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Article

Public sentiment and ethical considerations of ChatGPT in higher education: Insights from data analytics of conversations on platform X

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Abstract: In today's fast-paced digital world, generative AI, especially OpenAI's ChatGPT, has become a game-changing technology with significant effects on education. This study examines public sentiment and discourse surrounding ChatGPT's role in higher education, as reflected on social media platform X (formerly Twitter). Employing a mixed-methods approach, we conducted a thematic analysis using Leximancer and Voyant Tools and sentiment analysis with SentiStrength on a dataset of 18,763 tweets, subsequently narrowed to 5655 through cleaning and preprocessing. Our findings identified five primary themes: Authenticity, Integrity, Creativity, Productivity, and Research. The sentiment analysis revealed that 46.6% of the tweets expressed positive sentiment, 38.5% were neutral, and 14.8% were negative. The results highlight a general openness to integrating AI in educational contexts, tempered by concerns about academic integrity and ethical considerations. This study underscores the need for ongoing dialogue and ethical frameworks to responsibly navigate AI's incorporation into education. The insights gained provide a foundation for future research and policy-making, aiming to enhance learning outcomes while safeguarding academic values. Limitations include the focus on English-language tweets, suggesting future research should encompass a broader linguistic and platform scope to capture diverse global perspectives.

Keywords: generative AI; higher education; text mining; academic integrity; public engagement

1. Introduction

In the current rapidly evolving digital era, generative artificial intelligence (AI) has emerged as a groundbreaking technology with profound implications across various sectors, including education, by enabling the creation of new content through algorithms that learn from extensive datasets (Tlili et al., 2023). An example of this is ChatGPT, a notable application developed by OpenAI, which utilizes the GPT-3 language model to generate human-like text based on input, facilitating interactions between machines and humans (Pavlik, 2023). The use of generative AI, such as ChatGPT, has implications across diverse fields like journalism, media education, tourism, and medical education (Ghosh and Bir, 2023; Pavlik, 2023; Sop and Kurçer, 2024). While generative AI offers opportunities for improved learning outcomes, concerns about academic integrity and the potential for cheating have been raised (Cotton et al., 2024). Despite these challenges, strategic planning can leverage generative AI as a valuable resource in medical education and other disciplines (Boscardin et al., 2023; van de Ridder et al., 2023).

The integration of ChatGPT in education necessitates ethical considerations, transdisciplinary digital literacy education, and discussions on its impact on student

learning and assessment (Dianova and Schultz, 2023; Elbanna and Armstrong, 2023; Zirar, 2023). Additionally, the utilization of AI chatbots in education has been associated with enhancements in learning outcomes, underscoring the importance of further research and leadership to ensure ethical AI use (Crawford et al., 2023; Wu and Yu, 2023). This examination is crucial not only to comprehend its direct influence on educational results but also to evaluate public perception and interaction with such technology on social media platforms like platform X (formerly known as Twitter).

Social media has become a critical platform for public discourse, reflecting and shaping opinions on a wide range of topics, including technological advancements in education (Cai et al., 2023). The real-time, widespread engagement found on these platforms provides a unique lens through which the public's perceptions and attitudes toward ChatGPT and its educational implications can be analyzed (Cai et al., 2023; Wang et al., 2023). Yet, despite the increasing integration of generative AI in education, there exists a notable gap in scholarly research concerning the general public's engagement and sentiment towards these technologies on social media platforms. This gap signifies a missed opportunity to understand the societal and educational ramifications of generative AI tools like ChatGPT.

Addressing this lacuna, this study aims to bridge this gap by conducting a comprehensive sentiment and thematic analysis of tweets related to ChatGPT and its implications on higher education. By analyzing the discourse on X, this research seeks to uncover the prevalent themes, sentiments, and patterns of public engagement concerning ChatGPT. This approach will enable us to grasp the collective sentiment towards ChatGPT in the context of higher education, highlighting concerns, expectations, and the perceived benefits and drawbacks of integrating such technologies into academic environments. Through this analysis, we aspire to provide insights into the broader societal and educational implications of generative AI, offering a foundation for future research and policy-making in the realm of AI and education.

2. Literature review

2.1. The origins of generative AI (ChatGPT)

Generative AI, a transformative force in artificial intelligence, is revolutionizing content creation across various domains, from art and entertainment to healthcare and finance. This technology utilizes advanced deep learning models like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs). GANs improve content quality through a dual-network system, while VAEs manage data compression and reconstruction, enabling the creation of new content that closely mimics real-world artifacts (Ahmad et al., 2022; Anantrasirichai and Bull, 2022; Peres et al., 2023; Sharifzadeh et al., 2020).

The applications of Generative AI are diverse, affecting fields such as art, where artists and designers collaborate with AI for new creative expressions, and entertainment, where it is used for producing realistic Computer-Generated Imagery (CGI) and deepfake videos. These advancements are not only fascinating but also raise significant ethical discussions regarding the authenticity and implications of AI-generated content (Cetinic and She, 2022; Sung et al., 2021). In the realm of text

generation, OpenAI's ChatGPT has demonstrated remarkable capabilities in mimicking human-like writing, thus aiding in story creation and other literary forms (Lee et al., 2022).

ChatGPT, in particular, has achieved significant milestones in natural language processing, engaging users in sophisticated dialogues and producing high-quality content. The platform has experienced rapid growth, accumulating a vast user base quicker than social media giants like TikTok, Instagram, and Spotify, thanks to its user-friendly interface that supports a wide range of functionalities including language translation and summarization (Garfinkle, 2023; Lund et al., 2023).

Moreover, the reach of Generative AI extends deeply into sectors like healthcare and finance. In healthcare, AI-driven tools are revolutionizing the creation of personalized medicine and speeding up the drug discovery process. Predictive models based on extensive data sets can simulate disease progression and treatment responses, vastly improving diagnostics and patient care (Rudolph et al., 2023). Financial institutions utilize AI to model complex market dynamics, enhance fraud detection, and automate customer services, thereby improving accuracy in risk assessment and overall efficiency (Eysenbach, 2023).

The expansion of Generative AI also impacts law and cybersecurity. Legal professionals use AI to draft documents and forecast legal outcomes, streamlining the judicial process. In cybersecurity, AI helps in developing sophisticated security protocols and simulating cyber-attacks to improve defense mechanisms (Kumar and Shah, 2024). The broad adaptability of Generative AI showcases its potential to enhance human capabilities across diverse domains. However, the growing capabilities of AI to create convincing deepfakes and other forms of counterfeit content call for robust ethical frameworks and a reassessment of copyright laws to mitigate misuse and ensure responsible deployment. Thus, the narrative of Generative AI is one of awe-inspiring technological advancement tempered by the critical need for careful and ethical use.

2.2. Generative AI in education

Generative AI, with its profound capabilities in creating content that mimics human-like outputs, has increasingly become a focal point in educational technologies. The application of Generative AI in education is multifaceted, ranging from personalized learning experiences to the generation of educational content and the facilitation of interactive learning environments. This literature review synthesizes recent research and developments in the field to highlight the impact and potential of Generative AI in transforming educational paradigms.

A significant area of application is the customization of learning materials. Generative AI can analyze a student's learning style, performance, and preferences to create personalized textbooks, exercises, and even educational games that cater to the individual's learning needs (Feuerriegel et al., 2024). For instance, a Generative AI system could adapt historical content to match students' learning styles, significantly improving engagement and retention rates. This capacity for personalization is seen as a key to unlocking individual potential and addressing the diverse needs within a classroom (Feuerriegel et al., 2024).

Furthermore, Generative AI has been employed in generating realistic scenarios and simulations that offer hands-on experience in subjects like science, technology, engineering, and mathematics (STEM) (Xu and Ouyang, 2022). Some researchers explored the use of GANs in creating complex, data-driven simulations for physics and chemistry labs, enabling students to conduct experiments in a virtual environment (Amirian et al., 2019). This application not only facilitates a deeper understanding of theoretical concepts but also overcomes the logistical and safety challenges associated with traditional lab settings (Amirian et al., 2019).

The role of Generative AI in automating the generation of educational content has also received considerable attention. AI-driven tools can produce a wide array of educational materials, from lecture notes and summaries to quizzes and exams, with minimal input from educators. This capability of AI to generate quizzes could adapt in real-time to the learner's proficiency level, offering a more effective assessment tool compared to static, one-size-fits-all approaches (Diwan et al., 2023).

Interactive learning through dialogue-based AI tutors represents another promising application. These AI tutors, powered by generative models, can engage students in natural language conversations, offering explanations, answering questions, and providing feedback in real-time. Despite these advancements, the literature also points to challenges, including ethical considerations around data privacy, the potential for reinforcing biases presents in the training data, and the need for oversight to ensure the accuracy and appropriateness of AI-generated content. Addressing these concerns is crucial for the sustainable integration of Generative AI into educational systems.

2.3. Public discussions on social media

Social media has fundamentally transformed the landscape of public discourse, emerging as a critical platform for first-hand information dissemination and societal interaction. Its unprecedented global reach and the ability to facilitate immediate communication have rendered it an integral component of modern digital society (Yoo et al., 2016). Social media platforms are lauded for their capacity to serve as a "voice of the people," allowing individuals to share their emotions, sentiments, and opinions freely (Ozturk and Ayvaz, 2018; Yoo et al., 2016). This democratization of information exchange has empowered users to influence and mold public opinion significantly. In times of crisis, be it human-made or natural disasters, social media proves indispensable in providing a support system for information sharing, seeking assistance, and mobilizing aid (Ozturk and Ayvaz, 2018). Furthermore, it offers a communal space for mourning, enabling a vast network of users to express grief and offer consolation over the loss of individuals, thereby fostering a digital community of support and remembrance.

Platform X, with its unique microblogging format, stands out as a powerful conduit for real-time communication. It facilitates the expression of public sentiment on a wide array of topics, from everyday concerns to global events. Lee and Goh's (2013) analysis of tweets following Michael Jackson's death highlights X's role in emotional and informational support. The platform not only serves as a space for mourning but also as a ground for diverse expressions, including rumor-mongering

and spam (Singh et al., 2023).

The discourse on social media platforms reflects a broad spectrum of public perceptions and engagement with Artificial Intelligence (AI) technologies (Hussain et al., 2024), especially concerning their integration into educational systems. These platforms, acting as global forums, reveal diverse opinions ranging from enthusiastic endorsement to cautious skepticism about the role of AI in enhancing learning experiences. Enthusiasts often highlight AI's potential to personalize learning, automate administrative tasks, and provide students with interactive, adaptive learning environments. They envision AI as a transformative tool that can cater to individual learning styles, pace, and preferences, thereby revolutionizing the traditional one-size-fits-all approach to education.

This research seeks to conduct an in-depth sentiment and thematic analysis of tweets concerning ChatGPT's role in higher education. Through examining the conversations on this platform, the study will identify dominant themes, emotional tones, and the nature of public interaction relating to ChatGPT by answering the following questions:

RQ1: What are the main topics/themes discussed by X users about ChatGPT's role in higher education?

RQ2: What are the levels of positive and negative sentiment in tweets shared by X users regarding ChatGPT's role in higher education?

3. Methods

This study utilized a mixed methods approach to investigate the conversations around ChatGPT's role in education on online platforms. This research design combines quantitative and qualitative research methods, enhancing the robustness of the findings (Cohen et al., 2002). A single dataset, consisting of collected tweets, was analyzed using two different methods: firstly, a qualitative thematic analysis was conducted to identify and interpret key themes within the tweets; secondly, a quantitative sentiment analysis was employed to measure the overall sentiment expressed in the data. This dual-pronged approach allowed for a comprehensive exploration of the topic, encompassing both the nuanced context of the discussions and the general attitude towards ChatGPT in educational settings.

3.1. Data collection and cleaning

Platform X data were collected using X API, a software interface that allows applications to communicate with each other or with hardware, facilitating the exchange of data or commands as part of an integrated system. The following search queries (hashtags) were used to collect relevant data: #ChatGPT, #Education and #AI, and #Education and #ChatGPT. As a result, a total of 18.763 tweets were collected. The dataset includes a variety of X content—original posts, retweets, responses, and quoted tweets. These tweets were then compiled into a Microsoft Excel spreadsheet (XLSX) file for subsequent cleaning and preparation.

The dataset, comprising a mix of unstructured and semi-structured data, required meticulous cleaning and processing to make it suitable for analysis. The data cleaning was conducted manually to ensure a high level of accuracy and context-aware

refinement. In so doing, a series of steps were done as follows:

Duplication Removal: Duplicate tweets, including repeated retweets and identical responses, were identified and removed.

Noise Elimination: Extraneous elements such as emojis, stop words (e.g., a, an, the, on, at), special characters (e.g., %, ., ^^), and weblinks were stripped away. Additionally, non-understandable comments, such as those composed of random characters or symbols (e.g., 🟡🟡🟡 +19168364464), were discarded, see **Table 1**.

Refinement of Data Format: The text was refined into a format that is readable by machines, ensuring the remaining data was clean and structured.

Table 1. Examples of types of removed 'noise' from the collected X data.

Type of Noise	Example
Stop words	a, an, the, on, at
Emojis	😂 ✌ 🌷
Special characters	⁒ . ^^ (ʘ‿ʘ✿)
Not understandable comments	🟡🟡🟡 +19168364464

For inclusion and exclusion purposes, tweets posted between 1 December 2022, and September 2023 were considered. Tweets from both public and individual accounts were included to provide a comprehensive view of the discourse, while those from accounts identified as bots or spam were excluded. To maintain consistency in data analysis, only tweets in English were included. Additionally, off-topic or irrelevant tweets were excluded during the manual review. Following this cleanup, the dataset was reduced from 18,763 to 5655 tweets.

3.2. Data analysis

Several analytical techniques were carried out to perform that analysis in both phases as follow:

Thematic analysis:

Scholars have argued that computer software can be used to efficiently analyze a large body of textual data (Crofts and Bisman, 2010; Sotiriadou et al., 2014). Sotiriadou et al. (2014) state that "a well-designed research study using appropriate qualitative software to assist in the analysis of data sets is a pathway to increasing the rigor and flexibility of the research". Qualitative analysis software, with features like concept mapping, facilitates the visualization of connections between codes and themes (Creswell, 2013). Thus, to address the first research question, the collected dataset was analyzed and visualized using Leximancer (Leximancer.com) and Voyant Tools (Voyant-Tools.org).

Leximancer is a software developed to analyze substantial amounts of text data. It employs algorithms to pinpoint crucial aspects and gather significant insights. According to the software's designer, "Leximancer conducts an automatic analysis of your text documents to discern the principal concepts within them. It provides essential ideas and actionable insights through dynamic interactive visualizations and robust data exports" (Leximancer, 2022, p. 3). Leximancer's advantages include its ability to handle large datasets and provide visual representations of themes and concepts.

However, a limitation is that it may not capture nuanced human interpretations of text, as it relies on automated algorithms.

Voyant Tools is an open-source, web-based software for textual analysis that automates the creation of metadata, the generation of keywords, and the organization of knowledge through visualizations. As a tool for text mining and processing, Voyant is especially valuable for individuals who handle large volumes of text data, including catalogers, digital humanitarians, librarians, transcribers, and archivists (Miller, 2018). The advantages of Voyant Tools include its user-friendly interface and comprehensive visualization capabilities. Its limitations may include a lack of depth in semantic analysis compared to more advanced tools.

Sentiment analysis

Automated sentiment analysis is commonly conducted using a diverse array of algorithmic tools. These platforms identify and classify emotive language through either machine-learning methodologies or lexical-based approaches. Pertinent to addressing the second research question concerning online users' perceptions of ChatGPT usage and its impact on higher education, the refined data corpus was processed using SentiStrength. This tool was employed to ascertain the positive, negative, and neutral sentiments present across the dataset. Subsequently, the results were quantitatively assessed and visually represented to succinctly display the aggregate positive, negative, and neutral sentiments within the study.

SentiStrength, a well-established tool in the field of sentiment analysis, leverages a lexical algorithm to categorize text. Available in both Java and Windows, this freely accessible software is particularly useful for researchers and educators. It evaluates emotional expressions on a dual positive-negative scale, allowing for application to new datasets without the necessity for previous training (Vilares et al., 2015). Thelwall et al. (2010) found that SentiStrength predicted positive emotions with an accuracy of 60.6% and negative emotions with an accuracy of 72.8%. While these figures might appear moderate, they indicate substantial agreement with human coders. SentiStrength's advantages include its user-friendly interface, multilingual capabilities, and effectiveness in processing informal language, such as that found in social media. However, its limitations include moderate accuracy compared to more advanced machine-learning models and reliance on a predefined lexicon, which may not cover all sentiment expressions.

SentiStrength operates using a refined lexical algorithm that encompasses 2310 sentiment-related terms sourced from the General Inquirer and the Linguistic Inquiry and Word Count (LIWC) programs (Thelwall, 2022). To enhance its ability to detect sentiment-laden words, the algorithm employs a rudimentary stemming technique that uses wildcard notations to accommodate various word conjugations (Hardian et al., 2021). Each term's sentiment value is determined based on its association in human-curated training data, with the software assigning positive scores ranging from 1 to 5, and negative scores from −1 to −5. Here, a score of 1 indicates an absence of positive sentiment, whereas 5 denotes strong positive sentiment; similarly, −1 signifies no negative sentiment, and −5 represents extremely negative sentiment. Additionally, the lexicon includes a category for non-sentiment terms, which are assigned scores of 1 or −1. These scores pertain to non-expressive words that share stems with other words typically associated with emotional expression. Furthermore, SentiStrength's coding

system is organized into three classifications: Positive, Neutral, and Negative, as delineated in **Table 2** presented below.

Table 2. Coding scheme in sentistrength.

Score	Code	Description
−5, −4, −3, −2	Negative	Extreme, strong, moderate and mild negative sentiment
5, 4, 3, 2	Positive	Extreme, strong, moderate and mild positive sentiment
−1, 0, 1	Neutral	No sentiment, no negativity and positivity

4. Results

To address the first research question, we employed Leximancer to conduct a systematic thematic analysis of the X dataset. This analysis yielded deep insights into the dataset, resulting in the identification of five distinct themes: Authenticity, Integrity, Creativity, Productivity, and Research. These themes are visually represented in **Figure 1**. The visualization also highlights the interconnections between these themes, particularly evident in the darkest areas of the figure. The themes were derived through a combination of automated analysis and manual validation. Initially, Leximancer automatically identified potential themes based on the frequency and co-occurrence of keywords. Following this, we manually reviewed and labeled the data to ensure the accuracy and relevance of the identified themes. This hybrid approach allowed for the efficiency of automated analysis while maintaining the contextual understanding provided by manual validation. Detailed discussions of each theme are provided in the subsequent paragraphs.

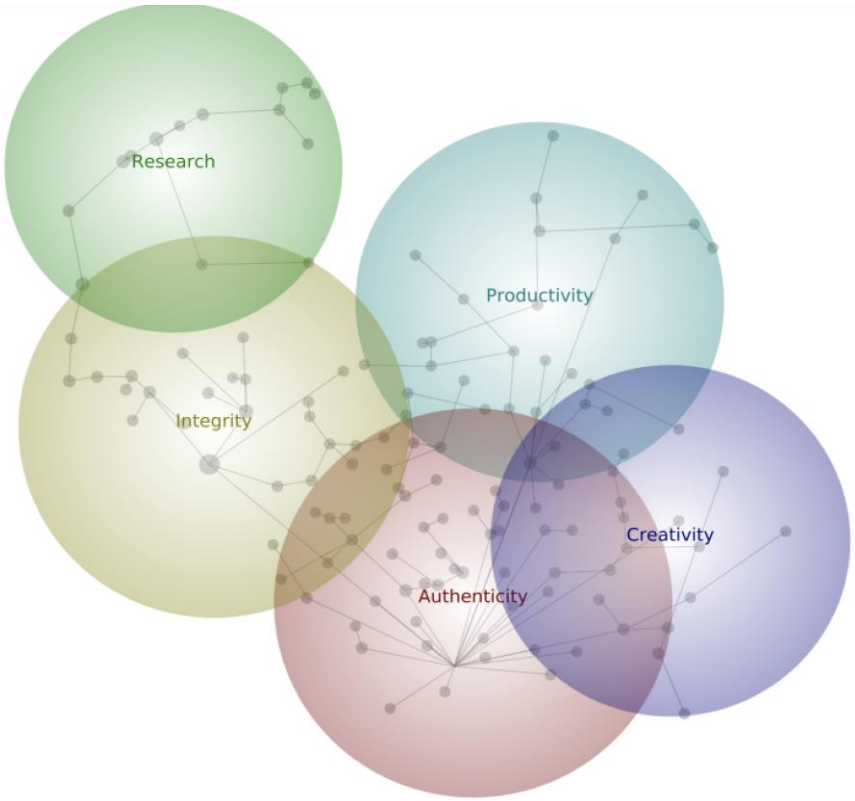

Figure 1. Concept map of the emerged themes.

Authenticity: Authenticity emerged as the most significant theme in the dataset, registering over 14,084 occurrences. This theme encompasses a variety of concepts linked to the use of ChatGPT, including creativity, originality, truthfulness, accuracy, and authenticity, among others. These concepts reflect the primary concerns and discussions among X users online. In the context of ChatGPT, authenticity relates to the AI's ability to emulate human-like interactions effectively, engaging users with responses that are not only correct but also relevant and nuanced, thereby ensuring the communication is both genuine and accurate without any misleading elements.

Integrity: Integrity is the second largest theme that emerges from the analysis, highlighted by its significant presence with numerous references. This theme revolves around key concepts associated with ChatGPT's use, such as honesty, ethical behavior, consistency, and reliability. These concepts underline the core discussions among X users, focusing on the ethical dimensions of AI interaction. Within the context of ChatGPT, integrity pertains to the AI's adherence to ethical standards, ensuring consistent, reliable, and honest interactions that uphold user trust and respect data privacy.

Creativity: Creativity surfaced as a notable theme within the dataset, marked by a substantial number of mentions. This theme includes concepts related to the use of ChatGPT such as innovation, originality, ingenuity, and imaginative responses. These aspects reflect the ongoing discussions among X users regarding the AI's capability to generate novel and unique content. In the context of ChatGPT, creativity pertains to the AI's ability to produce inventive and original responses that demonstrate a level of thoughtfulness and adaptability in interactions.

Productivity: Productivity was identified as a key theme in the dataset, evidenced by its frequent mentions. This theme encompasses concepts related to the use of ChatGPT, such as efficiency, effectiveness, time-saving, and enhancement of work processes. These facets highlight the discussions among X users about how AI tools like ChatGPT can streamline tasks and improve output. Within the context of ChatGPT, productivity refers to the AI's ability to assist users in completing tasks more efficiently and effectively, thereby enhancing overall work productivity and optimizing time management.

Research: Research emerged as a crucial theme in the dataset, with a significant emphasis on its relevance. This theme includes concepts related to the use of ChatGPT such as data analysis, information gathering, hypothesis testing, and scholarly communication. These elements reflect the discourse among X users about the potential of AI tools like ChatGPT in academic and scientific inquiries. In the context of ChatGPT, research pertains to the AI's capability to assist in the exploration and synthesis of information, facilitating more robust and efficient research processes. But also, as a potential threat to academic honesty.

Furthermore, analysis of the dataset using Voyant-tools yielded additional insights, as depicted in the word cloud shown in **Figure 2** below. This visualization enhances our understanding of the data by highlighting key terms and patterns.

Figure 2. Visual representation of key terms in the dataset.

To address the second research question, we utilized SentiStrength to analyze the sentiment of the cleaned dataset, adhering to the coding scheme detailed in **Table 2**. This analysis aimed to understand X users' online interactions about using ChatGPT in higher education. Based on 5655 tweets derived from selected keywords, the sentiment analysis revealed a diverse range of sentiments. A majority of the texts demonstrated positive sentiment (46.6%), while a significant portion was neutral (38.5%). The remaining tweets displayed negative sentiment (14.8%). **Figure 3** illustrates the distribution of sentiments across these categories. This distribution indicates that discussions are predominantly informational or factual, with less frequent expressions of strong emotional opinions. Such a sentiment distribution is insightful for gauging the general tone of conversations regarding using ChatGPT in an educational setting, particularly highlighting a focus on neutral and objective exchanges.

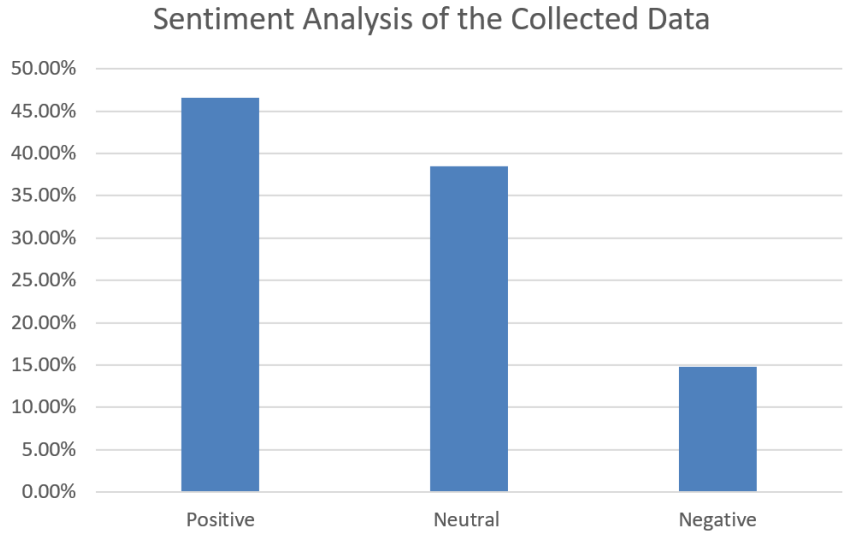

Figure 3. Sentiment analysis of the collected data.

However, upon closer examination of the tweets with negative sentiment (14.8% of the total dataset), we observed that users raised a variety of concerns regarding the use of ChatGPT in higher education. For instance, several users expressed dissatisfaction with the accuracy and reliability of ChatGPT's responses. They reported instances where the AI provided incorrect or misleading information, leading to concerns about its dependability as a learning tool. These users highlighted the potential risks of students relying on inaccurate data, which could hinder their academic progress and understanding of subjects.

Users also raised ethical concerns, particularly around data privacy and security. Tweets mentioned apprehensions about how student data is collected, stored, and used by ChatGPT. Additionally, there were concerns about the ethical implications of AI potentially perpetuating biases, leading to unfair or skewed educational outcomes.

Another significant concern was the potential impact of ChatGPT on students' learning experiences. Users worried that the convenience of AI might lead to a reduction in critical thinking and problem-solving skills. They feared that students might become overly dependent on AI-generated answers rather than engaging deeply with the material.

Technical issues were frequently mentioned, with users reporting difficulties in integrating ChatGPT with existing educational platforms. Some tweets highlighted challenges related to the AI's user interface and its ability to handle complex or nuanced queries, which could limit its effectiveness in an educational setting.

5. Discussion

The thematic exploration of tweets regarding ChatGPT's role in higher education has elicited a rich tapestry of public opinion, nuanced by a confluence of hopes, skepticism, and ethical considerations. As revealed through a combination of thematic textual analysis and the implementation of Voyant-tools, the public discourse encapsulates a spectrum of sentiment ranging from apprehensive to optimistic.

The theme of Authenticity is paramount, resonating with the collective desire for AI-generated content that maintains a semblance of human-like quality and interaction. It highlights the public's expectation that AI should not only generate accurate information but also reflect contextual appropriateness and original thought. This demand for high-fidelity content mirrors the broader societal pursuit for genuine and trustworthy interactions in the digital age.

Integrity is closely interwoven with the authenticity theme, emphasizing the ethical dimensions that arise with AI's expanding capabilities. The public conversation is rife with concerns about the potential for AI to compromise academic honesty. As with the foundational principles that govern educational institutions, the discourse on ChatGPT frequently returns to the tenets of honesty, ethical behavior, and consistency.

The theme of Creativity signals both opportunity and challenge. On the one hand, there is acknowledgment of ChatGPT's potential to inject innovation into the learning process. On the other hand, it prompts a reevaluation of the creative process and the role AI plays within it. Questions arise about the ownership and originality of AI-generated content, reflecting a broader discussion on the impact of technology on human creativity.

Productivity as a theme brings forward the pragmatic benefits of ChatGPT. The discourse suggests that AI tools like ChatGPT are anticipated to enhance efficiency and optimize task management within educational settings. This reflects an optimism that AI can augment human capacity by taking on rote and time-consuming tasks, thereby freeing humans to engage in more complex, value-added activities.

The theme of Research delves into ChatGPT's role in scholarly pursuits. While ChatGPT is seen as a facilitator that can expedite the research process, there is a counter-narrative that scrutinizes its influence on academic rigor and the integrity of

research outputs. This duality encapsulates the tension between embracing AI as a tool for advancement and guarding against its potential to disrupt academic norms.

The sentiment analysis from the tweets paints a picture of a public divided yet engaged, with a majority expressing positive sentiments toward ChatGPT's potential benefits in higher education. A significant portion of neutrality, likely reflecting a factual or informational stance, suggests a wait-and-see approach. Negative sentiments, while lesser in proportion, underline genuine concerns about misuse, bias, and the overshadowing of human-led academic effort. These findings align with the study by Li et al. (2023), which identified similar concerns in the context of ChatGPT's use in education, including academic integrity, impact on learning outcomes, and policy challenges. Their discourse analysis also emphasized the need for ethical and responsible AI use.

Ethical implications

The ethical implications of using AI in education are multifaceted, particularly concerning data privacy and the potential for bias in AI-generated content. The use of AI in education often involves the collection and processing of vast amounts of data, including sensitive personal information, raising significant privacy concerns. Students and educators need assurances that their data will be protected and used responsibly. Implementing robust data anonymization techniques, establishing clear and transparent data policies, and ensuring informed consent for data collection and use are critical steps to mitigate these privacy concerns.

Bias in AI-generated content is another significant ethical issue. AI systems can inadvertently perpetuate or amplify existing biases present in the data they are trained on, leading to biased educational content that can adversely affect learning outcomes and perpetuate inequality. Mitigating these biases requires using diverse and representative training data, conducting regular audits of AI systems for bias, and involving diverse stakeholders in the design and development of AI systems to ensure multiple perspectives are considered.

Implications for policy and practice

Given the ethical concerns, it is imperative for educators and policymakers to take proactive steps to mitigate the risks associated with AI in education. Institutions should develop comprehensive guidelines that address the ethical use of AI, focusing on data privacy and bias mitigation. These guidelines should be regularly reviewed and updated to reflect technological advancements and emerging ethical considerations. Educators should be trained in AI literacy to understand both the capabilities and limitations of AI tools, recognizing potential biases and understanding data privacy issues.

Transparency in how AI tools are used can help build trust among students and faculty. This includes clear communication about data usage and AI decision-making processes. Policies should promote the use of AI as a complement to human effort rather than a replacement, enhancing productivity and creativity while ensuring that human oversight is maintained. Continuous monitoring and evaluation of AI tools are essential to ensure ethical usage, with regular assessments of their impact on data privacy and bias. Clear policies regarding the ownership of AI-generated content should be established to protect intellectual property rights and ensure fair use.

Future research should focus on developing more sophisticated techniques for

data privacy protection and bias mitigation in AI systems. This includes exploring new methods for anonymizing data, creating more diverse training datasets, and developing tools for bias detection and correction. Additionally, research should investigate the long-term impacts of AI on educational outcomes and equity, ensuring that AI tools are used in ways that promote inclusive and ethical educational practices.

6. Conclusion

This study, through a systematic analysis of public sentiment via X, has illuminated the multifaceted perceptions surrounding the use of ChatGPT in higher education. The sentiment is predominantly positive or neutral, signaling a general openness to the integration of AI in educational contexts. However, it is tempered by significant concerns about academic integrity and the ethical use of AI technology.

The positive sentiment underscores a societal readiness to harness AI for personalized learning and increased productivity. The neutrality indicates a considerable amount of discourse focused on information sharing rather than impassioned opinion. The presence of negative sentiment reflects caution, highlighting the need for ongoing dialogue and ethical frameworks to navigate the incorporation of AI like ChatGPT in educational settings responsibly.

These insights affirm the importance of proactive engagement from educators, policymakers, and technology developers to ensure that AI is integrated into education in a manner that enhances learning while safeguarding academic values.

This study has several limitations. Firstly, it is restricted to English-language tweets, which may not fully capture global perspectives. This linguistic limitation results in the underrepresentation of insights from non-English-speaking regions and cultures. Secondly, the representativeness of the dataset is a notable limitation. X users are not a fully representative sample of the general population, exhibiting demographic biases regarding age, gender, socioeconomic status, and geographic location. These biases could influence the results and limit the generalizability of the findings. For instance, younger, more tech-savvy individuals are more likely to use X, potentially leading to an overrepresentation of their views compared to other demographic groups.

Additionally, this study focused solely on one platform. Expanding the scope to include other social media platforms such as Facebook, Instagram, LinkedIn, and YouTube could yield a richer, more diverse set of opinions. This broader approach would contribute to a more comprehensive understanding of public attitudes toward AI in education, as different platforms have distinct user bases and modes of engagement.

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