2025 ASEE Northeast Section Conference, March 22, 2025, University of Bridgeport, Bridgeport, CT, USA.

Generative AI in Education: Platforms, Applications, and Ethical Considerations

Muqri, Mohammad
College of Engineering and Information Science
DeVry University
Ontario, CA
mmuqri@devry.edu

Obeid, Simon
College of Engineering and Information Science
DeVry University
Allentown, PA
SObeid@devry.edu

Duclos, Gusteau
College of Engineering and Information Science
DeVry University
New York, NY
gduclos@devry.edu

***Abstract*— Generative AI is a transformative branch of artificial intelligence capable of creating new content, including text, images, music, and code. While it offers significant opportunities across multiple domains, including education, it also raises ethical concerns around issues such as copyright, misinformation, and bias. This paper explores the potential of generative AI to revolutionize teaching and learning, with a focus on its impact on student outcomes. Through an examination of selective platforms such as ChatGPT, Character AI, Gemini, and Deep Seek, this paper aims to introduce students to the fundamentals of building AI-powered applications using large language models (LLMs). Students will engage in hands-on learning by exploring chatbots, question-answering systems, and other AI-powered tools, gaining a deeper understanding of both the potential and limitations of generative AI in educational settings.**

Keywords—transformative; education; ethical

I. INTRODUCTION/BACKGROUND

Generative Artificial Intelligence (AI) is revolutionizing education by providing innovative tools to enhance learning experiences, automate assessments, and support personalized instruction. AI refers to the capability of a computer system to mimic human cognitive functions such as learning and problem-solving. Machine Learning (ML), a subset of AI, enables systems to analyze data, recognize patterns, and make decisions with minimal human intervention. Deep Learning (DL), a further subfield of ML, is inspired by the structure and function of the human brain and forms the backbone of many AI applications, including generative AI.

Generative AI specifically focuses on creating new text, audio, video, or other content types using algorithms like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs). Unlike traditional AI, which is designed to mimic human intelligence across various applications, generative AI aims to produce new data that resembles real-world examples by learning patterns from existing training data. Large Language Models (LLMs), such as OpenAI's GPT series, power generative AI by identifying structures in vast datasets as in [1] and continuously improving through fine-tuning and prompting.

Generative AI operates in three phases:

- **Training**, to create a foundation model that can serve as the basis of multiple gen AI applications.
- **Tuning**, to tailor the foundation model to a specific gen AI application.
- **Generation**, **evaluation and retuning**, and continually improve its quality and accuracy.

The integration of AI in education has the potential to transform traditional pedagogical methods, offering adaptive learning pathways tailored to individual student needs. Generative AI makes learning experiences more personalized by analyzing large volumes of educational data and generating customized quizzes, lessons, and feedback. However, assessing the effectiveness and impact of AI-driven education remains a challenge. To address this, we propose a holistic assessment system that evaluates the role of generative AI in teaching and learning environments.

II. REAL-WORLD CASE STUDIES ON AI-DRIVEN EDUCATION PLATFORMS

Several AI-driven education platforms have demonstrated significant advancements in personalized learning and student engagement. Some notable examples include:

- **Deep Seek**: A cutting-edge AI-powered platform that leverages deep learning to create dynamic and interactive educational experiences. Deep Seek uses real-time student performance data to adjust lesson plans, recommend resources, and provide instant

feedback, making learning as in [5] more efficient and tailored to individual needs.

- **Squirrel AI**: A Chinese adaptive learning platform that personalizes education by analyzing student performance and adjusting content difficulty in real time. It has been widely adopted to bridge learning gaps and improve student outcomes in STEM subjects.
- **Khan Academy AI Tutor**: Integrated with OpenAI's GPT models, Khan Academy's AI tutor provides students with an interactive learning assistant that can guide them through complex subjects, answer questions, and provide personalized feedback.
- **Carnegie Learning**: This platform combines AI-driven adaptive learning techniques with cognitive science principles to improve math education. It offers customized learning pathways based on student progress and comprehension levels.

III. DATA/FORMULATION/METHODOLOGY

To systematically evaluate the effectiveness of generative AI in education, we have developed a holistic assessment system. This system incorporates multiple metrics, including student engagement, learning outcomes, and instructor feedback. The assessment framework is structured using a rubric-based methodology that categorizes AI-generated content based on relevance, coherence, and pedagogical value. Data collection involves student performance analytics, qualitative surveys, and comparative analysis of AI-assisted versus traditional teaching methodologies.

Additionally, our assessment considers the impact of selective AI-powered tools such as Deep Seek, IBM Watson Education [6] and Khan Academy's AI tutor. These systems analyze student progress, provide real-time feedback, and help educators create effective lesson plans. AI-driven tutoring platforms like Squirrel AI offer scalable, personalized tutoring, ensuring students receive support anytime and anywhere. Platforms such as DreamBox and Knewton dynamically adjust lesson difficulty based on student performance, fostering a personalized learning experience.

IV. ANALYSIS

In this section, we analyze the rubric for each assessment criterion. We examine how AI-generated content aligns with learning objectives, measuring its impact on student comprehension and knowledge retention as in [3]. The analysis includes statistical comparisons of assessment scores, student feedback on AI-generated material, and qualitative insights from educators. Additionally, we assess the adaptability of AI tools in different educational settings and their effectiveness in fostering critical thinking and creativity among students.

Organized by our University IEEE Online Students Branch, all the three authors of the paper participated in the" Special Presentation for National Engineers Week" on Generative AI and Education, followed by assessment of AI applications using Deep Seek AI.

Table 1 presents the program outcome, assessment domain, rating, benchmark, and sample size for the "AI Applications using Deep Seek", which was held on Feb 20th, 2025. The sample size for this workshop was 13 students.

Table 2 presents the assessment questions for AI Applications using Deep Seek workshop which was mapped to Student Learning Outcomes (SLOs).

TABLE I. AI APPLICATIONS USING DEEP SEEK

Program Outcome	Assessment Domain	Rating	Benchmark	Sample Size
Leveraging STEM	**Understand DeepSeek**	61%	70%	13
Leveraging STEM	**Utilize DeepSeek**	61%	70%	13
Evaluation	**Generate Images**	84%	70%	13
Evaluation	**Evaluate AI tools**	76%	70%	13
Advanced Application	**Utilize application**	92%	70%	13

Assessment Criteria:
The benchmark is 70% successful completion for each question.

Assessment results:
Question 1:
- Number of participants: 13
- Number of correct responses: 8
- Percentage of completion: 61%

Question 2:
- Number of participants: 13
- Number of correct responses: 8
- Percentage of completion: 61%

Question 3:
- Number of participants: 13
- Number of correct responses: 11
- Percentage of completion: 84%

Question4:

- Number of participants: 13
- Number of correct responses: 10
- Percentage of completion: 76%

Question5:

- Number of participants: 13
- Number of correct responses: 12
- Percentage of Completion: 92%

TABLE II. ASSESSMENT MAPPING FOR AI APPLICATIONS USING DEEP SEEK

Program SLOs		**AI Applications using Deep Seek**
Leveraging STEM	**SLO#1**: Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.	Assessment questions: 1. Deep Seek R1 is 1.2 times faster than ChatGPT-4. (**Understand Deep Seek**) 2. Deep Seek R1 is versatile for general-purpose tasks. (**Utilize Deep Seek**)
Design	**SLO#2**: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.	N/A
Professional Skills	**SLO#3**: Communicate effectively in a variety of professional contexts.	N/A
Evaluation	**SLO#4**: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.	Assessment questions: 1. Deep Seek R1 can create a graphic image for any project. (**Generate Images**) 2. Which of the following is not a key feature of DeepSeek-R1? (**Evaluate AI tools**)
Teamwork	**SLO#5**: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.	N/A
Advanced Application	**SLO#6**: Use systemic approaches to select, develop, apply, integrate, and administer secure computing technologies to accomplish user goals.	Assessment questions: 1. Generative AI operates in three phases. (**Utilize application**)

Deep Seek is a promising AI ChatBot for coding assistance, capable of producing effective solutions as in [1] with some guidance, besides other real world AI education platforms discussed earlier. Other investigations were conducted to compare DeepSeek with ChatGPT outcomes.

Generative AI also plays a role in content creation. AI-driven tools, such as Content Technologies and Carnegie Learning, generate customized textbooks and educational resources [4] tailored to students' needs. These innovations save teachers time and ensure that students receive up-to-date, relevant material. Furthermore, AI-powered assessment tools provide real-time analysis of student performance, allowing educators to intervene promptly and address learning gaps.

However, the integration of generative AI in education raises ethical concerns, including data privacy, algorithmic bias, and academic integrity. Ensuring that AI tools are used responsibly is crucial to maintaining fairness and trust in the education system. Our assessment framework also considers these challenges and explores strategies to mitigate potential risks.

V. CONCLUSION

Generative AI presents transformative potential in education, enhancing the teaching and learning process through adaptive content generation as in [2] and personalized learning experiences. Our holistic assessment system provides a structured approach to evaluating AI's effectiveness, ensuring that it aligns with pedagogical goals. While AI offers

significant advantages, challenges such as ethical considerations, content bias, and the need for human oversight remain.

Future research should focus on refining AI-driven educational tools to maximize their benefits while addressing these challenges. The development of more sophisticated neural network architectures, including transformers and generative models like GANs and VAEs, will further advance the capabilities of AI in education. As reported by HolonIQ, the global ed-tech market is projected to reach $404 billion by 2025, highlighting the growing impact of AI in this sector.

By leveraging AI responsibly, educators can create more engaging and effective learning environments as in [3]. As AI continues to evolve, its role in education will expand, offering new opportunities to improve learning outcomes while ensuring ethical considerations are met. The future of education will increasingly depend on the responsible integration of AI technologies to foster a more inclusive and adaptive learning experience.

REFERENCES

[1] John W. Prados, George D. Peterson, and Lisa R. Lattuca, “Quality Assurance of Engineering Education through Accreditation: The Impact of Engineering Criteria 2000 and Its Global Influence,” Journal of Engineering Education, pp. 165-184, January 2005.

[2] Gina Svarovsky and David Shaffer, “Design meetings and design notebooks as tools for reflection in the engineering design course”, IEEE 36th Annual Conference, Frontiers in Education, pp. 165-184, San Diego, CA, USA, 27-31 October 2006.

[3] Robin S. Adams, Jennifer Turns, and Cynthia J. Atman, “Educating effective engineering designers: the role of reflective practice,” Design Studies, Vol. 24, No. 3, pp. 275-294, May 2003.

[4] C.I. Dym, Alice M. Agogino, Ozgur Eris, Daniel D. Frey, Larry J. Leifer, “Engineering design thinking, teaching, and learning,” Journal of Engineering Education, pp. 103-120, 2006.

[5] Gibney Elizabeth, "China's cheap, open AI model DeepSeek thrills scientists", Nature, Vol. 638, No. 8049, pp. 13–1423, January 2025.

[6] Plenty, Rebecca "Pearson Taps IBM's Watson as a Vrtual Tutor for College Students", Bloomberg, No. October 25, 2016.