

# **Harnessing AI Chatbots in Higher Education for Innovative and Ethical Advancements in the Built Environment**

**Oluibukun Gbenga AJAYI, Namibia**

**Key words:** Higher Education, Pedagogy, Artificial Intelligence Chatbots, Built Environment, Generative AI, ChatGPT

## **SUMMARY**

As artificial intelligence (AI) continues to revolutionize various sectors, higher education faces both unprecedented opportunities and challenges in maintaining academic integrity while maximizing the potential of AI technologies. This paper explores the introduction of AI chatbots in education, with a particular focus on the built environment fields. It is aimed at evaluating the robustness of AI chatbot integration while identifying the advantages and disadvantages it presents within higher education. The study addresses the pressing need for innovative, safe, and reliable deployment of AI chatbots in academia. It also provides valuable insights into recognizing content generated by AI chatbots, empowering educators to maintain academic integrity while embracing technological advancements. Considering that students can potentially exploit AI chatbots to engage in unethical practices during assessments, innovative means of examining students that mitigate the risk of AI-driven cheating are also proposed by examining alternative assessment methods. This paper not only outlines the transformative potential of AI chatbots in higher education but also serves as a guide for educators to ensure the ethical and effective use of AI technologies within the built environment fields. It advocates for a harmonious coexistence between traditional pedagogical methods and AI-driven innovations, fostering a dynamic and integrity-driven educational experience for all stakeholders in higher education.

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# **Harnessing AI Chatbots in Higher Education for Innovative and Ethical Advancements in the Built Environment**

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## **1. BACKGROUND AND CONTEXT OF AI INTEGRATION IN HIGHER EDUCATION**

The integration of artificial intelligence (AI) into higher education is one of the most pivotal shifts and disruptive innovations in contemporary academia (Sullivan et al., 2023). As the digital age reshapes the way we live and work, it also redefines the very essence of teaching and learning (Ilieva et al., 2023). Over the last decade, AI-driven technologies have gained prominence across industries (Arogundade, 2023), and the education sector has proved to be a dynamic testing ground for the transformative potential of AI (George & Wooden, 2023).

In response to this rapid evolution, educators and institutions have embarked on a quest to harness AI's capabilities, striving to enrich the educational experience, boost learning outcomes, and equip students with skills tailored to the demands of a technologically-driven world (Popenici & Kerr, 2017). The integration of AI in higher education is not merely a trend; it has become an imperative which is increasingly recognized as a source of competitive advantage (Hannan & Liu, 2021). However, this transformation is not without its complexities, particularly as it intersects with the quest for academic integrity.

The application of AI in higher education extends across various disciplines, from intelligent tutoring systems to automated grading and data analytics for personalized learning (Zawacki-Richter et al., 2019). One noteworthy facet of this AI revolution is the emergence of AI chatbots which are intelligent conversational agents designed to interact with students in a human-like manner (Baidoo-anu & Owusu, 2023). At the core of these chatbots are AI-driven software programs designed using natural language processing (NLP) and machine learning (ML) algorithms, to interact with users in a conversational manner by simulating human-like conversations (Aydin & Karaarslan, 2023). These AI chatbots have the potential to revolutionize the educational system, because they offer personalized support, instant access to information, and a dynamic learning experience. Advancements in machine learning and natural language processing (NLP) technologies are, therefore, making the concept of a "smart university" increasingly attainable (Furey & Martin, 2019). This university, which takes pride in its potential to reduce expenses while simultaneously improving efficiency and accessibility (Schiff, 2021), could take advantage of AI to independently manage a broad spectrum of tasks such as automating administrative responsibilities, developing curricula, delivering instruction, conducting assessments, and even managing the process of issuing transcripts and degrees (Hannan & Liu, 2021).

Within the multifaceted sector of higher education, the built environment fields occupy a unique position. The built environment refers to the human-made surroundings that provide

the setting for human activity, ranging from individual buildings and public spaces to entire cities and landscapes. It is the interplay of physical structures, spaces, and natural elements that shape the human experience in the places we inhabit. Understanding the built environment involves digging deep into the dynamics between design, functionality, sustainability, and societal impact. Disciplines such as architecture, geoinformation technology, surveying and geomatics, building and construction management, urban and regional planning, land, estate and property studies, etc, are at the forefront of innovation, as they shape the physical world we inhabit, and as such, are not left out in the significant applicability of AI chatbots (Tarabishy et al., 2022) because these intelligent conversational agents offer a direct path to enhancing education in these fields. In the context of higher education, programs related to the built environment equip students with the knowledge and skills to contribute meaningfully to the planning, design, and construction of our living spaces.

As the built environment field where the fusion of theoretical knowledge and practical application is paramount continues to evolve with advancements in technology and methodologies, the need for effective and innovative educational approaches become increasingly apparent and AI chatbots can bridge the gap by offering students hands-on and dynamic learning experiences. These tools are capable of democratizing access to knowledge, providing instantaneous access to vast repositories of information, and assisting in the resolution of complex, real-world problems (Klutka et al., 2018). Yet, these potential benefits are accompanied by ethical concerns, particularly when it comes to academic honesty and privacy.

This article aims to address the multifaceted challenge of integrating AI chatbots into higher education, with a specific focus on their application within the built environment fields. It provides a critical assessment of the current landscape of AI chatbot integration in higher education, evaluating the technical and pedagogical robustness of these systems, while exploring the unique advantages AI chatbots offer to built environment education even as it also addresses the ethical and practical challenges that accompany their use. Recognizing the potential for academic dishonesty, and in response to concerns about cheating, the article provide educators with practical strategies for identifying content generated by AI chatbots and also presents innovative approaches to assessment that deter students from unethically relying on AI chatbots. Addressing these objectives will equip educators, administrators, and policymakers with a comprehensive understanding of the opportunities and challenges presented by AI chatbots in higher education, particularly within the built environment disciplines.

The rest of this paper is structured as follows; first, an overview of the multifaceted roles of AI-chatbots in higher education is provided (section 2). This is followed by an overview of the robustness of the integration of AI Chatbots in higher education and the implementation challenges (section 3). Section 4 presents practical insights and tips for identifying AI chatbot generated content, with a particular focus on the responsibilities of higher educators in maintaining academic integrity, while innovative assessment methods designed to deter AI-

chatbot cheating are discussed in Section 5. Finally, the article concludes by shedding light on the future prospects and potential applications of AI-chatbots in higher education, particularly within the context of the built environment (Section 6).

## 2. THE ROLES, CURRENT TRENDS AND POTENTIAL BENEFITS OF AI CHATBOTS IN HIGHER EDUCATION

AI Chatbots play significant roles in the built environment higher education. Klutka et al. (2018) opined that the goals for AI in higher education include increase outcomes, increase access, increase retention, lower cost, and decrease time to completion. Zawacki-Richter et al. (2019) also identified four key areas of AI applications for teaching and learning which are profiling and prediction, intelligent tutoring systems, assessment and evaluation, and adaptive systems and personalisation. Some of these multifaceted roles (See Figure 1), current trends and potential promises of the integration of AI chatbots in higher education are discussed as follows:

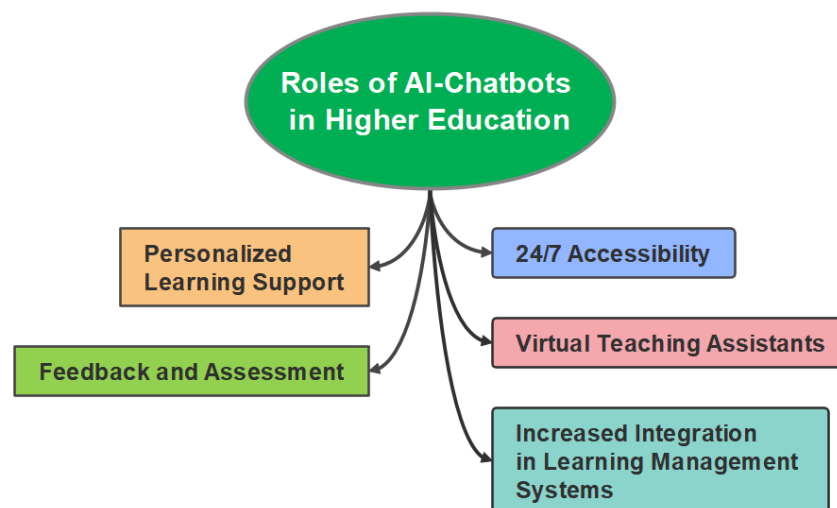


Figure 1: Basic roles of AI-chatbots in higher education

- 1. Personalized Learning Support:** AI chatbots can provide individualized assistance to students, offering guidance on coursework, resources, and study strategies (Baidoo-anu & Owusu, 2023). In the built environment disciplines, where students often grapple with complex design and construction challenges, personalized learning experiences are invaluable. AI chatbots are very good in tailoring content and support to individual student needs (Siirtola & Juha, 2019). They adapt to each learner's needs by analysing individual learning patterns, thereby offering immediate feedback and a tailored, user-defined educational experience, which fosters a more individualized learning journey. This promotes self-directed and asynchronous learning where students are given more autonomy in their learning and are able to complete coursework at their own pace (Bradáč & Kostolányová, 2016). This approach allow students to work at a time that is convenient for them, and it can be particularly

beneficial for students who may have other responsibilities or who may have difficulty attending classes in real-time.

2. **Supporting Diverse Learning Styles:** Built environment education encompasses a diverse array of learners, each with their own unique styles and preferences (Siirtola & Juha, 2019). AI chatbots are adaptable and as such, can cater to different learning styles. They offer a variety of resources, including textual explanations, visual aids, and interactive simulations and intelligent tutorial systems (ITS), which ensures that students engage with content in the way that suits them best thereby adapting to the student's unique learning style, pace, and performance (Bradáč & Kostolányová, 2016). This inclusivity promotes a more accessible and equitable learning environment. It also optimizes student learning experience and academic outcomes (Firat, 2023).
3. **24/7 Accessibility:** Unlike traditional office hours, AI chatbots are available round-the-clock. Students can seek answers to queries at any time and this fosters continuous learning outside the structured classroom system. This advantage encourages independent and flexible learning, enabling students to have greater control over their time and the freedom to complete their coursework at their own preferred speed. It also permits students to engage with their studies at a time that suits their schedule, making it particularly advantageous for individuals with additional commitments or those facing challenges in attending real-time classes (Baidoo-Anu & Ansah, 2023).
4. **Administrative Support:** Beyond the classroom, chatbots are capable of managing administrative responsibilities like self-enrolment, course registration, and offering details about campus services, and campus navigation (George & Wooden, 2023; Hannan & Liu, 2021). This simplifies administrative procedures and, in the process, allows faculty members to focus more on research and other responsibilities (Heilinger et al., 2023), which saves valuable time for both students and staff members.
5. **Feedback and Assessment:** AI chatbots can facilitate formative customized assessments which ensures that immediate feedback on quizzes and assignments are provided (Barber et al., 2021). They can also help in grading routine tasks, allowing educators to focus on more complex evaluation. As an example, these bots can assess students' written assignments and deliver automated feedback on aspects such as grammar, spelling, and sentence structure (George & Wooden, 2023).

The adoption of AI chatbots in higher education is rapidly gaining momentum, with several notable trends. For example, AI chatbots are becoming integral components of learning management systems (LMS) and intelligent tutorial systems (Manju & Anilkumar, 2020). They seamlessly interact with course content and resources thereby promoting flexibility in learning and enhancing the learning experience (Bernacki, 2016). One of the key benefits of intelligent tutorial systems is their capacity to deliver personalized instruction to students, an advantage that cannot be easily achieved in traditional classroom environments. Also, many institutions are employing AI chatbots as virtual teaching assistants which assists educators in

managing administrative tasks, responding to student queries, and even delivering course content (Essel et al., 2022).

The promise of AI chatbots in higher education lies in their potential to revolutionize the learning experience. Figure 2 presents four (4) cardinal anchors that rightly position these tools to revolutionize higher education.

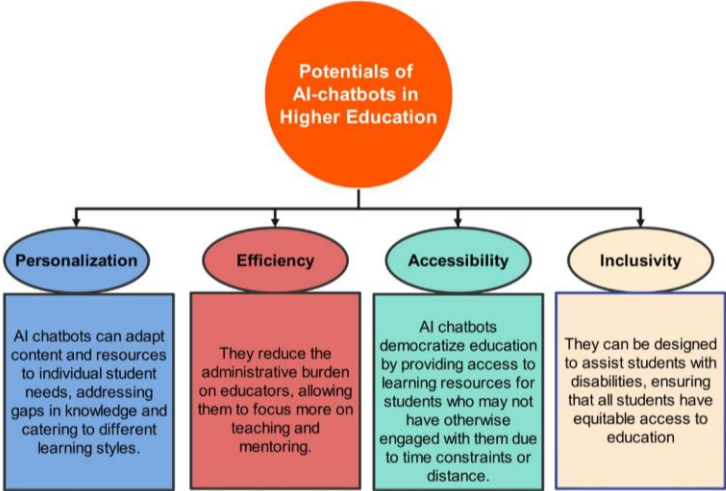


Figure 2: Potentials of AI chatbots in higher education

**3. ROBUSTNESS OF AI CHATBOT INTEGRATION**

The successful deployment of AI chatbots in educational settings hinges on their technical reliability, user experience, and acceptance by both students and educators. Thus, the complex landscape of AI chatbot robustness encompasses evaluations of technical capabilities, user perceptions (see Figure 3), and the formidable challenges and potential roadblocks that must be navigated for seamless integration are discussed in this section.

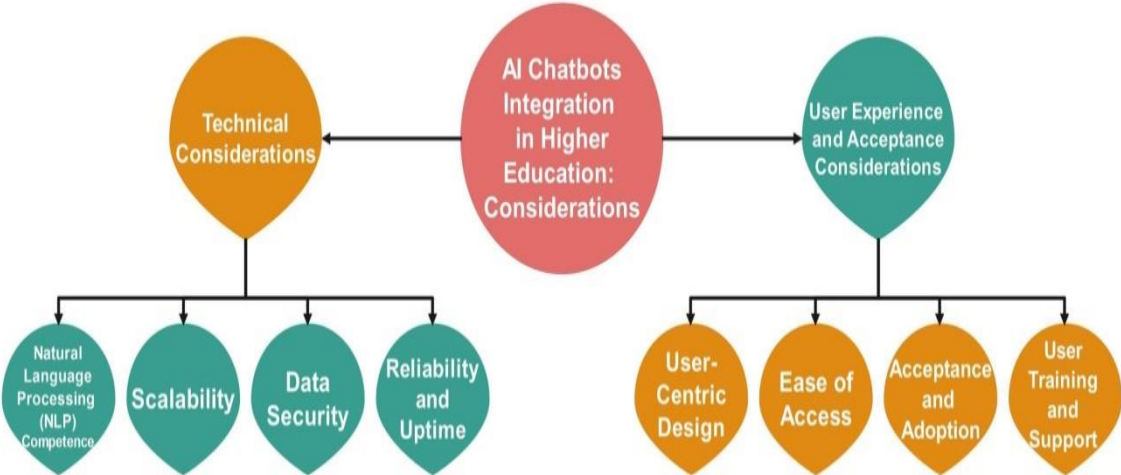


Figure 3: Considerations for the adoption of AI chatbots in higher education

### 3.1 Evaluation of the Technical Robustness of AI Chatbot Systems

At the core of AI chatbot integration is the critical examination of their technical robustness which considers the following:

- a. **Natural Language Processing (NLP) Competence:** The ability of AI chatbots to understand and respond effectively to human language is paramount. Evaluations must assess the sophistication of NLP algorithms, their accuracy, and their adaptability to different dialects and languages.
- b. **Scalability:** The technical infrastructure supporting AI chatbots must be scalable to accommodate a potentially vast user base. Evaluations should consider how well chatbots perform under increased load in order to ensure their capacity and to be sure they can meet the demands of a growing educational institution.
- c. **Data Security:** The robustness of AI chatbots extends to data security. Assessments must thus critically scrutinize the measures in place to protect sensitive information and ensure that data is handled in compliance with relevant privacy regulations.
- d. **Reliability and Uptime:** The reliability of AI chatbots is critical for uninterrupted educational support. Evaluations should examine system uptime, response times, and the mechanisms in place for addressing technical issues promptly.

### 3.2 User Experience and Acceptance among Students and Educators

The robustness of AI chatbots is not confined to technical capabilities alone; it also hinges on user experience and acceptance within the educational system. Considering the acceptance of AI chatbots by educators and learners, the following must be thoroughly examined:

- a. **User-Centric Design:** A key factor in user experience is the design of AI chatbots. Evaluations should consider whether chatbots are designed with a user-centric approach, ensuring that interactions are intuitive and efficient.
- b. **Ease of Access:** Assessments must also scrutinize the accessibility of AI chatbots. Are they available across devices and platforms, ensuring that users can engage seamlessly regardless of their preferred technology?
- c. **User Training and Support:** The robustness of AI chatbots is amplified by the provision of adequate user training and support. Are resources available to help both students and educators maximize their engagement with chatbots?
- d. **Acceptance and Adoption:** User acceptance is a pivotal aspect of chatbot robustness. Evaluations should gauge the extent to which students and educators are willing to embrace AI chatbots as valuable tools in the learning process.

### 3.3. Challenges and Potential Roadblocks in AI Chatbot Implementation

The integration of AI chatbots into higher education is not without its formidable challenges. Baidoo-Anu & Ansah (2023) highlighted several inherent limitations of chatbots, including the reinforcement of existing biases through data training, and concerns related to privacy. Akgun & Greenhow (2022) also advised against the utilization of AI-driven algorithms to forecast individual behaviours based on data gathered from interactions between chatbots and humans, expressing concerns about fairness and individual autonomy in this context. Additionally, Murtarellia et al. (2021) underscored the growing information imbalance associated with AI chatbots like ChatGPT, pointing out that human interactions with these bots can facilitate the gathering of personal data for the purpose of constructing user profiles. Another potential challenge of AI chatbots is the accuracy and reliability of the contents they generate (Grassini, 2023). For example, because ChatGPT, like many other generative AI chatbots, is trained on extensive raw dataset and unfiltered information, it may lack objectivity and has been known to contain significant inaccuracies and biases (Sallam, 2023, Gravel et al., 2023, Wen & Wang, 2023). The effectiveness of generative models relies heavily on the caliber and variety of the data used during their training. If these training datasets contain biases, these biases can inevitably influence the model's output. Also, generative models such as ChatGPT operate solely based on statistical patterns they have learned from their training data. Consequently, these models do not possess a true comprehension of the concepts they assist students in learning (Chomsky et al., 2023, Pegoraro et al., 2023). The following are some of the other potential specific challenges that may be encountered in the adoption of AI Chatbots in higher education:

- a. Potential for Academic Dishonesty:** While AI chatbots offer significant advantages, they also introduce the potential for academic dishonesty (Dehouche, 2021, Debby et al., 2023). Students could exploit chatbots to complete assignments, quizzes, or exams on their behalf because they are capable of generating high quality texts that easily bypass plagiarism-checkpoints (Gao et al., 2023), thereby undermining the integrity of assessment processes. As AI chatbots become more sophisticated, identifying instances of cheating becomes increasingly challenging which necessitates the need for stringent measures to uphold academic honesty (Sullivan et al., 2023).
- b. Ethical Considerations, Privacy Concerns and Data Security:** AI chatbots require access to substantial amounts of data to personalize learning experiences and this raises concerns about privacy and data security (Alkhaqani, 2023). Educational institutions must ensure that robust data protection measures are put in place to safeguard sensitive information, including student records and communication logs. Transparency in data collection and usage is essential to mitigate privacy concerns.
- c. Resistance to Change:** Resistance to new technologies is not uncommon in educational settings. Assessments should consider the readiness of both students and educators to adopt AI chatbots and identify strategies to mitigate resistance. For example, Faculty members, teaching assistants, student counsellors, and



administrative staff may fear that intelligent tutors and expert systems will take their jobs and this may incite them to protest against its implementation (Zawacki-Richter et al., 2019).

- d. Maintenance and Updates:** The long-term robustness of AI chatbots requires ongoing maintenance and updates just like every other systems. Evaluations should explore the sustainability of these systems and the institutions' capacity to support them.
- e. Equity, Inclusion and Access:** There may be disparities in access to and acceptance of AI chatbots among diverse student populations. The adoption of AI chatbots may inadvertently exacerbate inequalities in education because not all students have equal access to technology or the digital literacy required to effectively engage with AI chatbots. Institutions must therefore address these disparities by ensuring equitable access to technology resources and providing support to students who may be at a disadvantage. Failure to do so could result in marginalized students falling further behind.

#### 4. IDENTIFYING CONTENTS GENERATED AI-CHATBOTS

One of the inherent challenges that the integration of AI chatbots in higher education poses as earlier discussed is the potential for academic dishonesty. As these intelligent conversational agents become more sophisticated, they can generate content that mimics human writing. In this section, few strategies and techniques educators can employ to recognize content generated by AI chatbots are presented in Figure 4 and discussed in more detail.

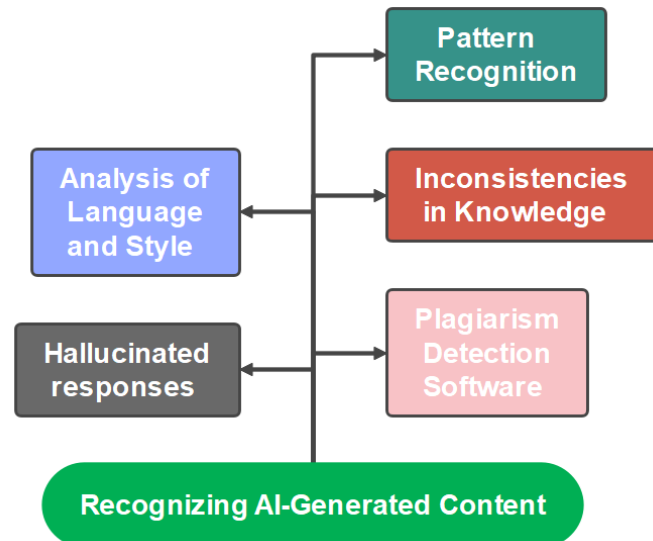


Figure 4: Strategies for identifying content generated by AI chatbots

#### 4.1. Methods and Techniques for Recognizing AI-Generated Content

1. **Analysis of Language and Style:** AI chatbots, while advanced, often exhibit distinctive language patterns and writing styles. Educators can analyse the syntax, vocabulary, and structure of written work to identify inconsistencies that may indicate AI generation.
2. **Plagiarism Detection Software:** Utilizing plagiarism detection tools, such as Turnitin and Grammarly, and even Open AI classifier released on 31 January 2023 can be highly effective in identifying AI-generated contents (Kirchner et al., 2023) by differentiating between AI-written and human-written text. These tools can flag content that matches online sources or exhibits signs of machine-generated text, though they are majorly advisory and can sometimes be incorrect. OpenAI advises users to treat the classifier's results as supplementary information and not exclusively for determining AI-generated content (Elkhatat et al., 2023).
3. **Inconsistencies in Knowledge:** AI chatbots may produce content that contains inaccuracies or inconsistencies (Falke et al., 2019, Maynez et al., 2020). Educators can compare the content with established knowledge and subject matter expertise to identify discrepancies.
4. **Pattern Recognition:** Repeated patterns within the text, such as redundant phrases or unnatural transitions, can be indicative of AI-generated content. Educators can employ pattern recognition techniques to spot such anomalies.
5. **Hallucinated responses:** AI chatbots can produce responses that might appear strange or incorrect, particularly when faced with vague or contextually deficient input. These responses arise from the AI model's text generation process, which relies on patterns it has acquired from its training data. It is crucial to note that AI chatbots lack consciousness or subjective experiences. Their responses are generated based on statistical associations in their training data. At times, these responses can seem disconnected from the context, somewhat resembling hallucinatory experiences, although they are fundamentally distinct. According to Bang et al. (2023), ChatGPT exhibits an average accuracy rate of 63.41% across ten distinct reasoning categories, encompassing logical reasoning, non-textual reasoning, and common sense reasoning. This level of accuracy suggests that ChatGPT can be considered an unreliable reasoning system. The authors of the study also noted that ChatGPT experiences issues related to hallucination.

#### 4.2. Educator's Roles in Maintaining Academic Integrity

Educators play a pivotal role in upholding academic integrity in the face of AI-generated content. Some of these roles include:

1. **Educational Initiatives:** Institutions can implement educational programs and workshops to raise awareness among students about the ethical implications of using AI chatbots to generate academic work (Debby et al., 2023). Educators can actively participate in these initiatives to foster a culture of academic honesty.
2. **Clear Assessment Guidelines:** Providing students with clear assessment guidelines and rubrics can deter the use of AI chatbots. When expectations are explicit, students are more likely to engage authentically with the coursework.
3. **Individualized Feedback:** Educators can offer personalized feedback on assignments, quizzes, and exams, fostering a sense of accountability among students. This direct interaction can also help identify discrepancies between students' knowledge and the content they submit.
4. **Continuous Monitoring:** Regularly monitoring students' progress and engagement with course material allows educators to detect sudden improvements in performance that may be indicative of AI assistance.

## 5. INNOVATIVE ASSESSMENT METHODS

The advent of AI chatbots in higher education has necessitated a reevaluation of traditional assessment methods. Innovative approaches educators can adopt to reimagine assessment in the AI era, emphasizing strategies to deter AI chatbot cheating are presented in this section.

### 5.1. Reimagining Assessment in the AI-Chatbot Era

Traditional assessment methods, such as written exams and essays, are susceptible to AI chatbot cheating. In response, educators are reimagining assessment in the following ways:

1. Project-based assignments where projects that require critical thinking, problem-solving, and the application of knowledge are assigned to learners is an effective assessment method. These projects often involve real-world scenarios and cannot be easily outsourced to AI chatbots.
2. Conducting oral assessments where students are required to explain concepts, solutions, or arguments verbally is also a very good method of assessments in the era of AI. This assesses not only knowledge but also communication skills.
3. Another strategy of student's assessment is involving students in the assessment process by having them evaluate their peers' work. This peer assessment strategy encourages a deeper understanding of course material and reduces the reliance on AI chatbots.
4. Moving away from high-stakes, end-of-term assessments to continuous evaluation throughout the course is also an effective assessment strategy. This approach places a premium on consistent effort and engagement.

## 5.2. Strategies for Designing Assessments that Deter AI Chatbot Cheating

Designing assessments that deter AI chatbot cheating requires careful consideration and innovative strategies. Educators must strive to craft questions that require students to apply knowledge in context-specific scenarios because AI chatbots struggle to navigate through complex real-world problems. Also, the importance of implementing time constraints in assessments can not be over emphasized. Time constraints must be implemented to prevent students from consulting AI chatbots, especially in open book assessments. Time-limited assessments encourage students to rely on their own knowledge and problem-solving skills. In addition to this, randomizing question order and values in assessments can prove to be effective because it makes it difficult for students to share questions or answers with AI chatbots. Meckler and Verma (2022) also suggested requiring students to write by hand during class sessions to ensure successful monitoring efforts. Finally, customizing questions for each student by drawing from a pool of variations is also a good method of designing assessments that deter AI chatbot cheating. This approach ensures that students face unique challenges, making it challenging for AI chatbots to provide answers.

## 6. FUTURE PROSPECTS AND CONCLUSION

While AI chatbots hold the potential to revolutionize education, a balanced approach to technology integration is essential. Technology should augment, not replace, the role of educators. Going forward, it is crucial to recognize that the heart of education lies in the nurturing of critical thinking, creativity, and human interaction. AI chatbots can be invaluable tools to support these objectives, but they must be employed thoughtfully, ethically, and in collaboration with all stakeholders. In the built environment fields and higher education at large, the advent of AI chatbots is marked by the pursuit of educational excellence while upholding the values of ethics, integrity, and inclusivity. Educators, technologists, policymakers, and students can collectively shape a future where technology enhances the human quest for knowledge and understanding by embracing these principles and actively engaging with the dynamic landscape of AI. The future of AI in higher education is marked by continuous evolution and innovation, and AI chatbots will likely continue to play an even more significant role in education.

## ACKNOWLEDGEMENT

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## REFERENCES

1. Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: addressing ethical challenges in K-12 settings. *AI Ethics* 2, 431–440. doi: 10.1007/s43681-021-00096-7
2. Alkhaqani, A. L. (2023). ChatGPT and academic integrity in nursing and health sciences education. *Journal of medical research and reviews*, 2023 VOL 1, NO. 1 10.5455/JMRR.20230624044947

3. Arogundade, O. R. (2023). Structuring Knowledge Bases with AI and Machine Learning. *Information and Knowledge Management* 8: 31–39.
4. Aydın, Ö., & Karaarslan, E. (2023). Is ChatGPT leading generative AI? What is beyond expectations? *Academic Platform Journal of Engineering and Smart Systems*. 11(3). <http://dx.doi.org/10.2139/ssrn.4341500>
5. Baidoo-anu, D. & Owusu Ansah, L. (2023). Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning. *Journal of AI*, 7 (1), 52-62.
6. Bang, Y., Cahyawijaya, S., Lee, N., Dai, W., Su, D., & Fung, P. (2023). A multitask, multilingual, multimodal evaluation of ChatGPT on reasoning, hallucination, and interactivity. *ArXiv preprint arXiv:2302.04023*. doi: 10.48550/arXiv.2302.04023
7. Barber, M., Bird, L., Fleming, J., Titterton-Giles, E., Edwards, E., & Leyland, C. (2021). *Gravity assist: Propelling higher education towards a brighter future*. Retrieved on 28 September 2023 from <https://www.officeforstudents.org.uk/publications/gravity-assist-propelling-higher-education-towards-a-brighter-future/>
8. Bernacki, J. (2016). Recommending learning material in Intelligent Tutoring Systems. *Annales Universitatis Mariae Curie-Sklodowska, Sectio AI—Informatica* 16: 1–2.
9. Bradáč, V., & Kateřina K. (2016). Intelligent Tutoring Systems. *Journal of Intelligent Systems* 26: 717–27.
10. Chomsky, N., Roberts, I., & Watumull, J.N.C. (2023). The False Promise of ChatGPT. *The New York Times*, p. 8. Available online: <https://www.nytimes.com/2023/03/08/opinion/noam-chomsky-chatgpt-ai.html>. Published 8 March 2023, accessed 28 September 2023.
11. Debby R. E. Cotton, Peter A. Cotton & J. Reuben Shipway (2023) Chatting and cheating: Ensuring academic integrity in the era of ChatGPT, *Innovations in Education and Teaching International*, DOI: [10.1080/14703297.2023.2190148](https://doi.org/10.1080/14703297.2023.2190148)
12. Dehouche, N. (2021). Plagiarism in the age of massive generative pre-trained transformers (GPT-3). *Ethics in Science and Environmental Politics*, 2, 17–23. <https://doi.org/10.3354/esep00195>
13. Elkhatat, A.M., Elsaid, K. & Almeer, S. (2023). Evaluating the efficacy of AI content detection tools in differentiating between human and AI-generated text. *Int J Educ Integr* 19, 17. <https://doi.org/10.1007/s40979-023-00140-5>
14. Essel, H. B., Vlachopoulos, D., Johnson, E. E., & Baah, P. K. (2022). The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. *International Journal of Educational Technology in Higher Education*, 19(1), 1-19. <https://doi.org/10.1186/s41239-022-00362-6>
15. Falke, T., Ribeiro, L., Utama, P., Dagan, I., & Gurevych, I. (2019). Ranking generated summaries by correctness: an interesting but challenging application for natural language inference. *In Proceedings of the 57th annual meeting of the Association for Computational Linguistics*, 2214–2220
16. Firat, M. (2023). Integrating AI Applications into Learning Management Systems to Enhance e-Learning. *Öğretim Teknolojisi Ve Hayat Boyu Öğrenme Dergisi—Instructional Technology and Lifelong Learning* 4: 1–14.

17. Furey, H., & Martin, F. (2019). AI education matters. *AI Matters* 4: 13–15.
18. Gao, C. A., Howard, F. M., Markov, N. S., Dyer, E. C., Ramesh, S., Luo, Y., & Pearson, A. T. (2023). Comparing scientific abstracts generated by ChatGPT to real abstracts with detectors and blinded human reviewers. *Npj Digital Medicine*, 6(1), 1–5. <https://doi.org/10.1038/s41746-023-00819-6>
19. George, B., & Wooden, O. (2023). Managing the Strategic Transformation of Higher Education through Artificial Intelligence. *Administrative Sciences*, 13(9), 196. <https://doi.org/10.3390/admsci13090196>
20. Grassini, S. (2023). Shaping the Future of Education: Exploring the Potential and Consequences of AI and ChatGPT in Educational Settings. *Education Sciences*, 13(7), 692. <https://doi.org/10.3390/educsci13070692>
21. Gravel, J., D'Amours-Gravel, M., & Osmanliu, E. (2023). Learning to fake it: Limited responses and fabricated references provided by ChatGPT for medical questions. *Mayo Clin. Proc. Digit. Health*, 1, 226–234.
22. Hannan, E. & Liu, S. (2021). AI: New source of competitiveness in higher education. *Competitiveness Review: An International Business Journal* 33: 265–79
23. Heilinger, J-C., Hendrik K., & Saskia N. (2023). Beware of sustainable AI! Uses and abuses of a worthy goal. *AI And Ethics* 26: 1–12.
24. Ilieva, G., Yankova, T., Dimitrov, A., Bratkov, M., & Angelov, D. (2023). Effects of Generative Chatbots in Higher Education. *Information*, 14(9), 492. <https://doi.org/10.3390/info14090492>
25. Kirchner, J.H, Ahmad, L., Aaronson, S., & Leike, J. (2023). New AI classifier for indicating AI-written text. OpenAI. Retrieved 29 September from <https://openai.com/blog/new-ai-classifier-for-indicating-ai-written-text>
26. Klutka, J., Ackerly, N., Magda, A.J. (2018). *Artificial Intelligence in Higher Education: Current Uses and Future Applications*. Louisville: Learning house.
27. Manju, G., & Anilkumar, K. S. (2020). Rule-based Cognitive Modelling for Multimodal Intelligent Tutoring Systems. *International Journal of Psychosocial Rehabilitation* 24: 17–26.
28. Maynez, J., Narayan, S., Bohnet, B., & McDonald, R. (2020). On faithfulness and factuality in abstractive summarization. *In Proceedings of the 58th annual meeting of the Association for Computational Linguistics*, 1906–1919.
29. Meckler, L., & Verma, P. (2022). Teachers are on alert for inevitable cheating after the release of ChatGPT. *The Washington Post*. Available at: <https://www.washingtonpost.com/education/2022/12/28/chatbot-cheating-ai-chatbotgpt-teachers/>
30. Murtarellia, G., Gregory, A., & Romentia, S. (2021). A conversation-based perspective for shaping ethical human–machine interactions: the particular challenge of chatbots. *J. Bus. Res.* 129, 927–935. doi: 10.1016/j.jbusres.2020.09.018
31. Pegoraro, A., Kumari, K., Fereidooni, H., & Sadeghi, A.R. (2023) To ChatGPT, or not to ChatGPT. *arXiv*, arXiv:2304.01487
32. Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, 12(1), 1-13. <https://doi.org/10.1186/s41039-017-0062-8>

33. Sallam, M. (2023). ChatGPT utility in healthcare education, research, and practice: Systematic review on the promising perspectives and valid concerns. *Healthcare*, *11*, 887.
34. Schiff, D. (2021). Education for AI, not AI for Education: The Role of Education and Ethics in National AI Policy Strategies. *International Journal of Artificial Intelligence in Education* *32*: 527–63.
35. Siirtola, P. & Juha. R. (2019). Incremental Learning to Personalize Human Activity Recognition Models: The Importance of Human AI Collaboration. *Sensors* *19*: 5151
36. Sullivan, M., Kelly, A., & McLaughlan, P. (2023). ChatGPT in higher education: Considerations for academic integrity and student learning. *Journal of Applied Learning & Teaching*, *6*(1), 1-10.  
<https://doi.org/10.37074/jalt.2023.6.1.17> <https://doi.org/10.37074/jalt.2023.6.1.17>
37. Tarabishy, S., Kosicki, M., & Tsigkari, M. (2022). Artificial Intelligence for the Built Environment. In: Bolpagni, M., Gavina, R., Ribeiro, D. (eds) *Industry 4.0 for the Built Environment. Structural Integrity*, Vol 20. Springer, Cham. [https://doi.org/10.1007/978-3-030-82430-3\\_5](https://doi.org/10.1007/978-3-030-82430-3_5)
38. Wen, J. & Wang, W. (2023). The future of ChatGPT in academic research and publishing: A commentary for clinical and translational medicine. *Clin. Transl. Med.*, *13*, 1207.
39. Zawacki-Richter, O. Marín, V. I., Bond, M, & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*. *16*:39. <https://doi.org/10.1186/s41239-019-0171-0>

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