When Code Begins to Dream: Anthropomorphism in AI Powered Educational Tools

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Abstract

Anthropomorphism, the attribution of human traits to non-human creatures, has become popular in artificial intelligence-powered educational technologies to improve user interaction and learner engagement. This study examines the importance of anthropomorphism in AI-driven educational aids, analysing its psychological foundations, use in large language models (LLMs), and effects on student learning outcomes. This paper employs a conceptual analysis of current AI products (e.g., ChatGPT, DuoLingo Max) and utilises theoretical frameworks such as Social Presence Theory and the Uncanny Valley hypothesis to investigate the impact of human-like design elements—voice, emotion, and behaviour—on learner motivation, trust, and comprehension. The discourse encompasses advantages, such as enhanced engagement and tailored feedback, as well as concerns, including emotional manipulation, misrepresentation of AI capabilities, and diminished critical thinking. The study concludes that although anthropomorphism can greatly improve educational experiences, its implementation must be meticulously adjusted to prevent ethical dilemmas and reliance.

Keywords: Anthropomorphism, Artificial Intelligence, Educational Tools, Ethics, Students

1. Introduction

The rapid proliferation of artificial intelligence research is giving rise to a multitude of ethical concerns including safety, risks, and more consequences than ever before. In order to properly address these challenges and take part in a constructive normative discourse, we contend that it is vital to carry out a scrutiny of fundamental concepts and categories. Anthropomorphism is leading in the categories. It is common practice to anthropomorphize artificial intelligence (AI) functionalities and advances, which signifies that they are conceptualized and described together with human traits. Recent breakthroughs in AI systems have catalyzed a range of creative goods, services, and business models, while inciting contentious public and academic discussions over the merger of people and machines (Vogt, 2021).

Assigning clearly human feelings, cognitive states, and behavioral characteristics to inanimate objects, animals, and more generally to natural occurrences and supernatural creatures is an example of anthropomorphism (Airenti, 2015; Epley et al., 2007). Anthropomorphism is a phenomenon that is widespread and is not necessarily tied to particular properties of the anthropomorphized object (Airenti, 2015).

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Furthermore, it is not dependent on the logical state of the entities that have been anthropomorphized. People tend to attach human attributes to things like religious leaders, animals, the environment, and technological artifacts (ranging from computational gadgets to robots), despite the fact that there is no evolutionary connection between people and these things and that they are noticeably diverse from living creatures. Consequently, anthropomorphism does not designate actual physical qualities or behaviors; instead, it embodies a specific human-like interpretation of these features and behaviors that transcends direct observation (Epley et al., 2008).

The practice of assigning human features to non-human entities, known as anthropomorphism, has been shown to greatly improve user engagement and comprehension in the perspective of instructional technology projects. This phenomenon is complicated because it involves a number of different psychological and social elements that exert an influence on how users interact with technology. In educational settings, anthropomorphism can improve learning by making complex systems more relatable and accessible, hence enhancing mental models of virtual agents and avatars (Nowak & Biocca, 2003). This can be accomplished by turning elaborate systems more tangible and straightforward. Furthermore, it assists in the advances of emotional links, which are requisite for the successful completion of learning experiences.

Folk psychology and basic psychology are both included in the field of anthropomorphism, which enables individuals to comprehend technology through the use of human-like behaviors that are easily recognized. According to Nowak & Biocca (2003), users tend to have a more positive reaction to anthropomorphized interfaces, which means that this slant has the potential to increase user satisfaction and contribute to the perceived legitimacy of instructional aides. Despite the fact that anthropomorphism has the potential to significantly enhance instructional technology, it is crucial to be conscious of the potential drawbacks associated with it. One of these drawbacks is the progress of erroneous expectations regarding the capabilities of the technology.

2. Antecedents of Anthropomorphism

A number of elements were identified that contribute significantly in giving rise to anthropomorphism. Initially, anthropomorphic characteristics have been considered to be a noteworthy aspect in determining is anthropomorphism. Three distinct categories pertaining to human characteristics: visible (such as appearance, movement of the body, facial expressions, and movements in the face), vocal (for example, voice), as well as psychological (Cao et al., 2019). Literature did, in fact, reveal that visual characteristics, such as a look that is human-like (Choi et al., 2019; Kim et al., 2019; Lee et al., 2015), eyes (Niu et al., 2018), and emotionality (Kim et al., 2019); verbal attributes, such as voice (Waytz et al., 2014) and language that is analogous to that of humans psychological distinctiveness, such as expressions (Araujo, 2018); and expressions the reason being that autonomous vehicles (Lee et al., 2015) can lead to anthropomorphism.

Wagner & Schramm-Klein (2019), findings indicated that social behavior, adaptability, and similarity to the user, their temperament, their autonomy, their voice, and their look and interaction are the elements that play a role in the evolution of AI enhanced technology (AIET), anthropomorphism. On the other hand, empirical findings are irregular in nature; Schroeder & Schroeder (2018) were unsuccessful to demonstrate that the human voice has the knack to motivate mimicry of human beings and also advocated that there should be humanistic characteristics included in AIET to attain a certain level of "humanness" in order to induce anthropomorphism.

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Finally, many kinds of partnerships via means of AIET (for example, by using AIET as a buddy or a servant) promote the exercise of anthropomorphism. It was discovered (Kim et al., 2019) that different kinds of connections with AIET form the manner in which consumers are able to experience anthropomorphism. Finally, studies have divulged that there is a considerable variation in the perceived intelligence of AIET belonging to the category of anthropomorphism (Moussawi et al., 2021).

3. Research Gap

Although anthropomorphism is becoming more popular in artificial intelligence-powered educational systems, most study focusses on its psychological and interactional benefits, such as greater user engagement and trust. However, the long-term cognitive and ethical effects of anthropomorphised AI on learners, especially in educational contexts where technological trust may impede critical thinking and autonomous learning, are still unknown (Scorici et al., 2024). Most current research focusses on user experiences or commercial applications, not how anthropomorphic design affects students' developmental trajectories, critical reasoning, and emotional reliance. There is also inadequate empirical evidence on how anthropomorphic cues in AI systems may manipulate or mislead learners, especially younger users, by producing illusions of human-like agency or comprehension. This study explores the pedagogical benefits and ethical challenges of anthropomorphised AI in education to fill these gaps and promote more responsible and informed design processes.

4. Objectives of the Study

1. To analyze the concept of anthropomorphism and its psychological foundations within the context of AI-powered educational tools.
2. To identify and discuss the ethical implications and potential risks associated with anthropomorphizing AI in educational environments, including issues of emotional manipulation, over-reliance, and privacy.
3. To propose guidelines for the responsible and pedagogically sound integration of anthropomorphic features in AI-driven educational tools.

5. Anthropomorphization in Large Language Models

In order to comprehend the probabilistic structure of language, large language models, also known as LLMs, are a category of neural networks that have been trained on a considerable entirety of textual data. Throughout the course of their history, LLMs have been employed for downstream chores such as machine translation and text categorization (Devlin et al., 2018; Raffel et al., 2020). Over the track of the past few years, the effectualness of conversational LLMs like ChatGPT and BARD has enabled them to become proficient at engaging with persons in a variety of settings. As an upshot of the fact that LLMs (Buscemi & Proverbio, 2024) are capable of carrying on conversations, an increasing number of businesses and manufacturers have begun to employ them for the purpose of hyper-personalization and customization.

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Table 1. AI products based on LLMs and their anthropomorphic features

Model Name	Description	Capabilities	Developed By	Parameters	Additional Notes
Seq2Seq	Deep learning technique used for machine translation, image captioning, and natural language processing. Shaikhiyeva et al., 2024)	Machine translation, NLP (Xue, 2024)	Google	N/A	Underlies several current LLMs, notably LaMDA; also used in AlexaTM 20B.
Eliza	Early natural language processing program from 1966, emulating dialogue through pattern recognition.	Dialogue simulation	Joshua Weizenbaum	N/A	Introduced early concepts of conversation al AI.
BERT-Large	Analyzes words in relation to their contextual environment, akin to human cognitive processing.	Natural language processing	Google	340 million	Grasps intricate meanings.
Claude	LLM focusing on constitutional artificial intelligence with branches Opus, Haiku, and Sonnet.	Recognizes complexity, humor, and subtlety	Anthropic	175 billion	Claude 3.5 Sonnet is the most recent version.
Cohere	AI system offering several LLMs for business applications.	Custom-training for fine-tuning	Aidan Gomez Ivan Zhang Nick Frosst	top-p, top-k, frequency penalty, and presence penalty	Provides command, re-rank, and embed models.
DeepSeek-R1	Open-source reasoning model for complex reasoning tasks.	Mathematical problem-solving, logical inference	Liang Wenfeng	671 billion	Enhances reasoning with reinforcemen t learning strategies.
Falcon	Transformers-based model family supporting multiple languages.	Multimodal operation	Technology Innovation Institute	11 billion (Falcon 2)	Open-source.

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Table 1. AI products based on LLMs and their anthropomorphic features (Cont.)

Model Name	Description	Capabilities	Developed By	Parameters	Additional Notes
Gemini Ultra	Google's family of multimodal LLMs for their chatbot.	Handles text, images, audio, and video	Google	1.5 trillion	Available in Ultra, Pro, and Nano sizes.
GPT-4o	OpenAI's multimodal successor to GPT-4 with enhanced features. (Liu et al., 2023)	Processes voice, image, and text	OpenAI	200 billion	Faster than GPT-4 Turbo, enables real-time interaction.
Llama-4	Utilizes transformer architecture, trained on varied data sources.	Multimodal language understanding	Meta AI	2 trillion	Available under an open license.
Mistral	Family of mixed expert models with extensive language support.	Text and visual data processing	Mistral AI	123 billion	Includes Pixtral Large for multimodal tasks.
Palm	Transformer-based model with a focus on reasoning tasks.	Coding, mathematics, question answering	Google	540 billion	Drives the AI chatbot Bard.
Qwen	Family of models by Alibaba Cloud supporting multiple languages.	Code production, data comprehension	Alibaba Cloud	Up to 72 billion	Supports 29 distinct languages.

AI products that are built on LLMs and their human characteristics are some examples. Certain goods are purposefully constructed to have an anthropomorphic appearance, (Hou & Lian, 2024) while others acquire such characteristics as a product of the design process (CHATGPT to be more precise). These goods have an ample series of uses, including those in academia, treatment, and entertainment. Until recently, LLMs (Ren, 2024) were confined to research laboratories and technological demonstrations at AI conferences. Currently, they are driving numerous applications and chatbots, with hundreds of distinct models accessible for personal deployment.

6. Overview of Theoretical Foundations

The use of anthropomorphism dramatically improves social presence in online interactions, which in turn influences user trust and satisfaction in a variety of scenarios, including customer service and healthcare. Among the factors that contribute significantly to the formation of these perceptions are the design aspects of anthropomorphic agents, which include human-like look and communication style. Anthropomorphism serves as the cornerstone of human-AI interaction, influencing the way individuals

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perceive and connect with machines. Elements like an engaging appearance and relatable communication style play a crucial role in shaping user trust and satisfaction. Theoretical perspectives such as the Social Response Theory, Uncanny Valley Hypothesis, Cognition-Motivation-Emotion Framework, Faith Theory, Social Presence Theory, and the Three-Factor Theory of Anthropomorphism shed light on the reasons behind human social and emotional responses to AI. (Adam et al., 2021; Verhagen et al., 2014; Diederich et al., 2019; Kim et al., 2019; Yu, 2020; Gursoy et al., 2019; Yen & Chaing, 2020; Schroeder & Schroeder, 2018, and Lee et al., 2015). Collectively, these theories demonstrate that anthropomorphism boosts social presence, fosters trust in capable machines, and encourages engagement. In practice, this is clear in customer service and healthcare, where humanlike AI enhances user engagement and elevates the quality of interactions.

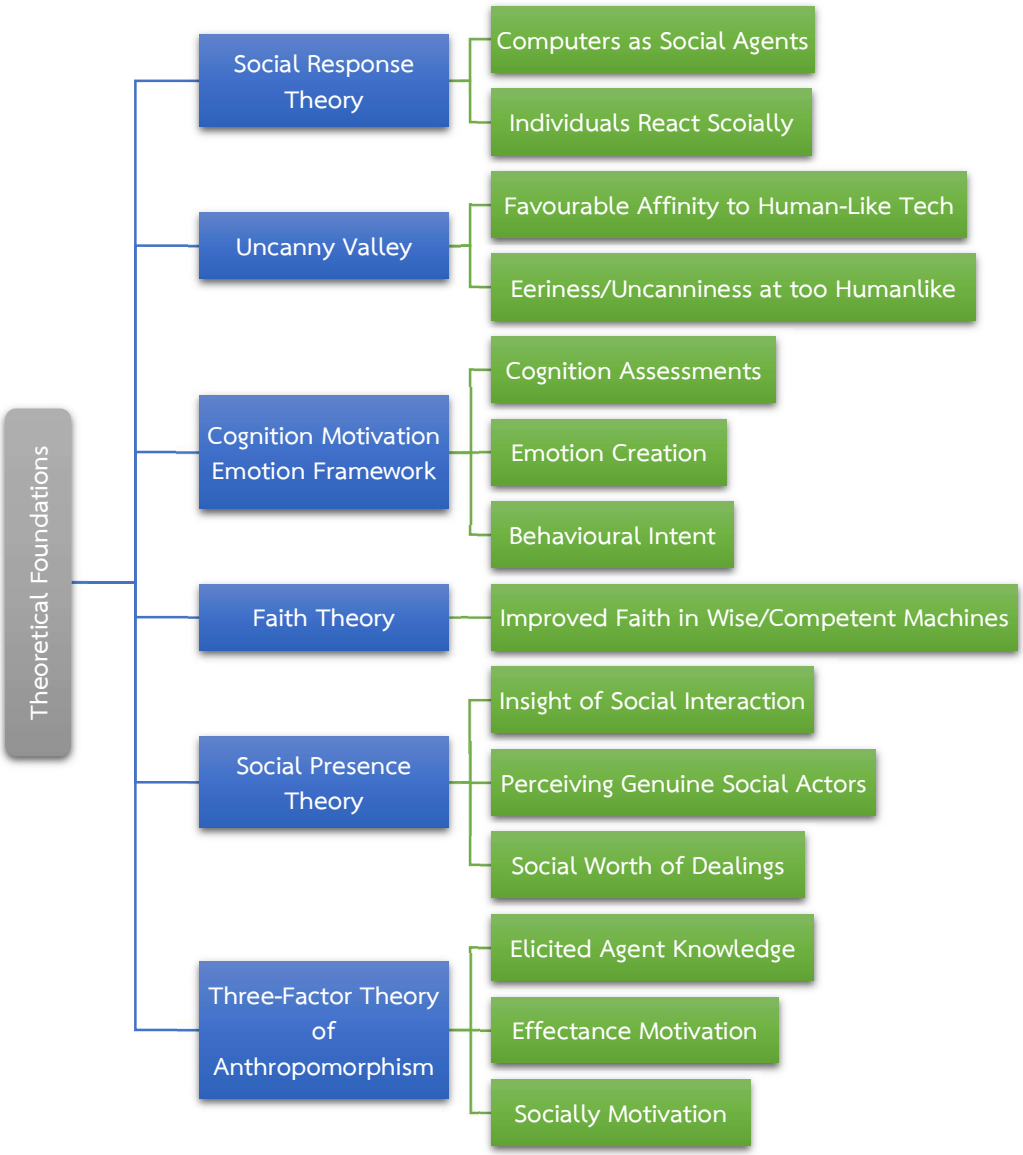

Figure 1. Theoretical Foundations

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This research is based on a multi-theoretical framework that elucidates the reasons and mechanisms behind users, especially students, reacting to anthropomorphised AI in educational settings. Each theory (Basyal & Sanghvi, 2023) offers a distinct perspective; however, they are interconnected by common issues of human-computer interaction, perception, trust, and emotional involvement.

7. Anthropomorphism's Future in AI backed Educational Tools

Educational tools driven by artificial intelligence, anthropomorphism, which is the practice of giving human-like features to non-human entities, can have a number of advantageous effects. The following are some critical benefits:

1. Enhanced Engagement and Motivation- Students have a greater likelihood of engaging with instructional materials that feel relatable and participatory. This is because learners are more liable to be motivated to learn. Learners may experience a greater sense of motivation to utilize AI tools and maintain engagement for extended lengths if these tools are endowed with human-like characteristics, such as empathy, humor, or the skill to connect in conversation.

2. Improved Learning Experience- Anthropomorphized artificial intelligence has the possibility to improve the learning experience by making difficult topics more approachable by presenting them in a style that is more personable and intelligible. According to Bai et al. (2023), a human-like artificial intelligence instructor, for instance, is able to explain complex ideas by employing metaphors that are easily understood by the learner or by modifying its tone to correspond with the learner's emotional state.

3. Personalized Learning- When AI-powered tools emulate human-like characteristics; they are able to simulate personalized engagement, which is similar to the dynamic that exists between a teacher and a student (Adam et al., 2020). This results in an atmosphere in which students have a better feeling of being supported, as they are presented with pointer that appears attentive and is tailored to their specific requirements.

4. Increased Comfort and Trust- Human like artificial intelligence designs have the potential to build emotional connections, so reducing anxiety, particularly in areas like as mathematics and physics, in which students may sense susceptible or lack confidence. Students might have a higher level of trust in artificial intelligence teachers if they appear to be understanding and empathic, which could result in improved learning outcomes.

5. Encourages Active Participation- The use of anthropomorphic artificial intelligence systems may inspire students to engage in more actively by providing them with the sketch that they are intermingling with a human-like assistant rather than a cold, impersonal machine. This may encourage students to ask questions or converse more freely.

6. Reduction of Social Barriers - Anthropomorphic artificial intelligence can serve as a non-judgmental and friendly option for pupils who may be timid or reluctant to interact with human teachers. In an educational setting, this can help decrease the obstructions that thwart individuals from asking questions or seeking assistance.

7. Reinforcement of Positive Behavior- Artificial intelligence technologies that mimic human behavior can imitate social cues such as praise, encouragement, or constructive criticism. This helps to facilitate the development of a growth mindset and reinforce positive learning behaviors. As a result, one may have a more optimistic outlook on the process of learning.

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8. Adaptive Emotional Feedback- Anthropomorphic artificial intelligence tools have the ability to respond to the emotional requirements of students through adaptive emotional feedback. The artificial intelligence may, for instance, provide reassurance or a reduced explanation to a learner who appears to be experiencing frustration. This would make erudition more adaptable and empathic.

9. Designed with Humans in Mind- According to Angelov & Gu (2018), the development of anthropomorphic machine learning is aimed at producing artificial intelligence systems that are not only more effectual but also better suited to the requirements of humans, hence improving the eminence of education as a whole.

According to Deshpande et al. (2023) anthropomorphized artificial intelligence has the impending to make the teaching and learning process more pleasurable, hence encouraging students to participate more actively with the subject matter. Users frequently develop emotional connections with anthropomorphized entities, which can result in enhanced information retention and a more personalized learning experience.

"The inclusion of potential limitations and risks related to the use of anthropomorphism in AI-powered educational tools has already been addressed under the broader discussion of ethical constraints and complexities, thereby contributing to a more balanced and comprehensive perspective."

8. Ethical Constraints and Complexities

As it comes to the design of educational technologies driven by artificial intelligence that anthropomorphizes learning experiences, there are various ethical questions that arise. It is necessary for these technologies to manage complicated concerns about agency, transparency, and the possibility of deceit, all while guaranteeing that users have equal access and that their privacy is respected simultaneously.

1. Over-Reliance on AI - An Excessive Use of Artificial Intelligence, students may have the hunch that these systems are more trustworthy or capable than they actually are if they are exposed to anthropomorphized artificial intelligence tools. These tools simulate human-like characteristics, such as empathy and humor. This can result in pupils placing an excessive amount of dependence on the artificial intelligence, coming to rely on it for direction and potentially putting critical thinking or collaboration with human teachers on the back burner.

2. Misrepresentation and Trust- When artificial intelligence systems are built to appear more human-like, users may be more apt to trust them, even if the information they deliver is inaccurate or biased. An ethical conundrum is created as a result of this situation since the system may unintentionally deceive students into deeming that it contains human-level comprehension or emotions, which can result in students placing their trust in it.

3. Emotional Manipulation- Anthropomorphized artificial intelligence systems have the ability to affect students' feelings by imitating emotional reactions such as empathy or encouragement. This type of manipulation is known as emotional manipulation. Concerns regarding emotional exploitation are raised as a upshot of this phenomenon, particularly for younger children, which might cause the border between genuine emotional exchanges and controlled, algorithmic responses to become blurry.

4. Privacy and Data Security - When students interact with anthropomorphized AI tools, they may divulge more personal or sensitive information because they perceive the AI as a trusted companion or instructor. This may escort to the disclosure of inappropriate or sensitive information. When the information gathered is abused, shared with third parties, or not effectively protected, this can lead to

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serious dangers to the privacy of the individuals involved. Ethical considerations also include the protection of data privacy and ownership, as well as the possibility of algorithmic prejudice, which might worsen existing disparities in access to educational opportunities (Igbokwe, 2023). For the purpose of mitigating these hazards and promoting the equitable utilization of AI technologies, institutions are required to adopt stringent ethical norms (Igbokwe, 2023).

5. Dependency and Diminished Social Skills- It is possible that kids will have less opportunity to develop their social and interpersonal skills as they interact with anthropomorphized AI rather than with their acquaintances or instructors. Shen et al. (2024) this could guide to a decrease in the magnitude of possibilities for students to form relationships with other people. Because of this, they may live through difficulties in communication, working together as a team, and resolving conflicts, all of which are imperative for their future personal and professional lives.

6. Ethical Transparency and Accountability - When dealing with anthropomorphized artificial intelligence, it is of the utmost importance to sustain transparency on the limitations, functions, and objectives of the AI. In the event that pupils are not conscious that they are slotting in with artificial intelligence (AI) or if the knowledge is not entirely correct about the decision-making process of the system, ethical concerns may develop. In addition, there is the problem of accountability: who is accountable if the artificial intelligence gives the student wrong advice or if it makes the student's educational experience more difficult? Apprehensions about the veracity of educational practices are raised as a outcome of the usage of artificial intelligence (AI), which can funnel to state of affairs in which pupils get deceptive information in an effort to boost their motivation (Sjödén, 2020). Transparency should be given top priority in ethical frameworks, with the endeavor of making certain that students are aware of the nature of their exchanges with artificial intelligence systems (Sjödén, 2020).

7. Stereotyping and Bias Artificial Intelligence Systems- They have the potential to unintentionally perpetuate biases based on racial, gender, or other social characteristics. When artificial intelligence (AI) appears to have human-like features, anthropomorphism can make these biases look even more subtle and pervasive. There is a possibility that users might struggle to quickly identify bias in these systems; hence, these tools may potentially promote harmful stereotypes and societal injustices if proper oversight is not implemented.

8. Diminished Role of Human Educators- A potential threat to the role of human educators in the classroom as anthropomorphized artificial intelligence becomes more integrated; there is a leeway that the role of human educators will be diminished. It's possible that students will turn to educational technologies driven by artificial intelligence for support or interaction rather than engaging with human teachers. The rapport between the teacher and the student, which is essential for providing mentorship, individualized guidance, and emotional support, may become strained over time as a result of this (Babu & Adhithya, 2023).

9. Ethical Agency and Responsibility - Intelligent systems ought to be acknowledged as entities that have ethical consequences, which call for a scaffold that takes into deliberation the function that they play in educational settings (Reddy et al., 2021). The ethical liability that are tied with the autonomous behaviors of artificial intelligence need to be tackled by designers in order to guarantee that these systems behave in a mode that is congruent with educational principles (Reddy et al., 2021).

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9. Conclusion

In conclusion, anthropomorphized artificial intelligence-powered educational tools provide substantial ethical distress that need to be properly addressed in order to verify that they are deployed responsibly and in the best interest of students' well-being and development. Furthermore, these technologies offer inimitable opportunities to increase learning.

Anthropomorphism, which is defined as the attribution of human-like attributes to non-human entities, is a significant factor that molds the way in which users interrelate with educational systems that are powered by artificial intelligence. Through the incorporation of human-like characteristics, such as personalized replies, empathy, or a conversational tone, these technologies have the potential to encourage a learning experience that is more engaging and participatory. The user's comfort and motivation are both increased as an effect of this perceived humanization, which also contributes to a deeper emotional connection with the technology, which can pilot to beneficial learning results.

On the other hand, despite the fact that anthropomorphism has the potential to bridge the gap between human instructors and AI systems, its consequences is somewhat complicated. At the same time, it has the potential to improve student engagement, foster trust, and make it easier for students to have individualized learning experiences (Dhagare, 2024). On the other side, learners may be misled into having inaccurate expectations about the capabilities of the artificial intelligence (AI) if they place an excessive amount of trust on these human-like features. Additionally, this may generate a false sense of companionship, which may restrict critical thinking or lead to an excessive dependence on technology. It is needed to strike equilibrium between human-like involvement and clarity regarding the constraints of the system in order to make successful use of anthropomorphism in educational surroundings. Educators and developers must exercise prudence with the degree of anthropomorphic features. Engaging educators, politicians, and engineers in the creation of AI technologies can improve their efficacy and ethical implementation (Wangdi, 2024).

Facilitating access to AI technology for all students can mitigate educational disparities and foster inclusivity (Gómez Cano & Colala Troya, 2023). This is to ensure that these facets contribute to the improvement of the educational process without sacrificing the autonomy or cognitive growth of learners. The development of educational tools that are powered by artificial intelligence will be based on the creation of schemes that are not just user-friendly but also pedagogically sound. This will enable students to take advantage of the convenience and personalization that AI provides, while simultaneously promoting critical thinking and autonomous problem-solving skills.

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