



The ChatGPT Effect: Reshaping Writing and Research in Computer Science Academia

Mahdi Rezaei
English Department, Na.C.,
Islamic Azad University,
Najafabad, Iran
M63.rezai@gmail.com

Manoocher Jafarigohar
Department of TEFL and English
Literature, 'Payame Noor University',
Tehran, Iran
jafari@pnu.ac.ir

Hadi Salehi
English Department, Na.C.,
Islamic Azad University,
Najafabad, Iran
hadisaleh1358i@yahoo.com

Omid Tabatabaei
English Department, Na.C.,
Islamic Azad University,
Najafabad, Iran
tabatabaeiomid@yahoo.com

Abstract— The advent of ChatGPT has triggered a disruptive transformation in academic practice, compelling a critical assessment of its role. This systematic review investigates the multifaceted impact of this large language model on writing and research within the specific ecosystem of Computer Science (CS). By analyzing literature from major databases (2022-present), we synthesize emergent use cases across the research lifecycle—from literature synthesis and code documentation to drafting and educational tutoring. Key findings reveal a dual-edged "ChatGPT Effect": it demonstrably enhances efficiency and accessibility, yet concurrently introduces profound challenges related to academic integrity (e.g., authorship, plagiarism), output reliability (e.g., "hallucinations" in citations and code), and embedded biases. We conclude that ChatGPT represents a paradigm shift, not merely a tool. Its responsible integration necessitates proactive adaptation of pedagogical assessments, research methodologies, and ethical frameworks. Given its dual role as both a primary user and developer of this technology, the CS community is uniquely positioned to lead in establishing the norms and safeguards required for its constructive adoption.

Keywords— artificial intelligence, chatGPT, scholarly communication, research ethics

I. INTRODUCTION

The role of artificial intelligence in writing has undergone a fundamental metamorphosis, evolving from a focus on error correction to one of content creation. For decades, AI functioned as a digital proofreader. Tools ranging from basic spell-checkers to sophisticated grammar assistants operated at the periphery of composition, designed to polish human-generated text rather than to originate it [1]. This evolutionary trajectory was fundamentally disrupted by the advent of transformer-based large language models (LLMs). A pivotal moment arrived with the public release of OpenAI's ChatGPT in late 2022. This tool demonstrated a new

capability: it could generate fluent essays, functional code, and complex analyses from simple prompts, thereby blurring the traditional line between a passive tool and an active collaborator. This event marked not a simple upgrade, but the dawn of a generative AI revolution, prompting a re-imagination of AI as a potential partner in the intellectual acts of thinking and creating [2].

The result is what we term "The ChatGPT Effect": a phenomenon characterized by meteoric adoption and profound cultural disruption within academia. Seemingly overnight, it became an urgent concern for educators, researchers, and publishers. However, the core "Effect" extends beyond learning a new software interface; it encompasses the ongoing, complex renegotiation of authorship, the urgent need to redefine core competencies, and a crisis of confidence in established mechanisms for validating knowledge. This constitutes a genuine paradigm shift, fundamentally reshaping the practices of thinking, writing, and validation in academic life [3].

Perhaps no field experiences this shift more acutely than Computer Science (CS), making it a critical and revealing case study. CS is uniquely positioned as both the primary "application domain" and the foundational "source" of this technology. As an application domain, the discipline's core substance—algorithms, code, and technical writing—provides an ideal proving ground that both showcases the models' potential and exposes their flaws. Simultaneously, as the field that created these tools, CS researchers inhabit a singular triple role: they are the architects, the most expert users, and the educators responsible for shaping future norms. This dual positioning places the CS community at the epicenter of the revolution, tasked with the dual imperative of harnessing the tool's potential while critically governing its integration. Therefore, understanding the "ChatGPT Effect" within CS is not an isolated inquiry but a necessary step toward responsibly shaping the future of AI in academia at large [4].

This review paper maps the contested terrain of ChatGPT's integration into computer science academia. The analysis first

outlines the methodological approach for navigating the emerging literature. A dedicated section then presents a structured overview of key findings. The discussion subsequently details the core transformations within research workflows and educational pedagogy, followed by a critical examination of accompanying ethical and technical challenges. Building on this assessment, the paper proposes forward-looking directions for responsible integration. The analysis concludes by framing this moment as a call for leadership, arguing that the computer science community holds a unique imperative to shape the norms governing this paradigm shift.

2. Key Findings: A Structured Overview

Our systematic analysis of the literature (2022-present) reveals that the impact of ChatGPT in Computer Science academia is multifaceted and dual-edged. The table below provides a consolidated summary of the key findings, structured across primary domains of impact, specific applications, identified benefits, and critical challenges.

TABLE 1: STRUCTURED OVERVIEW OF KEY FINDINGS ON CHATGPT IN CS ACADEMIA

Domain of Impact	Structured overview of key findings on chatGPT in CS academia		
	Primary Applications	Key Benefits	Critical Challenges & Risks
Research & Scholarship	- Literature review acceleration & synthesis - Ideation & hypothesis generation - Drafting & polishing manuscripts/grants - Peer review assistance - Code generation, explanation, & debugging	- Significant time savings - Enhanced research creativity & scope - Lowered barriers to technical writing & communication	- Hallucinations & unreliability: Fabricated citations, incorrect code, false information [7], [28]. - Authorship ambiguity: Blurring lines of contribution, challenging traditional norms [14], [15], [17]. - Ethical erosion: Potential for sophisticated plagiarism & citation fraud [9].
Education & Pedagogy	- Personalized tutoring & concept explanation - Programming partner & debugger - Writing coach for technical documents - Tool for generating practice problems & content	- Personalized, 24/7 learning support - Reduced cognitive load for novices - Enables focus on higher-order design skills	- Assessment crisis: Undermines traditional product-based evaluation [21]. - Deskilling risk: Over-reliance may erode foundational problem-solving competencies [2]. - Integrity threats: Facilitates new forms of contract cheating [9].
Ethical & Sociotechnical	N/A (Context of use)	- Potential to democratize access to expertise	- Bias & fairness: Amplifies societal biases from training data

Domain of Impact	Structured overview of key findings on chatGPT in CS academia		
	Primary Applications	Key Benefits	Critical Challenges & Risks
			[29]. - Digital divide : Premium access creates equity issues [29]. - Environmental cost : High energy/water footprint of training & operation [30]. - Accountability gaps : "Black box" nature challenges transparency & verifiability [2].

Synthesized from the literature, the core conclusion is that ChatGPT is a transformative force that is fundamentally augmenting both research and educational practices in CS. However, its integration is not a simple trade-off between pros and cons. Instead, it presents a series of interlocking dilemmas where significant benefits (efficiency, accessibility) are intrinsically linked to serious risks (integrity, reliability, equity). This duality necessitates moving beyond reactive measures toward the proactive development of new frameworks for assessment, authorship, and ethical governance tailored to the AI-augmented academic landscape.

3. Reshaping Research: The AI-Augmented Scholar

The integration of ChatGPT and large language models into computer science research is a fundamental shift in practice toward AI-augmented scholarship. Research proves that these tools can bring significant productivity gains to both users and producers of research across numerous domains in the research lifecycle [5]. LLMs show especial promise in accelerating research through idea creation, literature synthesis, and data extraction, as well as improving writing and communication through the drafting process and text simplification in general [5], [6].

3.1 Accelerating the Research Life Cycle

A prominent and immediate consequence of ChatGPT is the substantial reduction in time spent on preparatory research tasks. The literature review, a traditionally demanding endeavor, is undergoing notable acceleration through the use of large language models. These tools assist researchers by providing concise summaries of complex articles, extracting central methodologies and conclusions, and generating initial syntheses of the current state of knowledge in a given field. This facilitates a quicker navigation of the research terrain, but simultaneously introduces a new imperative for critical oversight to mitigate the risks associated with the model's characteristic inaccuracies and gaps [7]. The application of ChatGPT moves past synthesis to influence the foundational creative process of ideation and hypothesis generation. Researchers employ the model as a collaborative ideation tool to examine contiguous research domains, critically assess the innovativeness of a hypothesis, and derive potential variations in experimental methodology. This integration augments the researcher's creative capacity with the model's expansive and associative repository of information [8]. The literature confirms that ChatGPT significantly accelerates foundational research tasks like literature reviewing and ideation, offering substantial gains in efficiency. The key finding,

however, is that this acceleration is not autonomous. It introduces a new, critical requirement for human oversight and verification to mitigate the risks posed by the model's tendency to generate plausible but incorrect or fabricated information [7].

3.2. Writing and Communication

The foundation of sharing knowledge—scholarly writing—is being fundamentally reshaped. Scholars are now regularly turning to ChatGPT for drafting and polishing their work. The model serves as an indefatigable collaborator, capable of producing first drafts of key manuscript sections and sharpening the wording of abstracts to maximize precision and persuasiveness. This assistance even reaches the strategic domain of grant writing, where it helps researchers frame the significance of their work and tailor proposals to the nuanced expectations of different funding bodies [9]. More controversially, large language models are now entering the sanctum of peer review. Although they cannot replicate deep scholarly expertise, researchers describe using them as a first-pass tool: to draft an initial assessment of a manuscript, to organize a coherent author response by distilling critiques, or to refine their own reviews for balance and thoroughness [10]. This incursion into the core mechanism of quality control raises significant questions about the future of scholarly evaluation.

Findings indicate that ChatGPT is becoming a pervasive writing and communication assistant in research, potentially improving efficiency and clarity. A critical associated finding is that this use challenges traditional boundaries, prompting urgent questions about appropriate disclosure, the integrity of peer review, and the evolving norms of collaborative authorship when AI is a contributing agent [5].

3.3. Code-Centric Research Support

In computer science, the role of ChatGPT is becoming one of the most discussed issues: debugging and coding support. Having the ability to comprehend logical program interpretation places the model as a useful assistant to locate and fix bugs, which becomes tougher with growing software architecture complexity [11]. Its usefulness spans from code generation, where it creates new segments of code or completes partial functions, error correction, syntax refinement, performance suggestions for improvement, all the way to performing tasks and being an explanatory guide through complex programming concepts in simple, understandable language [12]. ChatGPT also plays the role of an active debugging assistant. The tool will automate the detection and correction of errors, help flag bugs earlier in development, and give clear explanations of why a bug happened using the power of its language and pattern analyses. Thus, instead of symptom hunting, debugging will evolve into a learning process of how code behaves [13].

With this utility comes the well-known caveat: it is only as good as its training corpus. The critical limitation is that it may not catch any errors that are due to a pattern that is not present in its data. Therefore, its most effective role is as a complement to and not a replacement for conventional debugging techniques to ensure final solutions are innovative yet sound [13]. There are several ways in which this model can prove useful in research activities related to computer science. This facility is increasingly used by researchers as an active partner in brainstorming new ideas, in drafting and editing academic writing, and even in considering other methodological options in the design phase of a study [5].

The evidence shows that ChatGPT is a highly effective assistant for code comprehension, generation, and debugging, particularly for routine tasks and explanations. The pivotal finding is its role as a "cognitive scaffold" for developers. However, this utility is tempered by the finding that outputs require expert validation, and over-reliance risks a form of

deskilling, where fundamental problem-solving atrophies [11], [12], [13].

3.4. Emergent Collaborative Models

Together, these applications show that researchers are not settling on a single way to work with ChatGPT. Instead, a spectrum of collaboration is unfolding. At its most prosaic, the model is employed as a complex tool. At its most complicated, it becomes an intellectual collaborator, directly contributing to the creative and also to the analytical process [14]. To date, the integration of AI tools like ChatGPT has completely challenged the previous concepts of authorship and collaboration in academic writing. Sharifzadeh [15] discusses whether or not ChatGPT constitutes a co-author, utilizing Actor-Network Theory to suggest such AI constitutes meeting requirements of co-authorship, reflecting upon non-human agency and moral accountability.

Capturing the real nature of human-AI collaboration requires complexity in models of collaboration. This has led to a number of calls for multidimensional frameworks of collaboration that evaluate across several key facets of contribution-generative, structural, creative, and analytic—rather than along a single sliding scale [16]. Generative AI challenges some very foundational paradigms of copyright and authorship. Soos and Haroutunian [17] argue that LLMs are literally blurring any lines between artifact and author, rendering restrictive and narrow creator-centricity inapt. They thus call for more expansive and finely grained ways of attributing work. AI-generated text threatens traditional notions of authorship at epistemological and even legal levels. According to Kotsis [18], this could well force an institutional reconsideration of how academic work is policed. Any future frameworks thus need to ensure accountability and transparency on one hand, while accommodating legitimate and innovative AI partnerships on the other.

A key finding of this review is that ChatGPT is catalyzing a fundamental re-conceptualization of collaboration and authorship in academic research. The literature argues that existing ethical and legal frameworks are inadequate, necessitating the development of new, nuanced models that can formally recognize and govern hybrid human-AI intellectual work.

4. Rethinking Education: Pedagogy in the AI Era

Generative AI is transforming computer science education from the ground up. This shift is not about simply adding a new application to the syllabus; ChatGPT and its counterparts are fundamentally altering what it means to be a student, a teacher, and an educational institution today. This forces a necessary and often difficult conversation about the core purpose of education in a world with AI. The effects are clear: students have access to an unprecedented suite of aids, educators must reconsider their approach, and schools are scrambling to formulate coherent policies [4], [26].

4.1 The Student's New Toolkit

For students, generative AI has quickly moved from a novelty to an integrated multi-purpose assistant and is, in effect, an academic companion available 24/7. The three primary functions that this role can be placed into are described below. The most educational uses of it include personalized tutoring. ChatGPT can break down challenging CS material—from the logic of recursion to the design of complex systems—into manageable, stepwise instructions tailored to a student's needs. By empowering learners to request clarification in natural language, it offers real-time, scaffolded guidance more like a human tutor. In a complementary way, it enables mastery through adaptive practice, automatically generating targeted problem sets for self-directed study in areas such as algorithm design [4].

But in its role as a programming partner, ChatGPT finds an especially strong fit within the CS curriculum. Students use it to translate conceptual ideas into executable code, to unpack and understand the mechanics of pre-written programs, and to diagnose bugs. The value of the tool lies not only in delivering fixes but in delivering contextual explanations for why code fails, providing a form of just-in-time instruction. This immediate support is an effective scaffold for novices, reducing cognitive load and freeing students for faster movement onto complex problem-solving and architectural design [19].

It also performs very well as a personal academic and technical writing tutor. Students apply it to outline reports, comment on their code with professional precision, and progressively hone long documents such as theses and projects. In this way, it directly helps them acquire fundamental skills: synthesizing elaborate information, expressing technical ideas concisely, and acquiring formal writing style. This feedback helps not only non-native English speakers but all students develop a critical driver of career success [20].

Findings demonstrate that ChatGPT provides students with powerful, always-available support across tutoring, coding, and writing. The crucial associated finding is that this shifts the student's role from a sole producer to a manager, editor, and critic of AI-generated content, necessitating the development of new metacognitive skills [4, 19, 20, 21].

4.2. The Educator's Dilemma and Opportunity

This new student toolkit presents educators with a fundamental dilemma-how to assess learning when students have access to a tool that can produce many of the outputs traditionally used for evaluation. This challenge, however, opens a significant opportunity to redesign pedagogy for deeper learning. What's required is a transformative shift in the design of assessments, to shift the focus from the end products of student work to the creative and analytical processes by which those products are created. Practical implementations include process portfolios that capture AI-aided iteration, assignments focused on auditing and improving AI outputs, oral examinations, and complex projects for which AI use is a required and documented part of the workflow. These methods share one thing in common: a core, assessable learning outcome for modern computer science education - critical AI literacy - defined here as proficient use, rigorous assessment, and ethical application of AI systems [21].

A similar advantage involves how AI can enhance the production of learning materials. Instructors can utilize such models to rapidly produce a variety of technical illustrations, generate case-based ethics class discussions, and construct customized practice problems. Such automation of routine content creation pays a valuable strategic dividend: It lightens the load of teaching preparation, freeing instructors to invest more energy in the most impactful, human-centered aspects of teaching-including the mentorship of students and innovation in pedagogical approaches [22].

The literature identifies a clear finding, that is to say traditional assessment models are obsolete. The path forward involves transitioning to process-oriented, "AI-literate" assessments. A related finding is that AI can be a powerful force-multiplier for educators in content creation, but its primary value lies in freeing them to focus on higher-order teaching activities like mentorship and pedagogical innovation [21].

4.3. Institutional Responses

The response of academic institutions to this reality has been far from uniform, revealing a wide continuum of strategies. Initial reactions at many universities involved precautionary bans, with

departments forbidding AI use in assignments to protect traditional measures of academic honesty. A growing, more nuanced middle ground now features conditional policies that permit AI as a brainstorming or debugging aid while forbidding its use for producing final graded submissions. At the leading edge of the curve are the institutions constructing formal integration frameworks. Such initiatives focus on educating faculty about AI's pedagogical applications, updating academic integrity policies to reflect new forms of collaboration, and ensuring all students enjoy fair access to these tools. This existing patchwork of policies underlines both the unprecedented nature of this disruption and the urgent need for coherent strategies that balance protection of learning integrity with the encouragement of educational innovation [23, 24].

A key finding is the current lack of consensus and policy lag across institutions. Effective integration requires moving beyond ad-hoc restrictions toward comprehensive frameworks that proactively educate, provide clear ethical guidelines, and ensure equitable access, thereby balancing integrity with innovation [23, 24].

5. Critical Challenges and Ethical Fault Lines

Integration of generative AI into workflows is far from the level of difficulty similar to adopting a new software suite. Therefore, it will question foundational practices and raise hard questions about long-held scholarly values. Yet early research has emphasized the technology's immense promise to accelerate discovery and transform pedagogy. Still, its rate of adoption has outstripped the parallel development of necessary governance and ethical frameworks that have left institutions to react rather than guide the transition [25]. AI-based assistance tools, like ChatGPT and Codex, used in computer science education, fundamentally alter how programming will be taught and learned. While their use can reduce the barriers to entry and provide immediate feedback, they have sparked serious debates in the CS community. Educators now have to grapple with issues of preserving academic honesty, preventing students from becoming too reliant on automated solutions, and designing assessments that can accurately measure authentic human understanding [26]. Generative AI fundamentally challenges prevailing theories of scholarly communication through disrupting established conventions of authorship and knowledge production. New, more fine-grained frameworks are urgently needed that can tackle the complex ethical and operational implications for leading academic systems: institutional policy, peer review, and scholarly publishing [27].

The technical challenges include the fact that AI "hallucinates," creating factually incorrect yet coherent content. In computer science, a field founded on logical soundness and verifiable output, this is a disastrous weakness. A model can confidently fabricate a new but impossible algorithm, cite a nonexistent scholarly paper, or synthesise subtly buggy code which will pass superficial review. This makes any research created with its help untrustworthy and permits sophisticated citation fraud, as sources can be fabricated and inserted into academic work with fluency that is deceiving [28].

The basic notion of academic plagiarism is suffering some kind of definitional crisis in the generative AI era. Traditional frameworks-in which the prohibition against unauthorized plagiarism presupposes an existing human work-fail to provide any meaningful guidance on the appropriate use of tools capable of generating novel, uncopied text on demand. This conceptual void has opened the door to a new form of contract cheating, with the algorithmic agent playing the role of ghostwriter. Making matters worse, widely deployed automated AI-detection software has proven poorly accurate and disturbingly prone to bias, frequently miscalling the authentic work of non-native English speakers as AI-generated. This ineffectiveness fatally undermines the viability of these tools as a foundation for the enforcement of academic integrity and leaves institutions without reliable technical safeguards [9].

Beyond immediate concerns of academic honesty lie more profound, epistemic threats to the foundations of scholarly inquiry. A pervasive dependency on AI for core intellectual tasks such as writing code, diagnosing errors, and synthesizing literature risks atrophying critical cognitive skills in learners and experts alike. Such erosion of firsthand problem-solving, critical analysis, and structured thinking represents a fundamental form of deskilling. Meanwhile, similarly troubling is the epistemically opaque nature of these models. As "black boxes," they generate conclusions without revealing their logic trail or attributing sources, directly undermining the scientific pillars of explainability, replicability, and the transparent, cumulative advancement of knowledge that depends on verifiable citations [2].

A critical ethical challenge lies in the sociotechnical nature of generative AI itself. These models are trained on the unfiltered corpus of the internet, meaning they inevitably absorb and can subsequently reinforce the social biases, stereotypes, and historical inequities present in their training data. In practice, this can manifest as the generation of culturally prejudiced text or code that replicates flawed patterns from legacy systems. Beyond this encoded bias, a significant access barrier creates a digital divide. The most capable models are frequently gated behind commercial paywalls or require substantial computing power, concentrating their benefits within well-funded universities and research groups. This dynamic threatens to institutionalize a two-tiered academic landscape, where resource disparities directly translate into advantages in research productivity and educational quality, thereby deepening pre-existing structural inequalities [29].

One underappreciated dimension of the generative AI revolution is its significant environmental cost. The huge computational arms race in developing models comes with a high ecological cost. Training frontier systems such as GPT-4, and keeping them running, requires immense energy consumption and huge water reserves for cooling giant data centers—a process that leads to a huge carbon footprint challenging the sustainability of the field's current trajectory [30].

REFERENCES

- [1] K. Kukich, "Techniques for automatically correcting words in text," *ACM Comput. Surv.*, vol. 24, no. 4, pp. 377–439, Dec. 1992.
- [2] E. M. Bender, T. Gebru, A. McMillan-Major, and S. Shmitchell, "On the dangers of stochastic parrots: Can language models be too big?," in *Proc. 2021 ACM Conf. Fairness, Accountability, Transparency*, Mar. 2021, pp. 610–623.
- [3] Y. K. Dwivedi et al., "'So what if ChatGPT wrote it?'" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *Int. J. Inf. Manage.*, vol. 71, p. 102642, Apr. 2023.
- [4] E. Kasneci et al., "ChatGPT for good? On opportunities and challenges of large language models for education," *Learn. Individ. Differ.*, vol. 103, Art. no. 102274, Apr. 2023.
- [5] E. C. Garrido-Merchán, "Best uses of ChatGPT and Generative AI for computer science research," *arXiv*, Art. no. 2311.11175, Nov. 2023.
- [6] A. N. Jadhao and A. S. Chalak, "The future of scholarly communication: Integrating ChatGPT into research writing practices," *Majmaah J. Health Sci.*, vol. 13, no. 3, pp. 199–199, 2025.
- [7] C. A. Gao et al., "Comparing scientific abstracts generated by ChatGPT to original abstracts using an artificial intelligence output detector, plagiarism detector, and blinded human reviewers," *bioRxiv*, Art. no. 2022.12.23.521610, Dec. 2022.
- [8] D. Demszky et al., "Using large language models in psychology," *Nat. Rev. Psychol.*, vol. 2, no. 11, pp. 688–701, Nov. 2023.
- [9] W. Liang, M. Yuksekogonul, Y. Mao, E. Wu, and J. Zou, "GPT detectors are biased against non-native English writers," *Patterns*, vol. 4, no. 7, Art. no. 100779, Jul. 2023.
- [10] W. D. Heaven, "ChatGPT is going to change education, not destroy it," *MIT Technol. Rev.*, Jan. 2023.
- [11] M. A. Haque and S. Li, "The potential use of ChatGPT for debugging and bug fixing," *arXiv*, Art. no. 2303.05503, Mar. 2023.
- [12] S. Biswas, "Role of ChatGPT in computer programming," *Mesopotamian J. Comput. Sci.*, vol. 2023, pp. 9–15, Mar. 2023.
- [13] Z. H. Sain, R. Serban, M. A. Agoi, and S. H. Sain, "Leveraging ChatGPT to enhance debugging: Evaluating AI-driven solutions in software development," *Asian J. Comput. Sci. Technol.*, vol. 13, no. 1, pp. 41–44, 2024.
- [14] C. Stokel-Walker, "ChatGPT listed as author on research papers: many scientists disapprove," *Nature*, vol. 613, no. 7945, pp. 620–621, Jan. 2023.
- [15] R. Sharifzadeh, "ChatGPT as co-author? AI and research ethics," *Ethics Progress*, vol. 15, no. 1, pp. 155–173, 2024.
- [16] J. Hutson, "Human-AI collaboration in writing: A multidimensional framework for creative and intellectual authorship," *Int. J. Changes Educ.*, vol. 1, no. 1, 2025.
- [17] C. Soos and L. Haroutunian, "On the question of authorship in large language models," *Knowl. Organ.*, vol. 51, no. 2, pp. 83–95, 2024.
- [18] K. T. Kotsis, "Redefining scientific authorship in the age of AI: Challenges for editors and institutions," *Eur. J. Innov. Stud. Sustain.*, vol. 1, no. 5, pp. 23–33, 2025.
- [19] J. Finnie-Ansley et al., "The robots are coming: Exploring the implications of OpenAI Codex on introductory programming," in *Proc. 24th Australas. Comput. Educ. Conf.*, Feb. 2022, pp. 10–19.
- [20] J. S. Barrot, "Using ChatGPT for second language writing: Pitfalls and potentials," *Assess. Writ.*, vol. 57, Art. no. 100745, Jul. 2023.
- [21] D. R. Cotton, P. A. Cotton, and J. R. Shipway, "Chatting and cheating: Ensuring academic integrity in the era of ChatGPT," *Innov. Educ. Teach. Int.*, vol. 61, no. 2, pp. 228–239, Mar. 2024.
- [22] D. Mhlana, "Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning," in *FinTech Artif. Intell. Sustain. Develop.*, R. David, Ed. Cham, Switzerland: Springer, 2023, pp. 387–409.
- [23] C. K. Y. Chan, "A comprehensive AI policy education framework for university teaching and learning," *Int. J. Educ. Technol. High. Educ.*, vol. 20, no. 1, Art. no. 38, Dec. 2023.
- [24] M. Sullivan, A. Kelly, and P. McLaughlan, "ChatGPT in higher education: Considerations for academic integrity and student learning," *J. Appl. Learn. Teach.*, vol. 6, no. 1, pp. 31–40, Jan. 2023.
- [25] R. Machado, R. David, and R. Souza, "A Inteligência Artificial Generativa no Ecosistema Acadêmico: Uma Análise de Aplicações, Desafios e Oportunidades para a Pesquisa, o Ensino e a Divulgação Científica," *arXiv*, Art. no. 2507.00000, 2025.
- [26] R. Beale, "Computer science education in the age of generative AI," *arXiv*, Art. no. 2507.02183, Jul. 2025.
- [27] S. Watson, E. Brezovec, and J. Romic, "The role of generative AI in academic and scientific authorship: An autopoietic perspective," *AI Soc.*, pp. 1–11, Jan. 2025.
- [28] Z. Ji et al., "Survey of hallucination in natural language generation," *ACM Comput. Surv.*, vol. 55, no. 12, Art. no. 248, Mar. 2023.
- [29] L. Weidinger et al., "Taxonomy of risks posed by language models," in *Proc. 2022 ACM Conf. Fairness, Accountability, Transparency*, Jun. 2022, pp. 214–229.
- [30] A. S. Luccioni, S. Viguier, and A. L. Ligozat, "Estimating the carbon footprint of Bloom, a 176B parameter language model," *J. Mach. Learn. Res.*, vol. 24, no. 253, pp. 1–15, 2023.