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Deploying AI Technology for Effective Teaching and Learning: The Need to Always Verify Information Gathered from Generative AI Tools

Ogbaga I. Nwoyibe

Department of Computer Science, David Umahi Federal University of Health Sciences, Uburu Ebonyi State, Nigeria.

International Institute for Machine Learning, Robotics, and Artificial Intelligence

***Corresponding author's email:**

ogbagain@dufuhs.edu.ng

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The rapid integration of Artificial Intelligence (AI) technologies in educational settings has transformed traditional teaching and learning methods, presenting both significant opportunities and challenges. This study explored the deployment of generative AI tools, such as GPT, DALL·E, ChatGPT, Jasper AI, and Socratic, highlighting their potential to enhance educational experiences through personalized learning, automated content creation, and real-time feedback. However, the inherent risks associated with AI-generated content, including misinformation, bias, and lack of accuracy, necessitated a critical examination of these tools. Utilizing the PRISMA framework, a systematic review was conducted across two databases, yielding 108 results, of which 18 peer-reviewed articles were selected based on rigorous eligibility criteria. The findings reveal a growing consensus on the need for verification mechanisms to ensure the reliability of AI outputs. Recommendations include the incorporation of AI literacy training in curricula, the establishment of verification protocols, the integration of real-time fact-checking features, and the promotion of critical thinking skills among the users to evaluate AI tools. Furthermore, ethical guidelines for AI usage in education are essential to address concerns regarding bias and misinformation. This study underscores the importance of fostering critical thinking skills among students and equipping educators with the necessary tools and knowledge to navigate the complexities of AI in education, ultimately enhancing the learning experience while maintaining academic integrity.

Keywords: prompt engineering, generative AI, artificial intelligence, educational technology, generative AI tools.

1. Introduction

The integration of Artificial Intelligence (AI) into education has reshaped the way teaching and learning are conducted, fostering a more dynamic, personalized, and efficient learning environment. AI technologies have become essential tools in modern classrooms, offering capabilities such as automated grading, personalized learning recommendations, real-time feedback, and data-driven insights into student performance (Chen et al., 2020). These tools have the potential to reduce the administrative burden on educators while simultaneously providing students with tailored learning experiences that adapt to their needs, learning pace, and academic goals.

Among these AI innovations, generative AI tools—such as language models and content generation platforms—stand out for their ability to produce human-like text, images, and even multimedia content based on minimal input from users. These tools have been widely adopted for various educational applications, from generating essays and solving complex math problems to creating visual aids and interactive content for students (Brown et al., 2020). For instance, language models like OpenAI's GPT can be used to assist students with writing assignments, research, and learning new concepts, while image generators like DALL·E can help visualize abstract or difficult-to-understand concepts in subjects like science and history (Ramesh et al., 2021).

However, despite their impressive capabilities, generative AI tools present significant challenges that need careful consideration, particularly regarding the accuracy and reliability of the content they produce. These tools generate content based

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on probabilistic patterns learned from large datasets, but they do not inherently understand the context, facts, or ethical implications of the information they produce (Bender et al., 2021). This can lead to the generation of incorrect, biased, or incomplete information. For example, AI-generated essays or responses might include factual inaccuracies, unsupported claims, or biased perspectives—particularly when the underlying datasets contain biases (Dipto et al., 2024).

The reliance on generative AI in education thus necessitates a strong emphasis on verification and critical evaluation of AI-generated content. Educators and students alike must be aware of the limitations of these tools and ensure that the information they provide is rigorously checked against reliable sources. The risk of misinformation, especially in academic environments, underscores the importance of promoting digital literacy and critical thinking skills alongside the use of AI technologies. This will help mitigate the potential for AI-generated content to mislead or perpetuate inaccuracies in educational settings (Geoffrey et al., 2024).

Therefore, while generative AI tools offer tremendous potential for enhancing educational experiences, they must be deployed with caution. Both educators and students should be equipped with the skills to verify AI-generated outputs to ensure they are factually accurate, ethically sound, and aligned with academic standards.

2. Literature Review

Artificial Intelligence (AI) has emerged as a transformative force in the educational landscape, offering novel ways to enhance teaching and learning processes. By automating routine tasks, enabling personalized learning, and providing instant feedback, AI technologies have significantly impacted both educators and students. Among these technologies, generative AI tools have gained attention for their ability to create text, images, and other forms of content. However, despite their promise, these tools can sometimes generate incorrect or biased information, highlighting the need for users to verify AI-generated content.

2.1 Generative AI in Education

AI applications in education have revolutionized traditional pedagogical models. Personalized learning systems leverage AI algorithms to adapt instructional content to the individual needs and progress of each student. By analyzing student performance and behaviour, I tools can customize resources and suggest learning paths that cater to the learner's style (Chen et al., 2020). This approach has led to better learning outcomes compared to conventional, one-size-fits-all methods.

Additionally, AI-driven grading tools have streamlined the evaluation process, allowing teachers to focus more on curriculum development and student engagement. The ability to handle large datasets also enables AI to offer insights into student progress, providing real-time data on performance, attendance, and engagement. Such tools create an interactive, learner-centred environment that supports both educators and students (Chima et al., 2024).

2.2 Popular Generative AI Tools in Education

Generative AI tools have become particularly popular for their capacity to produce content autonomously. They can generate everything from essays to images and even multimedia, making them valuable resources for education. However, they also present challenges, particularly around the accuracy and bias of their outputs. Below are five prominent generative AI tools used in education, along with a discussion of their contributions and limitations:

i. **ChatGPT by OpenAI:** One of the most widely used generative AI tools is ChatGPT, a conversational AI that can generate human-like text based on prompts. In educational settings, ChatGPT can act as a virtual tutor, answering student queries, offering explanations, and generating essay drafts. While this tool can be highly useful, its outputs may sometimes contain inaccuracies or incomplete information due to its reliance on probabilistic patterns rather than verified facts (Brown et al., 2020). Educators and students must therefore double-check the information generated to ensure its academic validity.

ii. **DALL·E by OpenAI:** DALL·E is another powerful tool from OpenAI that generates images from textual descriptions. In classrooms, DALL·E can be used to create visual aids for lectures, presentations, and projects, making abstract concepts more tangible. For example, science teachers can use DALL·E to visualize chemical reactions or biological structures. However, the generated images, while creative, are not always scientifically or contextually

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accurate, requiring educators to verify their appropriateness for instructional use (Ramesh et al., 2021).

iii. **Grammarly:** Grammarly is an AI-powered writing assistant that not only checks grammar and spelling but also suggests improvements to clarity, tone, and style. In educational environments, Grammarly supports students by enhancing their writing skills and offering suggestions for better sentence structures and vocabulary. While it can generate alternative phrasings or paraphrased content, it is crucial to review its recommendations to ensure that the generated text maintains academic integrity and aligns with the original meaning (Nazari et al, 2021).

iv. **Socratic by Google:** Socratic is an AI-powered app designed to assist students with problem-solving in subjects like math, science, and literature. By simply taking a picture of a problem or entering a question, students receive AI-generated step-by-step explanations. Socratic serves as a valuable tool for instant homework help or clarifying complex concepts. However, the explanations it generates, while often accurate, still require verification, particularly for complex subjects, as some nuances or details may be oversimplified (Alex, 2019).

v. **Jasper AI:** Jasper AI is a generative tool that creates content for a variety of purposes, from blog posts to essays and marketing materials. In an educational context, Jasper AI can assist educators in creating lesson plans, summaries, and articles on specific topics. It is also useful for students when drafting essays or reports. However, similar to other generative tools, Jasper's outputs can sometimes lack depth or precision, especially when handling highly technical or specialized academic topics. Users must critically review its content before relying on it.

2.3 The Need for Constant Verification

While the aforementioned generative AI tools bring immense value to educational processes, they are not foolproof. AI-generated content is produced by algorithms that analyze large amounts of data, but these algorithms do not inherently understand the context or accuracy of the information they generate. Consequently, AI models can produce false or misleading content—especially when the input prompts are vague or poorly formulated (Bender et al., 2021).

Verification of AI-generated information is crucial in education. Students, in particular, may over-rely on generative AI tools for assignments and research, which could result in the spread of misinformation. Educators must encourage critical thinking and information literacy skills, teaching students how to cross-check AI-generated content with credible sources such as peer-reviewed journals or textbooks (Dipto et al., 2024).

Furthermore, generative AI models can sometimes reflect biases embedded in their training data. This can lead to outputs that unintentionally perpetuate stereotypes or present a skewed perspective on certain issues. Thus, a critical review of AI outputs is essential to ensure that educational content remains unbiased and inclusive (Geoffrey et al., 2024).

2.4 Best Practices for Using Generative AI in Education

To harness the full potential of AI in education while minimizing risks, educators should employ best practices that emphasize critical engagement with AI-generated content. One such practice is integrating AI tools with traditional methods of information verification. This could involve cross-referencing AI outputs with peer-reviewed literature, utilizing established educational resources, or consulting subject-matter experts when necessary (Saqib & Zia, 2024).

Furthermore, educators should teach students digital literacy skills that enable them to critically evaluate AI-generated content. Understanding how AI systems work, including their limitations, can help students use these tools effectively without over-relying on them (Ng et al., 2021). Educators can also set clear guidelines on the ethical use of AI in research and assignments, encouraging students to always verify AI-assisted work

2.5 The Technology Behind Generative AI Operations

The specific technologies behind GenAI are part of the family of AI technologies called Machine Learning (ML) which uses algorithms to enable it to continuously and automatically improve its performance from data. The type of ML that has led to many of the advances in AI that we have seen in recent years, such as the use of AI for facial

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recognition, is known as Artificial Neural Networks (ANNs), which are inspired by how the human brain works and its synaptic connections between neurons.text generative AI and image-generative AI use different techniques. For instance, ChatGPT uses a Generative Pre-trained Transformer (GPT), while image GenAI typically uses Generative Adversarial Networks (GANs).

2.6 The Working Principle of Text-Generative AI Models

The text generative AI uses a type of ANN known as a General-purpose Transformer, and a type of general-purpose Transformer called a Large Language Model. This is why AI Text GenAI systems are often referred to as Large Language Models or LLMs. The type of LLM used by text GenAI is known as a Generative Pre-trained Transformer, or GPT (hence the 'GPT' in 'ChatGPT').

ChatGPT is built on GPT-3 which was developed by OpenAI. This was the third iteration of their GPT, the first being launched in 2018 and the most recent, GPT-4, in March 2023 (see Table 2). Each OpenAI GPT iteratively improved upon the previous through advances in AI architectures, training methods, and optimization techniques. One well-known facet of its continuous progress is the use of growing amounts of data to train its exponentially increasing number of 'parameters'. Parameters might be thought of as metaphorical knobs that can be adjusted to fine-tune the GPT's performance. They include the model's 'weights', numerical parameters that determine how the model processes input and produces output.

In addition to the advancements in optimizing AI architectures and training methods, this rapid iteration has been made possible due to the massive amounts of data and improvements in computing capabilities available to big companies. Since 2012, computing capabilities used for training GenAI models have been doubling every 3-4 months. By comparison, Moore's Law had a two-year doubling period (OpenAI, 2018; Stanford University, 2019).

3. Research Methodology

This study employed a systematic review approach to examine the deployment of AI technology for effective teaching and learning, with a focus on the importance of verifying information generated by generative AI tools. To ensure the rigour and comprehensiveness of the review, we adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, a widely recognized framework for conducting systematic reviews that promotes transparency and replicability.

3.1 Data Sources and Search Strategy

We conducted an electronic search of two primary databases, **PubMed** and **Google Scholar**, using carefully curated search queries that reflected the focus of our study. These databases were chosen for their extensive collections of peer-reviewed articles and multidisciplinary research content, ensuring that the results were both relevant and comprehensive. The search was carried out up to **October 10, 2023**, to capture the most recent and relevant studies on the deployment of AI in education and the implications of generative AI tools.

The search queries included terms such as "AI in education," "generative AI," "AI and teaching," "verifying AI content," and "educational AI tools." The search strategy was iterative, allowing for the refinement of terms to capture as broad a range of relevant literature as possible. The review procedures are presented in Figure 1.

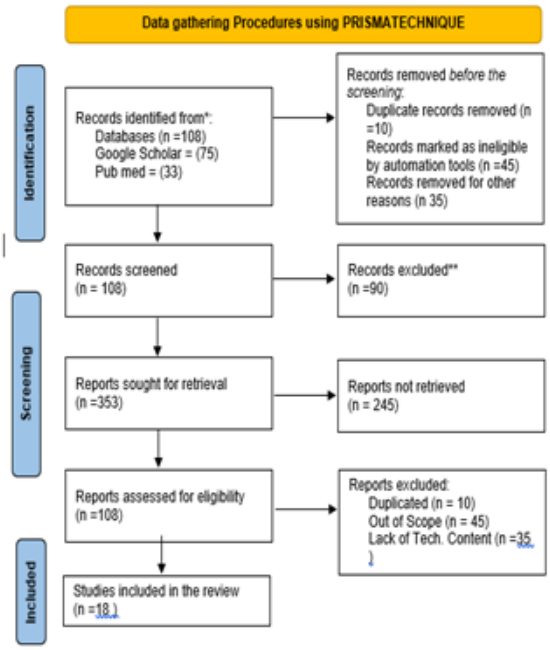

Figure 3: Data Gathering Methodology

3.2 Screening and Eligibility Criteria

The initial search yielded **108 results**, which were subjected to a screening process to ensure the

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relevance and quality of the materials for this study. The following **eligibility criteria** were applied to select the final articles:

1. **Relevance to Research Scope**: Articles had to be directly related to the use of AI technology in teaching and learning, with a specific focus on generative AI tools and the importance of content verification.
2. **Publication Date**: To ensure that the research was current, we prioritized articles published in the last five years (2018-2023).
3. **Technical and Educational Focus**: We included only articles that contained substantial technical details on AI tools, their deployment in education, or discussions about the challenges of verification.
4. **Peer-reviewed Articles**: Given the academic nature of this study, we included only peer-reviewed publications to ensure the quality and reliability of the content.
5. **Language**: We limited the search to English-language publications to avoid potential translation inaccuracies.
6. **Exclusion Criteria**: Duplicate articles, studies irrelevant to the research question, and materials that lacked technical content or focus on AI in education were excluded.

3.3 Justification for Screening and Criteria

The eligibility criteria were developed to ensure that the selected articles would provide relevant insights into the deployment of AI technology in education and address the verification issues specific to generative AI tools. We excluded irrelevant articles to maintain a focused analysis, particularly on the technical and educational implications of using AI tools in classrooms. Articles that lacked a strong technical foundation or did not address the verification of AI-generated content were excluded, as these topics are central to our research question.

Additionally, the decision to use **PubMed** and **Google Scholar** was based on their expansive coverage of technical, educational, and interdisciplinary studies. PubMed was specifically chosen for its robust indexing of articles related to the technical aspects of AI, while Google Scholar provided access to a wide array of studies across multiple disciplines, including education, computer science, and ethics.

3.4 Final Article Selection

After applying the eligibility criteria, **18 articles** were selected for inclusion in the review. These articles offered comprehensive insights into the use of AI tools in education and discussed both the potential and limitations of generative AI in teaching and learning. The excluded materials were either duplicates, irrelevant to the scope of our study, or lacked the technical depth required to inform the discussion on AI deployment in educational contexts.

3.5 Rationale for Methodology

We adopted the PRISMA methodology for this research to ensure a systematic and transparent approach to the literature review. PRISMA allows for a structured process of identifying, screening, and selecting relevant studies, increasing the review process's reliability and replicability (Moher et al., 2009). By using well-defined inclusion and exclusion criteria, we ensured that the selected literature was both relevant and of high quality, facilitating a robust analysis of AI tools in education. This approach also allowed us to identify gaps in existing research, which will inform future studies on the verification challenges posed by generative AI in educational settings.

4. Results and Discussion

The systematic review conducted for this study, based on the PRISMA framework, resulted in the selection of 18 peer-reviewed articles that provided valuable insights into the deployment of AI technology for effective teaching and learning, with a particular focus on the need to verify information generated by generative AI tools. The review identified several key themes regarding the benefits and challenges associated with using generative AI tools in education, as well as strategies for mitigating the risks of misinformation.

1. Widespread Adoption of AI in Education: The articles reviewed revealed a growing trend in the adoption of AI tools across various educational settings. AI technologies are being used to automate tasks, provide personalized learning experiences, and facilitate real-time feedback. Many educational institutions are leveraging AI for grading, assessment, and creating individualized learning paths for students (Chen et al., 2020; Xu et al., 2021). This reflects a positive shift toward more technology-driven approaches to teaching, allowing educators to focus more on fostering critical thinking and creativity among students.

2. Generative AI Tools in Teaching and Learning: Generative AI tools, including large language models like GPT (OpenAI, 2020) and image-generation tools like DALL·E (Ramesh et al., 2021), are increasingly being used by educators and

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students alike. These tools have been praised for their ability to assist with content creation, including drafting essays, generating research ideas, solving mathematical problems, and creating visual aids (Brown et al., 2020). The tools also offer opportunities to enhance student engagement by providing more interactive and personalized learning experiences.

The review identified five prominent generative AI tools frequently discussed in the literature:

i. **GPT (Generative Pre-trained Transformer)**: Used for text generation, including essay writing and answering questions.
ii. **DALL·E**: Generates images from textual descriptions, useful in creating educational visual aids.
iii. **ChatGPT**: A conversational agent that can simulate human-like discussions, enabling students to explore topics interactively.
iv. **Jasper AI**: Focuses on content creation, often used for generating high-quality educational articles and reports.
v. **Socratic by Google**: An AI tool designed to assist students by providing solutions to academic problems, especially in subjects like math and science.

While these tools have demonstrated the potential to enhance the learning experience, concerns were raised about the accuracy and reliability of the information they generate.

3. Challenges of Generative AI: Misinformation and Bias: A common theme among the reviewed articles was the risk of **misinformation** and **bias** in AI-generated content. Since generative AI tools produce content based on patterns learned from large datasets, they can sometimes generate factually incorrect information, perpetuate existing biases in their training data, or fail to account for nuanced understanding (Bender et al., 2021; Dipto et al., 2024; Ogbaga 2023). Several studies highlighted instances where AI-generated text included inaccuracies, unsupported claims, or biased perspectives, especially when addressing complex or sensitive topics.

The review also noted that generative AI tools cannot verify the factual accuracy of their output, underscoring the need for users—both educators and students—to critically evaluate and cross-reference AI-generated content against reliable sources (Marcus & Davis, 2021). This issue is particularly significant in academic settings, where the integrity and accuracy of information are paramount.

4. Verification Strategies for AI-Generated Content: Several of the articles reviewed emphasized the importance of **verification** mechanisms when using generative AI tools in education. Educators are encouraged to teach students how to critically evaluate AI-generated content by cross-referencing it with trusted academic sources, using plagiarism detection tools, and ensuring that the generated content adheres to ethical and academic standards (Geoffery et al., 2024).

Additionally, some studies explored the integration of verification algorithms within AI tools themselves, suggesting that future iterations of generative AI models could incorporate real-time fact-checking features to minimize the risks of misinformation (Ramesh et al., 2021). Although this feature is still under development, its potential implementation could further enhance the reliability of AI in educational settings.

5. Implications for Educators and Policy Makers: The findings from the selected studies point to significant implications for educators and policymakers. While generative AI offers promising opportunities to revolutionize teaching and learning, its limitations in terms of accuracy and bias cannot be ignored. Educators must be trained not only to use these tools effectively but also to understand their limitations and teach students how to critically assess AI-generated content (Chen et al., 2020).

Furthermore, policymakers are urged to consider the ethical implications of widespread AI adoption in education. Developing frameworks that address the responsible use of AI tools, particularly regarding content verification and the prevention of bias, will be crucial in ensuring that AI contributes positively to education without undermining academic integrity (Geoffery et al., 2024).

5. Conclusion and Recommendations

5.1 Conclusion

In conclusion, this study reveals that while generative AI tools offer significant advantages in enhancing teaching and learning, they also come with inherent risks of misinformation and bias. The findings stress the need for verification processes and critical thinking to mitigate these risks, ensuring that AI is used responsibly in educational contexts. Educators and policymakers play a crucial role in fostering the ethical and accurate deployment of AI in education, making it vital to prioritize digital literacy and develop frameworks that address these

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challenges. With responsible implementation, AI technology has the potential to revolutionize education, making it more personalized, efficient, and inclusive.

5.2 Recommendations

Based on the findings of this study, the following recommendations are proposed to enhance the effective deployment of AI technology for teaching and learning, while addressing the risks associated with generative AI tools:

i. **Implement AI Literacy Training**: Educators and students should be trained in AI literacy, focusing on how to critically assess AI-generated content.
ii. **Establish Verification Protocols**: Educational institutions must create verification mechanisms to cross-check AI-generated information with reliable academic sources.
iii. **Integrate Fact-Checking in AI Tools**: AI developers should incorporate real-time fact-checking features to ensure the accuracy and reliability of AI outputs.
iv. **Develop Ethical AI Usage Guidelines**: Establish ethical guidelines to govern the responsible use of AI in education, addressing concerns such as bias, accuracy, and privacy.
v. **Promote Critical Thinking Skills**: Educators should emphasize critical thinking, teaching students to evaluate AI-generated content and verify its accuracy.

5.3 Future Directions and Research Gaps

The study highlights the potential for future research to focus on developing **AI tools with built-in verification mechanisms**. While some AI models are currently exploring real-time fact-checking features, these are still in their nascent stages. Research into improving these tools could help mitigate the risks of misinformation and enhance the reliability of AI-generated content in educational settings (Ramesh et al., 2021). Additionally, future studies could investigate how to better integrate AI into the educational curriculum while maintaining ethical standards and ensuring that students are equipped to critically evaluate AI outputs.

Moreover, the gap in understanding the long-term effects of AI on student learning outcomes should be further explored. While generative AI has shown promise in improving student engagement and personalizing learning experiences, its impact on students' cognitive and critical thinking skills over time remains unclear. Longitudinal studies could provide deeper insights into how AI influences educational practices and student development.

Conflict of interest

The authors declare no conflict of interest.

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