment may contain cargos from multiple sources; however, the term autolysosome may still be used if the content is overwhelmingly autophagic. The engulfment of dying cells via phagocytosis also produces lysosomes containing cytoplasmic structures, which necessitates considering an extracellular origin in settings where apoptotic cell death is expected.

For many situations, examining both early and late autophagic vacuoles provides valuable data on overall autophagy status [2]. Immunocytochemistry targeting cytosolic proteins like SOD1 or CA can help determine the stage of autophagy.

In some autophagy-inducing conditions, multi-lamellar membrane structures are observed alongside conventional autophagosomes. These may be multiple double layers of phagophores, autolysosomes, or fixation artifacts. They must be distinguished from myelin or surfactant. Such multi-lamellar bodies are typical in lysosomal storage diseases and in cells treated with inhibitors U18666Aor chloroquine [3].

Special features can be clarified by immuno-TEM with gold-labeling [4], using antibodies against cargo proteins and LC3 to confirm the autophagic nature of the compartment. Immuno-TEM also helped identify the autophagoproteasome, which consists of LC3-positive autophagosomes costaining for components of the ubiquitin-proteasome system (UPS). This suggests that both autophagic and UPS activities may occur within the same organelle. In plants, ATG8 can be labeled using anti-GFP antibodies for GFP}-\text{ATG8 fusion proteins [3].

Despite the challenges of labeling LC3, its increasing commercial availability makes it a key tool. However, it is vital to remember that LC3 can be associated with nonautophagic structures, and LC3 puncta can

appear in autophagy-deficient cells. LC3 is involved in specialized endocytosis like LC3-associated phagocytosis and can also decorate vesicles involved in nonconventional secretion systems. The success of immuno-TEM depends on high-quality antibodies and proper sample preparation. Authors must provide quantitative controls to demonstrate labeling specificity over different cellular compartments [4].

TEM is an extremely informative and powerful method, providing unparalleled subcellular resolution in a complex cellular environment. Its successful application relies on the accurate identification of autophagic structures, which is necessary for reliable quantitative results via morphometry. Ultimately, electron microscopy is best used in combination with other methods to ensure the complex and holistic approach that is now essential for progress in autophagy research.

Atg8 and the Atg8-family proteins are the most commonly monitored autophagy-related proteins, utilized in multiple assays.

Western Blotting and Ubiquitin-like Protein Conjugation Systems

Atg8 is a ubiquitin-like protein conjugated to phosphatidylethanolamine (pe) [2]. In yeast, this is referred to as Atg8-PE. Mammalian homologs belong to two major subfamilies: MAP1LC3/LC3 and GABARAP. The LC3 subfamily includes LC3A, LC3B, LC3B2, and LC3C, while the GABARAP family includes GABARAP, GABARAPL1, and GABARAPL2/GATE-16 [3]. After cleavage by the protease ATG4B [4], the proteins exist in an unprocessed form (LC3-I) and a pe-conjugated form (LC3-II).

The pe-conjugated form, despite being larger, exhibits faster electrophoretic mobility on sds-page gels due to increased hydrophobicity. The positions of both LC3-I (unconjugated, approximately 16 to 18

kilodaltons) and LC3-II (conjugated, approximately 14 to 16 kilodaltons) must be indicated on western blots. It is critical to specify the isoform being analyzed due to functional and tissue-specific differences; for example, some evidence suggests the LC3 subfamily may be dispensable for bulk autophagy in certain cells, while the GABARAP subfamily is absolutely required [3]. Pink1-prkn-dependent mitophagy heavily relies on the GABARAP subfamily with minimal need for LC3.

LC3 is the primary Atg8-family homolog examined in mammalian cells and is commonly characterized as an autophagosome marker. LC3 is synthesized as proLC3, converted to LC3-I, and finally modified into LC3-II. Atg8-PE/LC3-II is the only protein marker reliably associated with completed autophagosomes, although it is also found on phagophores.

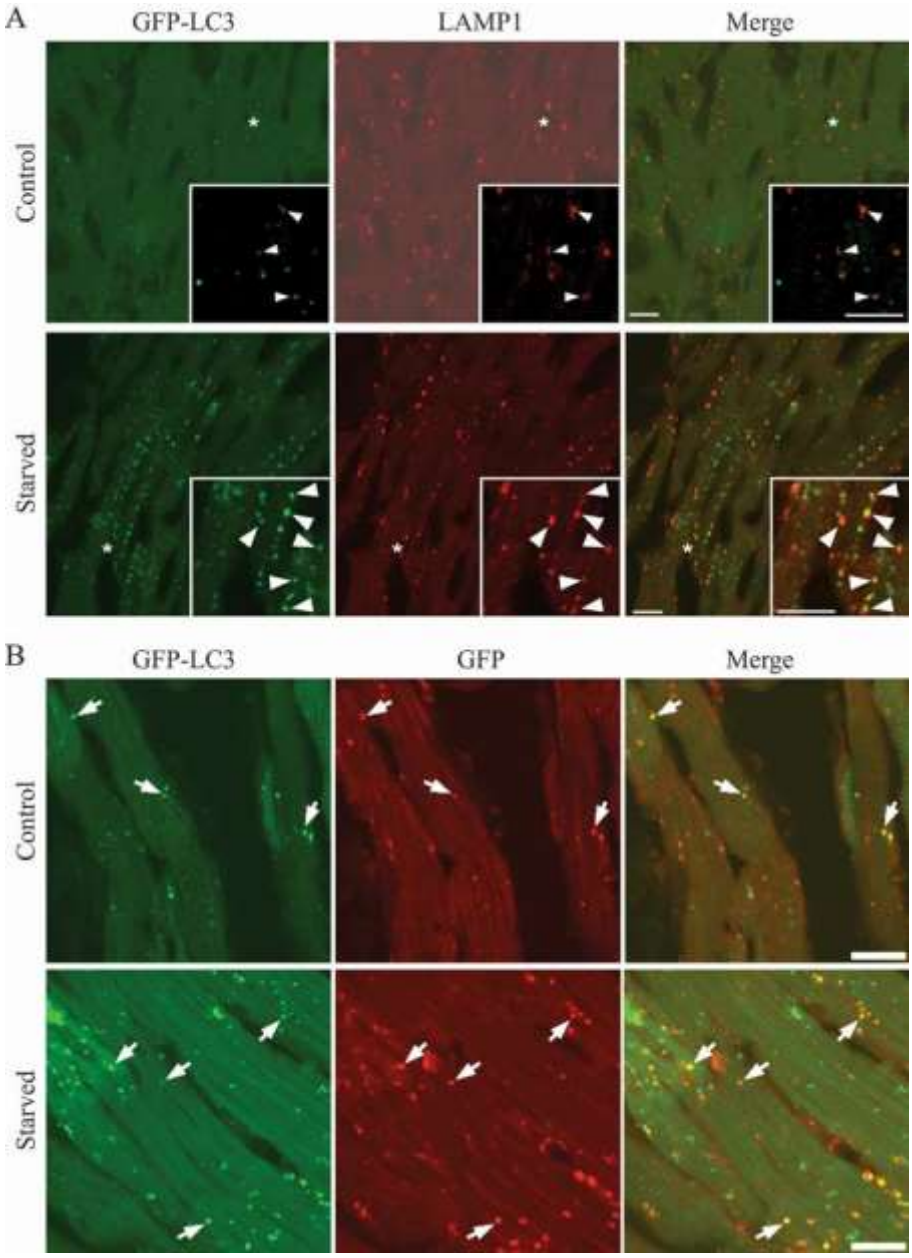

Fig 3.GFP fluorescence in the autolysosome can be recovered upon neutralization of the pH.

Unlike yeast, where Atg8 levels increase significantly upon induction [2], the total levels of LC3 in mammalian cells do not necessarily change predictably. Autophagy induction can lead to an increase in the conversion of LC3-I to LC3-II or a decrease in LC3-II if lysosomal turnover is rapid. A high ratio of LC3-I to LC3-II is often seen in neural lineage cells [3]. For instance, SH-SY5Y neuroblastoma cells show only a slight LC3-II increase

after nutrient deprivation, but a clear reduction in LC3-I, suggesting high basal flux, which is confirmed by a greater LC3-II increase when lysosomal degradation is inhibited [4].

GFP-LC3 emits green fluorescence in the autolysosomes of post-mortem processed heart sections (Fig 3). Cryosections of 3.8% paraformaldehyde fixed ventricular myocardium from 3-week-old GFP-LC3 transgenic mice at the baseline (Control) or starved for 24 h (Starved) were processed for immunostaining using a standard protocol (buffered at pH 7.4). Most of the GFP-LC3 puncta are positive for LAMP1, suggesting that the autolysosomes had recovered GFP fluorescence. (B) Colocalization between GFP-LC3 direct fluorescence (green) and indirect immunostaining for GFP (red). Sections processed as in (A) were immunostained for GFP using a red fluorescence-tagged secondary antibody, and the colocalization with GFP fluorescence was examined by confocal microscopy. Almost all of the red puncta emit green fluorescence. Scale bar: 10 μm. Image provided by Xuejun Wang

Stimuli that affect the transcription or translation of LC3 can complicate interpretation, potentially leading to misinterpretation of autophagy activation or inhibition. LC3-I is much more abundant than LC3-II in brain and spinal cord tissue [4], making LC3-II most easily detectable in enriched fractions of autophagosomes, autolysosomes, and endoplasmic reticulum. To ensure accurate detection of the much weaker LC3-II band in such lysates, an appropriate gel that provides sufficient separation from the strong LC3-I band must be used. Immunoblot analysis of membrane and cytosol fractions from cell lysates, with appropriate sample loading, is critical for achieving quantifiable and comparative signals in studies involving the brain.

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STEP-BY-STEP DIAGNOSIS AND MANAGEMENT OF THE NOCEBO/DRUCEBO EFFECT IN STATIN-ASSOCIATED MUSCLE SYMPTOMS PATIENTS

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Statin intolerance represents a significant clinical challenge where adverse effects (AEs), most commonly Statin-Associated Muscle Symptoms (SAMS), lead to therapy discontinuation and consequently increase the risk of adverse cardiovascular (CV) outcomes [9, 14, 15]. While statins are highly effective in both primary and secondary prevention of CV disease, with each one mmol/L reduction in low-density lipoprotein cholesterol (LDL-C)

producing an approximate twenty-five percent relative reduction in major vascular events annually [3], complete statin intolerance occurs in only a small minority of patients, estimated at only three to five percent [Abstract]. Globally, intolerance is cited as occurring in between five point nine and seven point zero percent of statin-treated patients, depending on the diagnostic criteria [16]. SAMS are the most frequently cited reason for stopping therapy [12], despite the fact that muscle pain is common in the older adult population eligible for treatment [13], suggesting a high likelihood of misattribution of symptoms not genuinely caused by the statin [9].

Beyond misattribution, a substantial portion of perceived SAMS arises from the patient's expectation that the medication will cause side effects, a phenomenon referred to as the nocebo/drucebo effect. Evidence from randomized controlled trials (RCTs) has shown that more AEs are reported under open-label statin use than under blinded conditions, with some reviews estimating that between thirty-eight percent and seventy-eight percent of SAMS-related intolerance can be attributed to expectation alone [17]. While the term "nocebo effect" refers to harm from the expectation of an inert substance, the International Lipid Expert Panel (ILEP) introduced the term drucebo effect (drug plus placebo) in 2018 to better describe adverse effects caused by expectation when taking a pharmacologically active substance [17, 19]. The drucebo effect is defined as the difference in symptom frequency or intensity between the blinded and open-label use of a drug, offering a quantitative insight into symptoms resulting from expectation [17].

Available data strongly support the significance of this phenomenon. The innovative Self-Assessment Method for Statin Side-effects Or Nocebo

(SAMSON) Trial enrolled patients who had stopped statins due to AEs, predominantly SAMS, and had them alternate between one-month periods of "no treatment," placebo tablets, and statin-containing tablets [20]. The results showed that symptom severity was similar during statin use and placebo periods but substantially lower during "no treatment," demonstrating that the symptoms were real, caused by the act of taking a tablet, but not by the pharmacological agent itself [20]. Six months after the trial, over half of the participants had restarted or planned to restart statin therapy after reviewing their personalized symptom data [20]. The similar statin WISE trial, which compared atorvastatin to placebo periods in two hundred patients, also found no difference in AE severity between the drug and placebo periods, leading two-thirds of participants to successfully resume statin therapy [22].

To ensure that therapy cessation is based on credible evidence, various organizations have developed definitions for statin intolerance. The ILEP's 2015 definition characterized statin intolerance based on the inability to tolerate at least two different statins at the lowest dose, confirmed statin-related AEs or significant biomarker abnormalities like elevated creatine kinase (CK), symptom resolution upon discontinuation or dose reduction, and the exclusion of predisposing factors like drug-drug interactions or thyroid disorders [23, 24]. However, achieving a tolerable regimen can take months, significantly increasing CV risk in high-risk patients [29]. Therefore, a proactive, patient-centered approach is required to prevent the emergence of subjective symptoms, especially since subjective symptoms with normal biomarkers are highly suggestive of the nocebo/drucebo effect.

This ILEP Position Paper presents a step-by-step approach to the identification and management of SAMS, with a primary focus on

preventing and managing the nocebo/drucebo effect to improve long-term compliance [Abstract]. At the initiation of statin therapy, a Personalized Lipid Intervention Plan (PLIP) is proposed [32]. The PLIP is a single-page document designed to promote informed, patient-centered decision-making by quantitatively estimating the individual's ten-year CV risk with and without statin therapy and offering a candid explanation of AE likelihood [32, 35]. Specifically, the PLIP should inform patients that muscle symptoms are common but rarely caused by statins [35].

Furthermore, prescribers must proactively address reversible risk factors that predispose patients to SAMS before commencing therapy [38]. These factors include: muscle symptoms resulting from exercise, which can be misattributed to the statin, necessitating personalized exercise advice [39, 40]; thyroid disorders, particularly hypothyroidism, which should be investigated and managed if suspected [23, 24, 39]; vitamin D deficiency, which, although inconclusive, may benefit from supplementation, especially for patients on simvastatin [39, 45]; and polypharmacy, which carries a high risk for drug-drug interactions with statins, requiring careful consideration of co-prescribed medicines like some antifungals, macrolide antibiotics, and HIV protease inhibitors [39, 46, 47]. By proactively managing these factors and utilizing communication tools like the PLIP, practitioners can mitigate the nocebo/drucebo effect, ensuring patients receive optimal, life-saving lipid-lowering therapy.

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Abstract Book of the of the II International conference InterSci 2025: Global innovations in modern science, Juraj Dobrila University of Pula, Croatia 17-19 November, 2025