



GENERATIVE AI IN EDUCATION: A STUDENT-CENTRIC SURVEY ON OPPORTUNITIES AND CHALLENGES

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Abstract : Integration of generic artificial intelligence (Gen AI) and large language models (LLMs) in education has created global interest due to their transformative ability in teaching, learning and research. This review synthesizes recent empirical studies and conclusions of pilot implementation in various educational contexts, especially in higher education and engineering subjects. Using the installed technology adopting model (TAMS), the review examines the major factors affecting the Gen AI adoption, including alleged utility, ease of use, social impact, facility and resistance factors. Highlight applications include AI-Assisted Research Partner, adaptive learning system and AI-supported evaluation environment. While important benefits such as students' engagement, personal teaching, and automation of educational functions are clear, challenges remain around morality, educational integrity, equity and institutional readiness. Paper infrastructure underlines the importance of policy framework for development, educator training, clear ethical guidelines and responsible integration. This ensures action for stakeholders to navigate the developed landscape of AI-enhanced education by proposing actionable recommendations for stakeholders and for sustainable, justified adoption.

IndexTerms - AI-assisted research, Adaptive learning systems, AI-driven assessment, Student engagement, Personalized learning, educational automation, Academic integrity, Ethical AI.

I. INTRODUCTION

Artificial Intelligence (AI) Technologies, especially the rapid advancement of generative AI (Gen AI) and large language model (LLM), is re-shaping the educational landscape worldwide. These tools - from the text generators such as the chat, the image creators such as the creators, to code assistants such as Git hub Copilot - are becoming integral parts of teaching, learning and educational research[1][3]. Their ability to generate original material, imitating human creativity and provide personal assistance provides personal assistance to increase educational results in subjects, especially in higher education and engineering. Regarding potential benefits, adopting Gen AI in education is affected by many factors, including alleged utility, ease in use, moral thoughts, institutional revival and digital literature and digital literature and digital literature and digital literateurs. While students use Gen AI for rapid essay writing, coding assignments, and project ideas, this trend also raises concerns about academic integrity, skill development and excessiveness on automated equipment. Empirical studies show that while Gen AI learner can support engagement, material manufacturing and efficiency, it is also needed strong guidelines, teacher training and moral safety measures to prevent misuse and ensure fair access[2].

This letter presents a comprehensive overview of the current research and survey findings on the use of Generative AI (GenAI) in the education sector. It considers both instructors' and learners' views on the main benefits and challenges related to GenAI tools. Additionally, it discusses how these technologies are being practically integrated into everyday teaching and learning environments. By synthesizing case studies and survey data - such as studying students from more than 1,000 universities in Indonesia - this task highlights the current status of GenAI use and the moral implications occurring with its proliferation. In the light of global teacher deficiency, growing class size and diverse learner needs[13], Gen AI emerges not only as a technological innovation, but also as a strategic promoter for educational changes.

The rapid evolution of artificial intelligence (AI), especially in the field of Generative AI (Gen AI) and larger language models delts (LLMs)[6], is fundamentally changing in contemporary education. This change is manifested by the creation of personal education experiences, AI-enhanced tutoring and automatic materials, all of which serve as impressive tools shaping education and teaching methods. Such changes are especially pronounced in technical areas such as higher education and engineering, where the demand for adaptive, efficient and scalable education approaches is important. Generative AI application, including ChatGPT, Dall E. Students give these resources the benefit of brain composition, essay design, coding, exam preparation and digital material creation. Instructional quality for teachers, tailor feedback, grading processes OPTIM presents a way to optimize and assist in administrative responsibilities. However, the widespread adoption of Guinea raises significant issues regarding academic integrity, dependence, editing skills and moral considerations. This correspondence provides a comprehensive analysis of the recent empirical study and survey data regarding the integration of Gen AI in educational contexts[8]. By examining the research of various institutions and countries, placing special emphasis on Indonesia's higher education system, it gains the insights of both students and faculty,

illuminating the practical effects of life deployment - absorbing its benefits, challenges and discrepancies between its potential and actual application.

Generative Artificial Intelligence (GenAI) and Large Language Models (LLMs) like ChatGPT and GPT-3 are reshaping the landscape of education by enabling more interactive, personalized, and efficient learning experiences. These technologies allow users to generate text, solve complex problems, assist with research, and even produce visual content. As GenAI continues to evolve, its potential to transform how education is delivered and consumed is becoming increasingly evident. One of the most significant benefits of GenAI in education is the opportunity for tailored learning. AI-powered tools can adapt content to suit individual learning paces and styles, making education more inclusive. They can also automate repetitive administrative tasks, such as grading and feedback, allowing educators to focus on more strategic and creative teaching responsibilities[12]. Furthermore, GenAI supports students with real-time feedback and explanations, improving their understanding of difficult concepts and promoting active learning. Despite its promise, the integration of GenAI in educational settings presents several challenges. A major concern is the lack of awareness and preparedness among both educators and students in using these tools effectively. Many institutions are still exploring how to embed GenAI into their teaching methods without undermining academic standards. The risk of misuse, particularly in the form of plagiarism or over-dependence on AI-generated content, is a pressing issue. AI's ability to produce essays or code raises questions about academic honesty, sparking debates about how to maintain integrity while embracing technological advancement.

Empirical studies have shown differing attitudes toward GenAI adoption. Students tend to welcome these tools enthusiastically, seeing them as useful learning aids. On the other hand, educators often express caution, concerned that AI might erode traditional teaching practices or encourage shortcuts in learning. This contrast in perspectives has underscored the need for clearer strategies and ethical guidelines in AI implementation[14]. To foster responsible usage, institutions must develop policies that regulate AI use and ensure alignment with educational goals. Training programs for educators are equally vital, equipping them with the knowledge to integrate AI into their classrooms effectively and ethically. It's also important to educate students about using GenAI responsibly, promoting critical thinking over reliance on AI-generated solutions. In practice, GenAI has already found productive use in fields like engineering and computer science, where it aids students in problem-solving and project work. However, concerns about students bypassing foundational learning through AI highlight the need for balance—using GenAI as a supplement rather than a substitute for genuine learning.

II. RELATED WORK

In educational devices[1], integration of large language models such as Artificial Intelligence, especially large language models such as GPT -4 is a growing trend in modern academics. Precious studies emphasize the importance of combining theoretical knowledge with practical, research-operated applications to increase learning results in engineering education. However, most of the graduate research capacity remains unused due to lack of structured support systems and equipment to suit the developments of students. Existing equipment is often less in providing personal guidance or actionable response. The ARC (AI-based research partner) addresses this difference by using advanced generic AI to composition, recommend and guide research activities between engineering undergraduate. Drawing from a diverse dataset of the student input and educational materials, the arc graduate provides a novel and intelligent approach to promote research engagement.

Increasing interest in integrating generative AI into education lies in the ability to change traditional teaching and learning patterns. Technologies such as GPT and Dall · E have demonstrated capabilities in material construction, adaptive learning and administrative automation. This study[2] indicates that while AI-operated equipment enhances individual learning and engagement, challenges remain in their practical implementation, especially about moral ideas and data privacy. Literature inf Through mixed-method approaches, including survey, interviews and classes, researchers are able to assess how tribal AI supports better learning results and more efficiency in educational management.

The integration of liberal AI in education, especially in programming instructions, has attracted significant attention in recent years. Study[3] by Luxon-Reeli et al. (2018) and Peers et al. (2020) has emphasized the importance of active learning and initial response in developing programming skills, while recent work by Kasnesi et al. (2023) Code highlights the ability of generic AI for assistance in generation and debugging. However, there remains concerns about the over-neutrality of students on AI-related materials without developing significant thinking and testing skills (Zawaki-Richter et al., 2019). It aligns with observation of the current study that when assisting AI equipment code development, they can obstruct the cultivation of problems and analytical abilities if not academically guided.

This study[4] provides a comparative analysis of the study of Chhatgpt-4 and Google's Bard, focus on the attitude of teachers about the equality index results, detection of AI-generated materials and their use in education. Using the mixed-Method approach in January 2024, the study evaluated the originality of the reactions from both devices using academic signals, with a literary theft test to detect AI and with Turnitin for GPTZERO.ME. The CHATGPT-4 demonstrated a low-equivalent index (3%) and high human-equality in the basic AI scan, while Bard showed a high index (9%) with intensive integration of academic materials. However, deep scan suggested that Bard AI could embed the content more subtle. The CHATGPT-4 was strong in the structured text output, while Bard provided multimedia-rich reactions including articles and pictures. Survey reaction from 20 doctoral students at PSU Open University Systems indicated high awareness and use of the AI tool, with 85% familiar and 70% of them. While many people saw AI beneficial in learning and supporting teaching, 60% expressed concern about educational integrity. Based on these findings, the guidelines for the use of AI use responsible in study education recommends: to reject AI devices only as authors listed to ensure supportive use, compulsory human monitoring, proper disclosure, and moral and academic and academic and academic and academic and academic and academically.

This paper[5] finds the vision of educated artificial intelligence (GAI) integration in better education, especially within Portugal's polytechnic. Overview of the literature outlines AI's growing relevance in school education, emphasizing its transformative ability in personal justice of personal evaluation, evaluation and instructional support. Previous research has cited imbalance in adopting GAI, in which the students of Kollge Ledge are more actively attractive than teachers, and show issues around ethics, record privacy and ness pain. Employing a quantitative method, surveyed 134 teachers in the branches of the use of based questionnaires. Results G.A.A. Adoption indicates a full gender-based full difference-mail teachers have a more tendency to apply devices like Chat GPT and Google Bard, while female teachers usually show more warning due to moral concerns. Despite this, both species shows the shared attention of student AI and shared the same benefits. The paper targeted by emphasizing the desire for a target specialist development and proposes to look at various organizations for elaborate comparative evaluation.

This paper[6] addresses the growing use of moral concerns around generic artificial intelligence (Genai) tools and their application, especially in relation to literary theft and educational integrity. Genai has raised questions about their ability to unknowingly contribute to literary theft due to the increasing availability of Genai devices and adopting Genai devices, including Chat GPT in educational settings, inadvertently available from publicly available data. Previous research has emphasized the need for clear guidelines and educational programs to help manage the use of generative AI (GenAI) in education. Generative AI tools are becoming a part of education, and how we use them can influence students' sense of right and wrong. That's why it's important to apply them thoughtfully. Research shows that both students and teachers need to be aware about the moral issues that include this technology. It additionally points out that instructors need assist and sensible strategies to preserve up with these adjustments and save you the generation from being misused.

The paper[7] by Eduardo Mangareli, discovers the integration of Generative AI and larger language models delts (LLMS) in engineering education, emphasizing their transformative probability and the developing requirements of the educational landscape. Introduction outlines the capabilities of LLM such as GPT, Bard and Cloud, in which their ability to produce consistent materials and the need to consider issues such as grounding and repayment and recovery-disabled pay generation. The method is mainly based on fantasy and practical insights, focusing on how AI can be embedded in curriculum, classroom methods and Software Fatware Engineering workflow. Key findings include update assessment methods, AI-contemporary lab work and prompt engineering and the need for teacher training in the use of Ethical AI. Discussion emphasizes the importance of constantly adapting to integration processes and developing complex thinking among future engineers. The paper concludes by envisioning a future where professionals must combine adaptability with strong technical skills to leverage AI tools responsibly and ethically across various domains.

Generative AI[8] gear like ChatGPT and Bard are reworking better education by way of improving writing, getting to know, and productivity (Dwivedi et al., 2023). However, their use raises moral concerns, particularly round educational integrity, plagiarism, and crucial questioning (Zhou et al., 2023). Floridi and Chiriatti (2020) spotlight blurred strains in authorship, at the same time as Choi et al. (2023) pressure the need for updated institutional guidelines and AI literacy. Students typically embrace GenAI for efficiency, while faculty are more cautious, fearing misuse (Mollick & Mollick, 2023). An examination conducted in Mexico revealed that students preferred ChatGPT, whereas instructors opted for simpler tools. Despite ethical apprehensions, students advocate for guidance rather than complete prohibitions. The academic discourse emphasizes the necessity for explicit guidelines on AI usage, ethical training, and transparent communication between students and faculty. As generative AI becomes increasingly prevalent, it is crucial to maintain a balance between innovation and academic integrity.

The paper[9] by Florian Shimanke examines the growing influence of generic AI tools such as chatgpt in academic surroundings and emphasizes the need to develop the media qualification to use these tools efficiently and morally. It introduces the challenges and opportunities that AI has provided, for example, improved efficiency in education, potential abuse of theft and a reduction in creativity in students. Focus on the current educational methods and the latest AIs develop to highlight the developed educational landscape, the study takes a fantasy approach. It underlines the importance of migrating from traditional grading methods towards continuous assessment models that reflect students' understanding over time. Also paper A.I. Meaning suggests integrating the curriculum by training the studies and promoting responsible consumption in the students. Looking forward, it stands for educational updates that match technological advances, and ensure that AI becomes a helpless in the learning process instead of the danger of educational integrity.

Recent study[10] on the integration of the generic AI in education broadly emphasize their adoption in the countryside, concentrating the limited focus on artistic education and even less in the attitude of art teachers. Although students usually appreciate the efficiency of writing AI equipment and creative functions, there are concerns of educational honesty, moral implications and potential dependence on technology. Politicians highlight the need for digital distinction and adequate access to AI resources. Teachers' approaches vary depending on institutional reference, showing more optimism and adaptability in broad universities than their colleagues in special art colleges, which usually express doubtism due to the reduction of traditional artistic values of AI fear. In particular, there is a significant difference in empirical research associated with teachers of institutions for higher education. This describes the need to detect their unique concerns, such as the authenticity of AI-transmitted material, professional function displacement and dynamics of developing student relationships in creative disciplines.

Recent literature[11] highlights the promises and conditions that are demanding normal integration in higher education. The study, which includes Biswar (2023) and Rakwah et al. (2023) AI displays the capacity of devices that talk to improve the participation of university students, facilitates private learning and guide the school -advanced models. However, anxiety with educational integrity is of good size, with cotton et al. (2023) AI -Report 35% jump in concerned error conduct. Sullivan et al. (2023) reveals inconsistent institutional reactions and emphasizes the need for standardized coverage. Researchers like Skavronskaya et al. (2023) and Tadio and Floridi recommend moral structures to use AI responsible. Overall, literature emphasizes the meaning of coordination with educational objectives, preparations for technical emergency situations and moral needs to create environment to meet students.

III. APPLICATIONS

3.1 Personalized Learning

Generative AI enables education to be tailored to each student's ability, pace, and learning preferences. Systems such as Learning Thread and Author ware use AI algorithms to structure content around an individual's progress and understanding. By analyzing performance data in real time, GenAI platforms adjust content difficulty, recommend resources, and suggest remedial support where needed. This ensures that learners receive the appropriate challenge and support, improving comprehension and retention.

3.2 Adaptive Learning Platforms

AI-powered adaptive learning systems continuously monitor how students interact with course content and perform on tasks. These platforms use this data to dynamically adjust the learning path. For instance, if a student struggles with a specific concept, the system can provide additional resources or simplified explanations. Conversely, advanced learners can be fast-tracked through content they've already mastered. These platforms foster self-paced learning, giving students more control over their educational journey.

3.3 Customized Content Creation

Generative AI excels in producing tailored educational content. From developing unique lesson plans to crafting individualized exercises and assessments, AI tools like Squirrel AI use data on student performance and preferences to generate materials that align with learning goals. Teachers can automate the design of content that suits different learning styles, ensuring inclusivity and personalization in instruction.

3.4 Intelligent Tutoring Systems

AI-driven tutors mimic one-on-one human instruction by providing personalized guidance. For example, IBM's Watson Tutor uses Natural Language Processing (NLP) to engage students in conversation, answer questions, explain difficult concepts, and provide learning hints. These AI tutors are accessible 24/7, offering consistent support outside of classroom hours, especially beneficial in large classrooms where individual attention is limited.

3.5 Feedback and Assessment Tools

Generative AI can automate grading and feedback processes through tools like Gradescope, which can analyze and assess written work and assignments. This not only reduces the workload on educators but ensures timely, consistent, and unbiased feedback for students. AI can highlight areas for improvement and suggest personalized next steps, accelerating the feedback loop essential for effective learning.

3.6 Administrative and Support Systems

Generative AI significantly improves administrative functions such as automated grading, scheduling, enrollment, and student communication. AI chatbots and virtual assistants streamline student support by answering frequently asked questions, guiding them through registration procedures, and offering reminders. These tools save faculty time and reduce operational bottlenecks.

3.7 AI-Enhanced Creativity and Engagement

In creative fields like art, music, and literature, Generative AI plays a pivotal role in content generation. It can assist students in brainstorming ideas, composing music, or generating artwork. Moreover, immersive technologies such as Virtual Reality (VR) and Augmented Reality (AR), when powered by GenAI, provide interactive learning experiences that make abstract or complex topics more tangible and engaging.

3.8 Case Study Applications in K–12 and Higher Education

AI applications vary across educational levels. In K–12 education, adaptive platforms and AI tutors offer highly personalized and engaging learning experiences, contributing to stronger foundational skills and improved student engagement. In contrast, higher education benefits more from AI's ability to handle administrative tasks efficiently and provide sophisticated academic tools. For instance, at the University of Melbourne, AI-powered formative assessment tools enhanced grading accuracy and allowed faculty to focus more on mentoring.

3.9 Computational Requirements and Challenges

Implementing Generative AI tools requires significant computational infrastructure, including GPUs, TPUs, high-speed networks, and cloud computing services. Educational institutions must also prioritize data privacy and cybersecurity, especially when dealing with sensitive student data. Moreover, resistance from educators and students remains a barrier. Effective implementation depends on orientation programs, training workshops, and transparent communication about AI's benefits and limitations.

IV. FUTURE DIRECTIONS

The next strategic plan for ARC includes significant improvements designed to expand its skills and influence on the academic sector. Expected resources, such as evidence-based recommendations, will provide information generated by AI accompanied by scientific situations and references, thus strengthening the academic legitimacy of the platform. In addition, there are intentions to expand the usefulness of ARC in various niche technology domains, which improves versatility in different academic fields. In connection with continuous processing to your recommendation algorithm, the platform will provide more individualized user experiences, enhanced collaborative tools, institutional research networks and integration with Learning Management Systems (LMS). The Generative AI in Education course aims to promote more personalized and adaptable learning experiences. Future innovations are expected to include adaptive learning resources that meet the needs, feelings and rhythm of students' learning. AI agents who work with human teachers can facilitate hybrid learning environments and offer students more adapted help. Cooperation between teachers and decision makers would be important to prepare moral standards, provide teachers training and ensure proper access to AI resources. According to programming training, the AI generative can become intelligent oriental system that helps students to solve, solve and test tasks. Adaptive teaching structures and better aid simulation will be important for promoting educational results. Future research should check the impact of GenAI on educational strategies, course development and student participation while establishing a parent.

V. SIGNIFICANCE AND IMPLICATIONS

Generative AI (GenAI) is reshaping the landscape of higher education by offering powerful tools that enhance learning, support academic research, and streamline administrative functions. One such innovation, ARC, represents a significant advancement in educational technology by directly addressing the challenges undergraduate students face when initiating and conducting research. Leveraging the capabilities of GPT-4, ARC intelligently parses academic content, provides tailored research suggestions, and offers real-time drafting support. Its interactive design simplifies the often-intimidating research process, guiding students from initial curiosity to meaningful academic output. By combining individual student data with a robust database of scholarly materials, ARC fosters deeper engagement with complex engineering concepts, while also promoting critical thinking, academic writing, and research skills. In doing so, it empowers students to become proactive researchers and lifelong learners. More broadly, GenAI holds transformative potential for education by introducing dynamic, learner-centered tools that improve student performance, engagement, and institutional efficiency. These technologies offer immediate feedback, clarify complex concepts, and adapt to individual learning

styles, enabling students to become more independent and motivated. For educators, GenAI streamlines time-consuming tasks such as scheduling, grading, and student data management. This shift allows teachers to focus more on mentorship and personalized instruction, aligning human-centered pedagogy with intelligent automation. The result is a more responsive, efficient, and inclusive educational environment.

This integration of AI in education is particularly impactful in early programming instruction, where GenAI can serve as a scaffold for students with little to no prior experience. By simplifying syntax, explaining logic, and offering real-time debugging help, AI tools lower the barrier to entry and make programming more accessible. However, this support comes with a caveat: over-reliance on AI-generated content may hinder the development of essential skills such as critical thinking, code verification, and problem-solving. The study of AI use in programming education highlights the importance of intentional pedagogy. Educators must design strategies that encourage students to engage actively with AI tools, learning not just from the answers but also from the reasoning behind them. This approach ensures that AI serves as an aid—not a crutch—fostering long-term skill development. The widespread adoption of GenAI is not limited to advanced academic settings or highly technical disciplines. A recent study conducted in a developing country reveals the deep penetration of AI tools in student learning environments, with a high response rate of 78.12% across diverse academic disciplines. This suggests that GenAI technologies are becoming mainstream and are used beyond traditionally tech-focused areas. The most commonly used tools—GitHub Copilot, ChatGPT, Codex, Grammarly, and ChatPDF—illustrate the broad appeal of GenAI, catering to both technical and general academic needs. This trend underscores the urgent need for institutions to rethink their policies, training programs, and ethical frameworks to keep pace with the evolving role of AI in education. The ethical dimension of GenAI integration cannot be overlooked. While these tools have the potential to democratize learning and enhance academic outcomes, they also introduce new challenges related to academic integrity, authorship, and critical evaluation.

A growing body of research emphasizes the need for educational institutions to develop thoughtful, balanced, and ethical approaches to GenAI adoption. Faculty members play a crucial role in this process—not only by staying informed about technological advances but also by actively guiding students in responsible usage. This involves teaching students how to critically assess AI outputs, understand their limitations, and apply them appropriately in academic contexts. In essence, the future of GenAI in education hinges on how well institutions, educators, and students navigate this new terrain. The benefits are clear: enhanced research capabilities, personalized learning, and greater operational efficiency. However, these gains must be balanced with ethical vigilance and pedagogical innovation. GenAI should not replace human judgment or creativity but rather complement it, creating a collaborative ecosystem where technology supports meaningful learning. As educational environments become increasingly digital, the successful integration of GenAI will depend on our ability to harness its potential while safeguarding the core values of education: intellectual growth, critical inquiry, and academic integrity.

VI. CONCLUSION

The future development roadmap for ARC involves a number of promising improvements to help it reach further and become more effective in the academic community. One of the major features under development is Evidence-Based Recommendations, which will give AI-driven recommendations backed by scholarly references and citations. This will go a long way in establishing the platform's academic integrity. ARC also aims to venture into more niche domains of engineering, expanding its reach to cover more academic disciplines. In addition to enhanced recommendation algorithms, users will have more tailored experiences, together with functionality such as richer collaboration tools, cross-institutional networks for research, and interoperability with learning management systems (LMS). The future of generative AI in education lies in tailoring learning experiences. Adaptive learning material that adapts to students' unique needs, emotional conditions, and learning pace is expected to become more common. AI combined with human teachers may result in hybrid learning spaces where students receive individualized assistance. Future progress must guarantee transparency in decision-making by AI, minimize bias, and maximize inclusivity. It will take cooperation between educators and policymakers to set ethical standards and train teachers so that all have access to AI-enhanced tools. Generative AI may also become a smart tutor in programming education to assist students in coding, debugging, and testing. Adaptive learning environments and AI simulation will be pivotal in enhancing learning outcomes. The future research agenda will emphasize the effects of GenAI on instructional methods, course design, and student motivation while ensuring responsible use and academic integrity. Balancing the promise of AI with ethical considerations and making sure that it is used as an assistant, not a substitute, will be key to the future of education.

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