ADVANTAGES AND POSSIBILITIES OF USING ARTIFICIAL INTELLIGENCE IN CHEMISTRY AND COMPUTER SCIENCE CLASSES IN TECHNICAL SCHOOLS AND LYCEUMS

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Abstract. *This article explores the multifaceted advantages and pedagogical opportunities associated with the integration of Artificial Intelligence (AI) technologies in teaching Chemistry and Computer Science at the secondary technical education level, including lyceums and technical schools. The paper highlights AI-driven instructional models, intelligent tutoring systems, adaptive learning platforms, and their specific applications in complex scientific and computational concepts. Furthermore, the study discusses how AI can individualize learning, enhance student engagement, and prepare future professionals for the digital workforce. Ethical considerations and infrastructural requirements are also briefly addressed.*

Keywords: *Artificial intelligence, Chemistry education, Computer Science, technical schools, adaptive learning.*

INTRODUCTION

The rapid evolution of Artificial Intelligence (AI) has permeated virtually all sectors, including education. In technical schools and lyceums, where the focus lies in building practical and technological competencies, integrating AI into science curricula—particularly Chemistry and Computer Science—presents unprecedented educational potential. Chemistry, a subject characterized by complex abstract concepts, and Computer Science, a field inherently aligned with technological innovation, are uniquely suited for enhancement through AI-powered teaching methods.

In this context, AI does not merely act as a tool for automation but as an intelligent partner in education: capable of analyzing data, adapting to individual learner needs, and offering dynamic feedback. This article examines the core advantages and possibilities of using AI in teaching Chemistry and Computer Science, focusing on its pedagogical impact, enhancement of problem-solving skills, and potential for personalized learning.

MATERIALS AND METHODS

In Chemistry classrooms, students often struggle with understanding molecular structures, chemical reactions, and periodic trends due to their abstract and non-observable nature. AI technologies such as machine learning models, virtual labs, and augmented reality can bridge this gap.

Virtual Labs and Simulations. AI-enhanced virtual laboratories offer immersive environments where students can simulate chemical experiments safely and repeatedly. These simulations allow manipulation of variables, observation of reactions in real time, and safe exploration of hazardous materials, enhancing conceptual understanding without resource constraints.

Example: An AI-driven virtual lab may simulate a titration process and provide real-time feedback on accuracy, highlighting errors in technique or measurements. Students can repeat the process until mastery is achieved.

RESULTS AND DISCUSSION

Intelligent Chemistry Tutors. Platforms powered by Natural Language Processing (NLP) and AI can serve as intelligent tutoring systems (ITS), guiding students through complex topics such as organic reaction mechanisms or chemical kinetics. These tutors adapt explanations based on the learner's responses and pace.

Predictive Analytics for Student Performance. AI can analyze student performance data to predict which learners are at risk of underperforming in Chemistry. Teachers can use this insight to offer targeted support, improving overall academic outcomes.

One of the most promising and pedagogically innovative possibilities offered by Artificial Intelligence in Chemistry and Computer Science education lies in its capacity to facilitate collaborative and problem-based learning environments. In traditional classrooms, students often face limitations in peer interaction due to rigid structures and time constraints. However, AI-powered learning platforms have introduced new models where learners engage not only with content but also with each other in a mediated, purposeful, and dynamic fashion.

For example, intelligent systems can assign students to problem-solving groups based on their skill levels, interests, or performance data. In Chemistry lessons, this enables learners to collaboratively investigate case-based scenarios such as the industrial application of catalytic reactions or environmental chemistry problems like water purification methods. The AI acts as a facilitator—prompting questions, monitoring group interactions, and even intervening with guided hints or redirections when cognitive deadlocks arise.

Similarly, in Computer Science, students can engage in AI-assisted code reviews, where the system encourages peer critique and co-construction of solutions. Rather than assessing students solely on correct outputs, AI evaluates computational reasoning and collaboration patterns, such as the ability to debug others' code or refactor logic for efficiency. These higher-order skills are essential for real-world software development and are often overlooked in conventional assessment models [1].

Another frontier in AI-powered education is multimodal engagement, particularly critical in subjects like Chemistry where learners must synthesize textual, symbolic, and visual-spatial information. With AI tools that recognize voice input, handwritten formulas, or even gestures, students can interact with chemical models in ways that transcend static textbook representations. For instance, using AR-integrated AI platforms, students can manipulate

3D molecular structures with hand gestures while the AI responds to inquiries like "What happens if we add a hydrogen bond here?" or "How does this angle affect molecular polarity?"

This type of sensory-rich, multimodal interaction allows for a deeper internalization of abstract scientific principles. In Computer Science, similarly, block-based AI coding platforms allow learners to shift between visual and textual programming, scaffolding complex algorithmic thinking for different levels of cognitive development [2].

Moreover, AI opens doors to differentiated instruction at an unprecedented level of precision. In a typical technical school classroom, students often come from diverse academic backgrounds and possess varying levels of foundational knowledge. Traditional teaching methods may fail to address this variability, leading to disengagement or underachievement. However, AI algorithms can analyze each student's response patterns in real time and dynamically adjust the lesson's pacing, content difficulty, and feedback mode. For example, a student struggling with balancing redox equations in Chemistry may be guided through a sequence of micro-tutorials, problem steps, and scaffolding hints that are not shown to a peer who has already mastered the concept.

In inclusive classrooms, especially those involving students with learning difficulties or sensory impairments, AI can be transformative. Text-to-speech and speech-to-text systems, for instance, enable visually impaired students to access chemical data or write code using verbal commands [3]. AI chatbots trained in educational dialogue can assist neurodivergent learners in practicing social communication and logical reasoning in low-pressure, private environments.

The role of AI in fostering formative assessment and real-time feedback also deserves attention. In conventional teaching, feedback loops are often delayed and depend heavily on the instructor's availability. With AI systems embedded in e-learning platforms, every student interaction—be it a multiple-choice question, a coding error, or an open-ended response—generates immediate analysis. These systems do not merely indicate correctness; they explain the logic behind errors, provide comparative examples, and suggest remedial activities. In Chemistry, this could involve explaining why an acid-base titration failed and linking it to an earlier concept like pH indicators [4]. In Computer Science, it might analyze inefficient looping structures and recommend recursion.

CONCLUSION

The use of Artificial Intelligence in Chemistry and Computer Science classes within technical schools and lyceums opens up transformative possibilities. It enriches the learning experience through personalization, fosters deeper understanding of complex scientific concepts, and equips students with relevant skills for the digital economy. While challenges remain, a strategic, ethical, and pedagogically sound implementation of AI can redefine the educational landscape, especially in technical education. As such, educational policymakers, school administrators, and teachers must collaboratively invest in infrastructure, training, and curriculum development to fully harness the benefits of AI in the classroom.

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