Review Article - The influence of Generative AI and ChatGPT on education

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الملخص

دخل مصطلح الذكاء الاصطناعي في حياتنا الرقمية، مؤثرًا في جميع جوانبها. وقد حظي الذكاء الاصطناعي التوليدي باهتمام متزايد لقدرته على إنتاج محتوى إبداعي وواقعي. أصبح الوصول إلى نماذج اللغات الكبيرة (LLMs) ممكنًا بفضل تطبيقات مثل ChatGPTوغيرها، التي تنتج محتوىً يُشبه إلى حد كبير النصوص التي يصوغها البشر. يُعدّ ChatGPT مثالًا بارزًا على تطور تقنيات معالجة اللغة الطبيعية، وهو عبارة عن روبوت محادثة طوّرته شركة .OpenAI يعتمد هذا النظام على بنية GPT (النموذج التوليدي المُدرب مسبقًا)، وقد أُطلق أول إصدار منه للجمهور في ٣٠ نوفمبر ٢٠٢٢. يهدف هذا البحث إلى استكشاف مفهوم الذكاء الاصطناعي التوليدي، والنماذج الأساسية التي ساهمت في تطويره، وتحليل دور ChatGPT في التعليم، بالإضافة إلى استعراض الدراسات الحديثة ذات الصلة. كما يتناول الفوائد المحتملة لـ ChatGPT في تعزيز التعلم الشخصي والتفاعلي، وتحسين استراتيجيات التدريس والتعلم. ويناقش أيضًا بعض المشاكل التي قد تنشأ عن هذه التقنية، مثل إمكانية نشر معلومات مضللة، والتحيز في بيانات التدريب، وقضايا الخصوصية. ويختتم البحث بتقديم مجموعة من التوصيات لمساعدة المعلمين والطلاب على استخدام هذا النظام بكفاءة في بيئة تعليمية إيجابية، تساهم في تعزيز عملية التعلم وتواكب التطورات التكنولوجية السريعة.

الكلمات المفتاحية :

الذكاء الاصطناعي التوليدي، الذكاء الاصطناعي الرمزي، الشبكات التوليدية المتنافسة (GAN)، ChatGPT

Abstract:

The term "Artificial Intelligence" has entered people's digital lives. Generative AI has gained increasing attention for its ability to produce creative and realistic outputs. Access to large language models (LLMs) has become possible because of applications like ChatGPT and others that produce results that closely mimic text produced by humans. ChatGPT is a chatbot that is a prime example of the advancement of natural language processing (NLP) technologies which was developed by OpenAI company. Based on the Generative Pre-trained Transformer (GPT) architecture, that the public was first able to access its version on November 30, 2022. This review aims to clarify the concept of generative Artificial

Intelligence (GAI), the main models that contributed to its development, and to analyze the role of ChatGPT in education, and highlights recent relevant literature. This study explores the potential benefits of ChatGPT in promoting personalized and interactive learning, and seek to improve teaching and learning strategies, and lighting of some of the issues with this technology are included, like the possibility of producing misleading information, biases in training data sets, and privacy issues. This review concludes with a set of suggestions to enable teachers and students to use this tool effectively in a positive learning environment that promotes student learning and keeps up, with the quick changes in technology.

Keywords: Generative Artificial Intelligence (GAI**)**, Symbolic Artificial Intelligence (SAI)، Generative Adversarial Networks (GANs), ChatGPT.

1) Introduction:

Recently, Artificial Intelligence (AI) has become more reliable and is having a direct impact on people's lives rather than just being a theoretical idea. AI relies on a diverse array of algorithms, technologies, and methodologies that enable systems to simulate human mental functions, for example learning, thinking, understanding written and spoken language, self-correction, and problem-solving [1]. All these features have enabled AI to do task that were thought it can only be done by humans. These days, machines can produce new, creative outputs that are similar or even better compared to humans generated content, making it difficult to distinguish between the two. For example, of such technologies are ChatGPT, Dall-E 2 and Copilot and so on, an intelligent tool that assists users with various tasks, such as text generation, answering questions, creating graphics and images, based on training data and providing knowledge support across a variety of fields. But even with these model's enormous potential, there are still issues and problems that need to be investigated further and resolved Responsibly [2]. This study will discuss AI in this setting, describing and outlining how it operates. It will go over the most significant models, that have influenced its creation then introducing ChatGPT as a well-known tool and stressing its significance in the field of

education, along with discussing some pertinent future recommendations, this paper will also evaluate the primary problems related to employing these technologies.

1.1 Research Problem

Due to the great development in information technology, especially in the field of artificial intelligence. Iraq continues to make significant progress in this area for several years ago. However, teachers, educators, and students need more research to focus on the concept of generative artificial intelligence and modern technologies. In addition, learning how combine AI tools with traditional teaching methods, and to know the main limitations and challenges that may arise from the use of these technologies such as data biases, privacy and security issues.

1.2 Research Aim

This study aims to discuss the Generative AI field in terms of its definition and basic concepts, focusing on ChatGPT which is an important tool and clarifying its growing role in the education field. The study looks at the possible educational advantages of utilizing these tools as well as the difficulties and dangers that come with them. The goal of my research is to answer the questions that follow:

1. What is generative artificial intelligence?

2. What were the most important models or pillars that have contributed to its development?

3. What is ChatGPT, and what are its main benefits for teachers and learners in the field of education?

4. What are the most significant limitations and challenges that the educational process faces when ChatGPT and similar tools are used?

2) Literature Review:

Regarding core technologies, Goodfellow et al. presented Generative Adversarial Networks (GANs) in 2014, a foundational innovation in creating systems that could generate new content

closely aligned with original data. It enabled AI systems to create innovative learning materials [3]. Later, in 2017, Vaswani et al. presented the Transformer model in their work "Attention Is All You Need," and it was the foundation for all following large language models such as ChatGPT. The models rely on the attention mechanism to extract context and produce coherent and accurate text [4]. According to the research by Baidoo-Anu and Owusu-Ansah, in 2023, there has been an increase in interest in the role of generative artificial intelligence, in improving the efficiency and quality of education by providing individualized help shaped to each student's needs, and the tools of artificial intelligence meant to supplement traditional teaching. It's necessary to understand the shortcomings of these tools and learn how to successfully combine them with other learning strategies [5]. Kirova and colleagues presented an important study in understanding the ethical consideration associated with the use of generative artificial intelligence models and the challenges arising from their use. The study indicated the need to develop transparent regulatory frameworks to ensure the responsible use of artificial intelligence [1]. Opinions in the literature are divided regarding whether generative AI tools like ChatGPT and others have true creative capabilities or only depend on gathering previously information, Haase et al. explained in a study to test creativity of AI tools, compare ideas generated by humans with those generated by six chatbots, then had them evaluated by humans and by specially trained artificial intelligence. they concluded that artificial intelligence tools possess creativity and can be considered genuine tools to assist humans [6].

3) A background on Contemporary Artificial Intelligence:

It is important to provide a concise overview of symbolic artificial intelligence, which reigned until the late 1980s, before discussing, generative AI models.

Symbolic AI distinct from current AI technologies based on statistical and probability and deep learning algorithms. Symbolic

AI relies on using symbols to represent a variety of objects, as well as the relationships between them, to process information and derive conclusions through specific logical rules in a way that humans can interpret; For example, children, bikes and street could be the objects. The relationships between children and bikes for example could be (children ride bikes) or (children own bikes) and (children sit on bikes) . A formal language is used to define these relationships so that computers can process them. An expert system is a classic application of symbolic AI, given its logical representation of knowledge. These systems address complicated issues that normally need for a high degree of human skill by using knowledge bases and inference procedures. It is used mostly in medical field to give the correct medicine based on the symptoms of the patient. Expert systems apply a set of rules based on the knowledge stored in its database to make judgments or offer suggestions [7]. Symbolic AI has many advantages, the most important of them:

1-Symbolic AI is characterized bye Clarity and transparency makes the reasoning process transparent, making it simpler for individuals to understand how a system reached to a conclusion.

2- Symbolic artificial intelligence is characterized by its adaptability to different fields by modifying knowledge bases.

3- Symbolic AI enables simple representing complicated knowledge in a formal and structured manner. However, it possesses the following weaknesses some of them:

1) Symbolic AI needs complete and well-defined knowledge to work accurately. Symbolic AI may not be efficient in fields where knowledge is not complete.

2) In Symbolic AI there is no self-learning as it cannot improve its performance without human intervention [7],[8].

This led to the need for models that are more capable of learning automatically without explicitly programming every rule. Machine Learning (ML) appeared as a branch of artificial intelligence that enabled using computers to learn from data and make decisions or

predictions depend on that data set [1]. Machine Learning (ML) along with its subset, Deep Learning, works to enhance these capabilities over time without giving them explicit programming. Deep learning relies on multi-layer neural networks to extract patterns, from data. designed to mimic the neurons in the human brain, in order to analyze complex multiple patterns in big datasets. Now, AI not only, performs tasks but also learns and adapts. Improvements in algorithms, computing, and data allow computers to discover patterns and execute tasks faster than humans [1].

4) What is Generative Artificial Intelligence (GAI):

GAI is a branch of artificial intelligence uses deep learning focuses on producing outputs simulating with a high degree of similarity to what a human would create such as, text, pictures, or audio [9]. This term "Generative AI" refers to models which generate new content by learning from the data they were trained on. These models generate content like human, which people can interact with and use, instead of producing only numerical predictions or system rules. A worldwide definition for Generative AI does not exist. This leads to multiple interpretations about the technology. For example, the decision tree model, which generates rules from data, incorrectly receives classification as a type of Generative AI by some individuals. The AI research community applies the term ‘generative’ to complex models which produce human-like content of high quality, not like discriminative models like decision tree models focus on predicting label probabilities from observations [10]. This technique is growing increasingly important for organizations. It makes automated decision-making process easier, finds patterns in big data sets, and boosts overall, efficiency [6].

4.1 The most important models that contributed to the development of Generative AI:

Certain of the foundational models have played an important part in generative AI development by improving the ability of systems to create human content like text, images, and audio in a quality and efficient manner. Some of them are:

1. **Generative Adversarial Networks (GANs):**

Generative AI concepts had existed for many years but gained extreme popularity only in the mid-to-late 2010s [10]. The Generative Adversarial Networks (GANs) framework, a unique method to generative modeling based on an adversarial mechanism between two neural networks, was proposed in 2014 by Ian Goodfellow and his team [3].

In this architecture, the first network, known as the generator, produces new synthetic data, almost exactly like the original data (such as an artificial image of a coin). On the other hand, the discriminator, the second network, aims to differentiate between synthetic and actual data. In the training process, the generator learns to create more realistic data, until the discriminator cannot be able to accurately differentiate between real and generated data. The most use of GAN technology is the generation of images, videos, and audio [5].

2. Large Language Models (LLMs):

Neural networks used for modeling and producing text data are referred to as (large) linguistic models (LLMs) [2]. LLMs models are used in a variety of applications, including suggesting text or email completions by predicting words or phrases depending on previous context. If a sentence starts with "he" or "she," for example, the probability of the following word being "is", is greater than that of "are." etc. [7].

3- The Transformer:

The transformer is artificial neural network architecture adopted on attention mechanisms, without the need for Recurrent Neural Networks (RNNs) or convolutional neural networks (CNNs) Which were used before that, Transformer model offers high performance in machine translation tasks, in addition to its high training efficiency thanks to its parallelism. The transformer model characterized by high-quality and short time for training data [4]**.** Transformer used to transform data efficiently from one form to another. For example, it can take any written text as input and generate outputs like new text, articles, or emails, or create audio or an image [7].

4- The Generative Pre-Trained Transformer (GPT):

The Generative pretrained transformer (GPT) is a type of Artificial Neural Network (ANN) models. It can generate a series of words, code, or other data from an input. There have been several versions of GPTs, like GPT1, GPT2, GPT3, GPT4 [7]. Recently GPT5 [11]. OpenAI has released many versions including: The GPT-1 model is based on the Transformer architecture and uses generative pre-training followed by adjustment for specific tasks [12]. GPT-2, which is known for its ability to generate more reasonable and realistic texts than its predecessor [13]. GPT-3, works effectively on a variety of NLP datasets, such as, question-answering, translation and task performance [14]. GPT-4, released in March 2023, which is distinguished by its ability to process text and images and produce output like human and Supports inputs whether texts or images [15]. Finally, GPT-5, released in August 2025, it is smarter than all previous versions, providing more useful answers in science, health, finance, mathematics, law, and other fields [11].

4-2 Main Components of Generative AI:

Generative AI is based on combining several basic factors in an advanced machine learning approach. Among of the most famous instances is Large Language Models (LLMs), i.e., ChatGPT, which rely on several factors to generate text [1]:

1-The models employ natural language understanding to determine the meaning of the user-provided input text.

2- Diverse training data set such as articles, stories, and conversations.

3- An architecture or model to randomly choose the next word in the response given the words in the sentence or line, such as generative adversarial networks (GAN), a Google's transformer architecture or Markov model.

4- Linguistic rules like grammar and logical rules are applied to ensure that the generated text is acceptable and consistent.

5- The response is generated by a machine-learning component with user interface to manage the needed communication.

The process of generation of text is the following:

1. The user creates a prompt.

2. The prompt is processed by the LLM's transformer engine.

3. For generating a response, the engine makes use of the knowledge gained from the model rules (Step 3.a) and set of training (Step 3.b).

4. A response is generated based on this analysis.

5.The response is returned to the user. See Figure 1 [1].

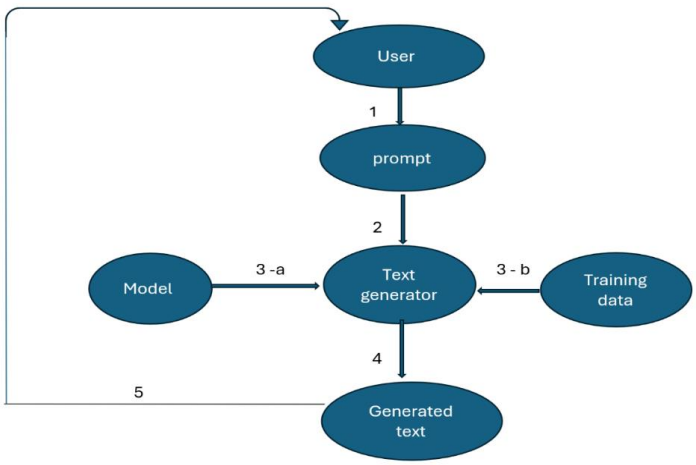

Figure 1: Diagram of an LLM Interaction

5) What is ChatGPT?

ChatGPT is sophisticated generative AI model specially designed to generate natural language text that is as much like human language as possible. It is a Large Language Model (LLM) based on the Transformer framework and a specific model of the Generative Pre-trained Transformer (GPT) developed by OpenAI. It was officially released on November 30, 2022. ChatGPT is a good Natural

Language Processing (NLP) tool. The model is trained on an immense and diverse amount of textual data and can generate logical and readable answers to a wide range of topics. The model can learn context and generate appropriate responses to various questions and prompts [16]. ChatGPT obtained over one million users in less than a week due to its surprising ability to perform advanced tasks, having a revolutionary impact in every field in our life [5]. OpenAI has released and developed several ChatGPT models over the past few years. The widely utilized the version, ChatGPT 3.5 (Chat Generative Pre-Trained Transformer), It was popular as it could be accessed on the Internet very conveniently and free access, after that ChatGPT 4, also existed but at a cost [17]. OpenAI introduced the GPT-5 model in August 2025 which functions as an intelligent system that operates through complex problem-solving techniques and answers diverse user questions. The GPT-5 model delivers superior performance compared to its previous versions because it can answer complex questions while showing better results at reducing hallucinations and improving ChatGPT's main functions which include coding and writing and healthcare applications [11]. But ChatGPT has its pitfalls as well. One major flaw is the "Black Box" problem where it becomes difficult to figure out how exactly the model generates some of its answers due to the complexity of its neural network structure and cryptic pattern-encoding operations. The model also doesn't always produce accurate responses it sometimes generates work which is seemingly true but actually wrong. Just like other AI tools, ChatGPT is also subject to bias since it reflects patterns in the human-developed data that it has been trained on, whose reliability and impartiality become moral issues [9].

The table below highlights some differences between GAI and ChatGPT:

Generative AI (GAI)	ChatGPT
GAI is a branch of artificial intelligence that encompasses various models and applications	ChatGPT is a specific application or model within the GAI
GAI can be applied to support innovation in education, involving content creation and decision support	ChatGPT promoting teaching and learning personalized and interactive learning.
Allows automation and augmentations of tasks in different fields that have traditionally been carried out by humans	In education ChatGPT assists students in writing assignments, answering questions and offering explanations.
Generative AI models may produce incorrect or bias outputs.	Limitations in ChatGPT involve generating wrong information, biases, and privacy troubles.

Table 1- showing a comparison between GAI and ChatGPT based on [2],[5].

5-1 The Function of ChatGPT in Improving Learning:

ChatGPT, as a generative AI tool, is regarded as a potential learning resource of the future that could raise the efficiency and quality of learning when integrated with educators and traditional teaching methods. Academic studies have listed several benefits of integrating ChatGPT into learning, including:

1-Personalized and Dialogue-Based Learning to Suit Student Needs.

ChatGPT can provide interactive tutoring considering ability and level differences in students. This increases learning outcomes as

well as academic achievement by allowing learners to ask questions and receive immediate feedback. Studies show that generative AI chatbots such as ChatGPT can be used to give math tutoring, leading to better outcomes.

2- The model ChatGPT can translate educational materials into many languages without missing meaning or context. This provides study materials to a larger group of people.

3- ChatGPT can grade assignments and essays quickly and accurately. It can also assist teachers in making lesson plans and activities, thus saving time for more innovative and interesting work. It can create questions for exams, solve them, and make complex subjects simple .

4- The model ChatGPT can develop adaptive systems that learn to adjust according to the performance and improvement requirements of the learner and predict future academic performance. This provides useful feedback to aid teaching decision-making.

5-Encouraging Self-Directed Learning: ChatGPT encourages students to organize their own learning schedules and establish independent learning habits. This increases autonomy and encourages students to learn online [5],[17].

5-2 The primary challenges that generative artificial intelligence, including CHATGPT:

1-Artificial intelligence is narrow and limited and differs from intelligence in human, which is flexible and creativity in nature. It may be good at creating texts or images, passing intelligence tests, or playing chess or checkers, but it does not possess the skills that humans possess, such as movement and perception [9].

2- Bias in training data: There is a risk that ChatGPT and other AI tools may perpetuate biases contained in the data they were trained on. The performance of these advanced chatbots depends on the data's quality they are trained on. If the data is biased, or incomplete,

it may negatively impact their results. ChatGPT and other similar technologies are trained on large datasets, and these datasets may contain biases or inaccurate information that could be reflected in the model's results. For example, if ChatGPT is trained on a dataset dominated by females, or by a particular culture or group, this could lead to biased output. It is important to carefully consider potential biases in training data and take steps to minimize these biases to make sure the integrity and transparency of the model [16]. Therefore, researchers will need to be more aware of these risks and take necessary measures, such as using diverse and representative training data, to reduce this problem.

3-Transparency and Explainability Lack

AI sometimes operates as a black box. We might not always know how decisions are generated, and this makes it hard to verify or replicate outcomes [9]. This might allow hidden biases to affect outcomes, which highlights the necessity of using the Explainable Artificial Intelligence, which can be defined as a collection of procedures and techniques that give people the ability to understand and have trust in the outputs generated by machine learning algorithms. The advantages of explainable AI are enhancing trust, and transparency in building AI models, ensuring the understanding and ease of results interpreting, and model evaluating [7].

4- Privacy and Security problems: AI platforms like ChatGPT are based on personal information for training and research, which may affect privacy. There needs to be fortifications against this data from misuse or unauthorized access. some personal information of public figures is already being used as training data, it may result in ethical dilemmas [16],[9].

5- High Resource Demands: Artificial intelligence requires energy, memory, processing power, and training on large amounts of data. Sometimes the data used is not suitable for the required purpose, which in turn leads to the production of incorrect algorithms [9].

6- Job Replacement: AI technologies such ChatGPT can automate processes and reduce the human workforce needs. This raises ethical concerns for losing jobs and changing skill sets. It is critical to use

these technologies ethically and consider their impact on people jobs [16],[18].

7-Lack of Human Interaction: There are students that need real emotional and personal interaction with teachers, which AI is not able to provide. Further, AI lacks true understanding of concepts as it responds based on trained data alone [5].

8- Overconfidence and Limited Accuracy: ChatGPT may give generic or unrelated responses to the subject because it lacks sufficient context [16].

1- One of the drawbacks of generative AI is that users tend to become too dependent on it, hence weakening their independent thinking abilities If used excessively.

6) Results and Discussion:

Generative AI is an advanced branch of artificial intelligence which generates new content such as text, images, or audio that is indistinguishable from the human's work. This shows the impact on professional practice. Despite having its own issues, like ChatGPT and other artificial intelligence tools. These tools are present in the educational field. However, their widespread usage was controversial among teachers. Some called for them to be banned in schools, whereas others developed AI content detection tools. There were also educational policies to assist teachers in stopping students' dependence on these tools in writing tasks like essays and homework. This calls for long lasting actions and not temporary defensive measures [5]. Previous studies have emphasized the potential benefits of utilizing modern technologies because they became part of our lives. However, it is necessary the researchers and educators are sufficiently aware of the associated challenges with these technologies such as misleading results and data bias.

7) Recommendations:

Instead of resisting rapid technological change, education systems need to accept and integrate generative AI tools into teaching

practices.As the tools go common in classrooms and workplaces, several actions are needed:

•Building Teacher Capacity

There is a need for training teachers on the appropriate use of generative AI tools according to their curriculum and teaching requirements. They may not be aware of the complete potential of using such tools in classes, so workshops and professional development training are important to increase their capabilities [18].

• New Assessment Design

The traditional models of testing need to be reconsidered. Educators need to discover how to create new models of testing that result in deeper learning. For example, rather than writing a traditional essay, students might analyze a film and provide a critical report. In coding, rather than writing full code from scratch, students might modify or improve a pre-existing piece of code. These methods result in problem solving and real-world knowledge [7].

• Preparing Students for Future Work Environments

Students must learn to interact positively with AI tools, as future workplaces will heavily rely on these technologies.

• Updating Curricula

Every field is impacted by AI, including the humanities, social sciences, medical sciences, engineering, and the arts. Every academic program needs to include at least one course that introduces students to artificial intelligence (AI) and how it affects their field. Because of the growing involvement of AI, academic integrity [7].

These changes pose some very important inquiries:

1- How can ChatGPT be utilized to effectively aid student learning؟

2- How can GAI tools be incorporated to train instructors to ensure they can use it properly in teaching classrooms?

3- Will these technologies reduce or exacerbate the digital divide?

Together, educators, academics, legislators, and tech specialists must create safe and efficient methods of applying generative AI tools to enhance learning and advance education.

8) Conclusions:

Generative Artificial Intelligence (GAI), along with predictive models and other AI tools, have significant potential to achieve tangible social and economic benefits by improving efficiency and service quality. As this potential grows, it is no longer possible to abandon the use of these technologies. Rather, efforts must be directed toward incorporating its use in our daily life responsibly and effectively. With AI remaining a constant in the future, it becomes important for educational and economic institutions to adapt to this reality by investment in technology and human capabilities working alongside it. It is worth mentioning that generative AI cannot be considered a replacement for humans, but rather as a tool that supports creativity in various fields. In this context, the responsible use of AI tools is necessary to ensuring the safety and quality of results. This requires a comprehensive understanding of how these tools are employed and avoiding the risks of hallucinations or the production of false content. Attention should also be paid to ethical aspects and potential risks. While this research provides a foundation for understanding the potential of AI in education, there is an urgent need for further applied research in real-world educational settings to verify the effectiveness of these tools in supporting effective and comprehensive learning.

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