

## “ChatGPT seems too good to be true”: College students’ use and perceptions



### of generative AI

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#### ABSTRACT

This study investigates how U.S. college students ( $N = 1001$ ) perceive and use ChatGPT, exploring its relationship with societal structures and student characteristics. Regression results show that gender, age, major, institution type, and institutional policy significantly influenced ChatGPT use for general, writing, and programming tasks. Students in their 30s–40s were more likely to use ChatGPT frequently than younger students. Non-native English speakers were more likely than native speakers to use ChatGPT frequently for writing, suggesting its potential as a support tool for language learners. Institutional policies allowing ChatGPT use predicted higher use of ChatGPT. Thematic analysis and natural language processing of open-ended responses revealed varied attitudes towards ChatGPT, with some fearing institutional punishment for using ChatGPT and others confident in their appropriate use of ChatGPT. Computer science majors expressed concerns about job displacement due to the advent of generative AI. Higher-income students generally viewed ChatGPT more positively than their lower-income counterparts. Our research underscores how technology can both empower and marginalize within educational settings; we advocate for equitable integration of AI in academic environments for diverse students.

#### 1. Introduction

The launch of ChatGPT in November 2022 caused disruption in many arenas, but one of the most commented upon was its impact on the education sector. While artificial intelligence (AI) is not new, the ability of everyday people being able to interact with it conversationally, coupled with the massive improvement of AI’s ability to generate human-like text (Dwivedi et al., 2023) and an unprecedented growth in users of a technology platform (Firat, 2023) has led to concern among educators about when, where, and how it is (and should be) used by students. Responses to ChatGPT and subsequent generative AI tools have varied greatly, ranging from enthusiastic adoption to complete prohibition (see, e.g., discussion in Fütterer et al., 2023).

Generative AI will continue to be a part of the evolving society, including in educational settings. As such, it is essential to move beyond a dichotomous discussion about the use of generative AI in education (Draxler et al., 2023), and rather to discuss how to effectively, ethically, and equitably integrate AI into educational settings. Generative AI offers powerful affordances for education, including providing immediate and personalized feedback to students, automating laborious mundane tasks,

and aiding in problem-solving activities (Cotton et al., 2023; Smolansky et al., 2023). ChatGPT can support the writing process of those who may need extra help, such as non-native English speakers (Warschauer et al., 2023). Also, ChatGPT can be an efficient tool to support CS (Computer Science) learning for underrepresented students, potentially influencing their success and career paths in CS (Amoozadeh et al., 2023).

On the other hand, ChatGPT and other generative AI come with limitations such as embedded biases and inaccuracies. Overrelying on ChatGPT for academic and professional tasks can lead to diminished writing ability and creativity, as well as increased instances of plagiarism among students (Draxler et al., 2023). Understanding the challenges and opportunities of generative AI in relation to teaching and learning is crucial for guiding higher education stakeholders in integrating generative AI to support students’ ethical and effective use (Cotton et al., 2023).

First, we need to understand how college students utilize and perceive ChatGPT in their academic and professional endeavors. The adoption of new technologies is shaped by user perceptions and usage patterns (Venkatesh & Bala, 2008) as well as student characteristics and experiences (Abdaljaleel et al., 2023; Tiwari et al., 2024). By identifying

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students' concerns and factors that influence the use of new technologies like ChatGPT, we can pinpoint what discourages or hinders their use in learning contexts (Hsu & Lin, 2022; Wingo et al., 2017). Identification of reasons that hinder certain students from using the new technology can help educators address emerging digital equity issues and suggest strategies to bridge potential gaps in generative AI utilization.

## 2. Theoretical framework

Our research is grounded in a critical theory of technology, which posits that technology is deeply intertwined with societal structures (Feenberg, 1991, pp. 31–46) and that it is neither inherently good nor bad, nor neutral (Kranzberg, 1986). This critical perspective recognizes the complex and intricate relationship between technology and the social, political, and economic systems in which it is situated. In the context of generative AI, particularly ChatGPT, we view that such technologies are embedded within societal dynamics and power relations. We posit that technology, such as ChatGPT, is not merely an instrument for academic tasks but part of a broader ecological system that includes cultural, social, and institutional factors (Warschauer, 1998, 2004). This perspective guides us to examine how students' interactions with ChatGPT are influenced by and reflective of their social and educational environments.

We draw a parallel between the emergence of generative AI and prior transformative technologies for print (e.g., Eisenstein, 1980) and digital (e.g., Warschauer, 1999) literacy, both of which similarly helped reshape notions of writing and authorship. Our study delves into how these changes manifest in the educational sphere, especially considering existing unequal power relationships and access disparities within society. Our investigation focuses on the interplay between students' ecological contexts and their use of and attitudes toward ChatGPT. We aim to provide an understanding of how college students interact with and perceive ChatGPT and nuanced insights into the evolving landscape of learning in the age of generative AI.

Our research is guided by the following questions:

RQ1: How frequently do students use ChatGPT for general tasks, writing, and computer programming?

RQ2: What factors are associated with students' use of ChatGPT for general tasks, writing, and computer programming?

RQ3: What are the common concerns among students regarding the use of ChatGPT in their course and professional work?

RQ4: Does sentiment toward ChatGPT use vary based on student characteristics?

## 3. Related work

Existing studies represent an array of findings on the frequency of generative AI use. Amoozadeh et al. (2023) found that most CS students across two universities in the U.S. and India have been using ChatGPT. Conversely, Petricini et al. (2023) reported infrequent use of ChatGPT by both faculty and students at a U.S. university, despite their belief that ChatGPT will inevitably be integrated into higher education. Bin-Nashwan et al. (2023) examined ChatGPT's use by scholars, noting those who reported higher academic integrity had lower usage of ChatGPT in their work. The findings of Bin-Nashwan et al. (2023) imply that the concerns about the ethics of using ChatGPT hinder the use of ChatGPT.

The perceived usefulness of ChatGPT among college students also shows variation. In Amoozadeh et al.'s (2023) study, about half of the students expressed distrust in the quality of generative AI outputs, with only a quarter of the students finding it helpful. Notably, students taking advanced computer science courses found generative AI useful as a supplement, although they did not completely trust the code it generated due to frequent errors. Petricini et al. (2023) found a consensus among faculty and students that ChatGPT use violates their institutional

policies, yet both groups acknowledged generative AI's value in education. Further, both faculty and students expressed a need for proper training in generative AI usage. Smolansky et al. (2023) found differing opinions between educators and students regarding generative AI's impact on online essay assessments across two universities in the U.S. and Australia. Educators favored ChatGPT integration, while students expressed mixed feelings due to concerns about diminished creativity and originality in writing.

Students have concerns and skepticism about using generative AI. A major concern is academic integrity, with perceptions that using ChatGPT could be regarded as cheating by students' institutions and instructors (Firat, 2023; Petricini et al., 2023). Another prevalent concern is that reliance on ChatGPT might erode students' creativity and critical thinking skills (Draxler et al., 2023). Baidoo and Ansah (2023) pointed out that generative AI's inherent limitations—being constrained to the data it was trained on—could limit the creativity of responses. However, studies have found that students who used generative AI to complete tasks produced outcomes with increased creativity. Zhou and Lee (2024) found that artists who used generative AI to help produce novel artwork earned more favorable evaluations from their peers. Habib et al. (2024) found that using AI to complete a task significantly increased students' creativity, such as coming up with more ideas and thinking outside the box.

Concerns about jobs being replaced by artificial intelligence in the future were also expressed by students (Shoufan, 2023). Indeed, automation is projected to replace some occupations, such as telemarketers, as generative AI can respond to human questions and responses (Frey & Osborne, 2024). However, automating certain tasks could enhance productivity by enabling workers to concentrate on additional duties rather than facing complete replacement (Lazarou & Rogalska, 2023). In addition, automating tasks can provide support to those employees who may need it the most, including novices and those with fewer skills (Gmyrek et al., 2023; Frey & Osborne, 2024). For example, customer agents with access to an AI assistant increased their productivity by 14% (Brynjolfsson et al., 2023). Similarly, software developers with access to generative AI software completed their tasks 56% faster than those without it (Peng et al., 2023).

The use of ChatGPT is influenced by different factors, including user characteristics. For example, students' positive perception of ChatGPT's usefulness predicted higher usage of ChatGPT (Faruk, Rohan, Nirut-sirikun, & Pal, 2023). Draxler et al. (2023) conducted a national survey study on the use of large language models by U.S. adults and found that females were less likely to use LLMs (large language models) than males. Interestingly, usage of LLMs by those middle-aged was more frequent than that of younger groups: adults between 55 and 64 were more likely to frequently use LLMs than those between 18 and 34.

In educational settings, ChatGPT has been shown to be an efficient tool for academic tasks, particularly due to the user-friendly interface and immediate responses (Kayali, Yavuz, Balat, & Çalısan, 2023). Monika and Suganthan (2024) found that most students recommended using ChatGPT in English language learning classrooms for both teaching and learning. These students reported that ChatGPT has helped improve their English skills. Similarly, Shaikh et al. (2023) found that non-native English speakers found ChatGPT easy to use for English learning tasks including writing, grammar, and vocabulary (Shaikh et al., 2023). The non-native English speakers utilized the model's prompt feature where the speakers were able to interactively engage in dialogues and writing. ChatGPT also has potential as a tool that supports computer programming including code completion and debugging (Biswas, 2023). For example, ChatGPT can find errors in users' code and provide explanations, examples, and guidance on solving coding problems. In addition, ChatGPT can be asked to explain the reasons for a bug, which can support users' programming knowledge (Surameery & Shakkor, 2023).

However, there are limitations to learning with ChatGPT. According to Bordt and von Luxburg's (2023) study, the accuracy of ChatGPT for

programming is still uncertain, at least for model 3.5, which earned a barely passing score on a computer science exam. Also, interaction with generative AI can be impersonal and detached. Resnick (2024) argued that while AI tutors and coaches can provide useful advice and information, they lack the capacity to build relationships, empathize, and create a learning community like human teachers. Creely (2024) also noted that AI-generated texts may lack the cultural nuances and authenticity of human language.

In this study, we focus on how college students use ChatGPT in their learning for general tasks as well as specific academic tasks (i.e., writing and programming). Although numerous papers have explored the potential applications of ChatGPT, studies of its real-world usage are just starting to emerge. We aim to fill this gap in the literature by examining the actual use of ChatGPT. Specifically, our study extends the existing literature with a nationally representative survey of U.S. college students on their use and concerns about ChatGPT. First, we aim to contribute to the literature by uncovering the frequency of ChatGPT usage among college students, particularly for writing and computer programming, to better understand how this new technology is being adopted in U.S. higher education. Second, we aim to identify the factors that influence students' use of ChatGPT for general and academic tasks, to reveal whether certain groups of students are gaining more benefits from this new technology over others. Third, by identifying the types of concerns students have about ChatGPT, we seek to inform stakeholders on how to support the ethical and effective integration of this new technology. Fourth, we explore the sentiment of students' concerns across different demographic characteristics. Analyzing these sentiments offers insights into users' perceptions of new technology adoption (e.g., Kwarteng et al., 2020; Zhang, Li, Milman, & Hua, 2021) and potential equity issues sprouting in the use of generative AI in education.

## 4. Methods

### 4.1. Participants and data collection procedures

A total of 1091 participants completed a survey through Prolific (<https://www.prolific.com/>), a research panel service identified as providing high data quality in online behavioral research (Peer et al., 2022). To recruit our sample, we set screening criteria on Prolific regarding students' current status: institution type (undergraduate degree program or technical/community college), student status, and residence within the U.S. The individuals registered on Prolific who met the screening criteria across the U.S. volunteered to participate in the study. We dropped 90 participants who failed to correctly answer two attention check questions, resulting in a final sample of 1001. We paid each participant according to Prolific's recommended rate of \$3.02 for a 15-min survey. Data collection took place from August 2023 to September 2023. Each participant completed the survey using an anonymized link delivered through Prolific.

Participants answered a series of multiple-choice questions on their use of ChatGPT, followed by one open-ended question and a demographic questionnaire. The following questions were included in the survey: demographics, computer self-efficacy (6 questions), frequency of use of ChatGPT (3 questions), institutional response to ChatGPT (one multiple choice question), one open-ended question on concerns about using ChatGPT, two questions on ChatGPT, one multiple choice question on family income. We employed three 7-point Likert-scale questions to gauge the frequency of ChatGPT use in general ("I use ChatGPT"), writing ("I use ChatGPT for writing"), and computer programming ("I use ChatGPT in my computer programming"), with options ranging from never to multiple times a day.

### 4.2. Analysis

We followed a concurrent triangulation mixed-method approach wherein quantitative and qualitative data sources were collected

simultaneously (Creswell, 1999). A concurrent triangulation mixed-method approach is appropriate for this study as we employ quantitative and qualitative data collection and analysis to cross-check our findings and for an in-depth understanding of the results. We give equal weight to both methods and interpret the data from the two methods together (Creswell, Plano Clark, Gutmann, & Hanson, 2003).

### 4.3. Quantitative data

We analyzed the ChatGPT usage questions using descriptive statistics in Stata, focusing on the percentage frequency of each type of use. To examine the factors associated with students' use of ChatGPT, we ran a separate multiple regression analysis for general use, use for writing, and use for programming while including the covariates of interest in the model. These covariates were native English status (native English speakers or non-native English speakers), major, gender, age, institution type, and institutional policy. We aggregated majors into STEM and non-STEM groups, with math, computer science, engineering, and physical sciences coded as STEM, and humanities, social sciences, and arts/performing arts as non-STEM.

### 4.4. Qualitative data

We analyzed the open-ended responses using two different approaches—Natural Language Processing ("NLP") and thematic analysis. The open-ended question prompted participants to express their concerns about using ChatGPT in their course or professional work in two to three sentences ("What concerns you about using ChatGPT in your course or professional work?"). Using both the NLP and qualitative approaches draws on the strengths of each approach, the results of the thematic analysis provide deeper insights (e.g., revealing nuances) into the data science outputs, such as keyword frequencies (Skeen et al., 2022). For NLP, we used the "sentimentanalysis" package in R Studio to generate a sentiment score between -1 (most negative) and 1 (most positive), based on dictionary-based semantic annotations (Aguilar & Baek, 2020). We then compared the sentiment scores across the student characteristics.

We conducted a thematic analysis using an inductive approach, following the phases of thematic analysis (Braun & Clarke, 2006). The first author began by iteratively reading and coding the data, identifying noteworthy features in the open-ended responses. After several iterations of generating initial codes, the other authors were consulted to refine these codes and identify emerging themes. Once themes were established, the authors collectively reviewed and refined them to ensure alignment with the coded examples and the overall dataset. Each theme was then defined and named. Finally, the first author re-examined the entire dataset to assign themes to each open-ended response (see Table 3 in the Supplementary File for the coding scheme).

## 5. Results

The majority of the participants reported enrollment in four-year universities ( $n = 713$ ), while the remainder reported being enrolled in community colleges or technical universities ( $n = 288$ ). There was about an equal number of STEM ( $n = 487$ ) versus non-STEM majors ( $n = 496$ ). Most participants reported English as their first language ( $n = 945$ ) (see Table 1 in the Supplementary File for full demographics). Regarding institutional policy on the use of ChatGPT, only 6.8% of the participants reported that their institution allowed its use and 29.07% of the participants reported that their institutions did not allow the use of ChatGPT. Most participants were either unsure of their institution's ChatGPT policy (43.5%) or reported that their institution does not have a specific policy (18.4%).

### Research Question 1: How frequently do students use ChatGPT for general tasks, writing, and computer programming?

Our results indicate a notable trend towards the adoption of ChatGPT

**Table 1**

Multiple regression results of general ChatGPT use and factors.

Measure	Estimate	SE	95% of CI	
Intercept	3.45 <sup>i</sup>	.24	2.97	3.92
First language <sup>a</sup>	.24	.26	-.27	.75
Major <sup>b</sup>	.47 <sup>i</sup>	.10	.27	.67
Gender <sup>c</sup>				
Female	-.63 <sup>i</sup>	.11	-.84	-.42
Other	-.88 <sup>i</sup>	.22	-1.31	-.45
Age <sup>d</sup>				
24-29	.25	.13	.005	.50
30-35	.42 <sup>a</sup>	.16	.10	.74
36-41	.56 <sup>b</sup>	.21	.14	.98
42-47	.85 <sup>b</sup>	.28	.30	1.40
Above 47	.44	.29	-.14	1.01
Education <sup>e</sup>	.49	.11	.26	.71
Institution <sup>f</sup>				
Does not allow	-1.36 <sup>i</sup>	.22	-1.78	-.93
Does not have a policy	-.29	.23	-.73	.16
Not sure	-1.01 <sup>i</sup>	.21	-1.42	-.60
Other	-1.00 <sup>b</sup>	.39	-1.77	-.24

Note.

<sup>a</sup> (1 = native, 2 = non-native).<sup>b</sup> (1 = non-STEM, 2 = STEM).<sup>c</sup> (1 = male, 2 = female, 3 = other).<sup>d</sup> (1 = 18-23, 2 = 24-29, 3 = 30-35, 4 = 36-41, 5 = 42-47, 6 = above 47).<sup>e</sup> (1 = community/tech, 2 = 4-year).<sup>f</sup> (1 = does allow, 2 = does not allow, 3 = does not have a policy, 4 = not sure, 5 = other).<sup>g</sup> =  $p < .05$ .<sup>h</sup> =  $p < .01$ .<sup>i</sup> =  $p < .001$ .

in U.S. colleges, marking a pivotal moment in the diffusion of this technology in higher education settings (see **Table 2** in the Supplementary File). The majority of students reported using ChatGPT for general purposes and about one-third of the participants (33.1%) indicated that they use ChatGPT for writing monthly, suggesting that they find ChatGPT to be a useful tool for general and writing tasks. However,

**Table 2**

Multiple regression results of ChatGPT use for writing and factors.

Measure	Estimate	SE	95% of CI	
Intercept	3.06 <sup>i</sup>	.23	2.60	3.52
First language <sup>a</sup>	.68 <sup>b</sup>	.10	.19	1.17
Major <sup>b</sup>	.28 <sup>b</sup>	.10	.09	.48
Gender <sup>c</sup>				
Female	-.32 <sup>b</sup>	.10	-.52	-.12
Other	-.69 <sup>b</sup>	.21	-1.11	-.28
Age <sup>d</sup>				
24-29	.05	.12	-.19	.29
30-35	.35 <sup>b</sup>	.16	.05	.66
36-41	.43 <sup>b</sup>	.20	.03	.83
42-47	.60 <sup>b</sup>	.27	.07	1.13
Above 47	.45	.28	-.11	1.00
Education <sup>e</sup>	.33 <sup>b</sup>	.11	.11	.54
Institution <sup>f</sup>				
Does not allow	-1.47 <sup>i</sup>	.21	-1.88	-1.06
Does not have a policy	-.73 <sup>b</sup>	.22	-1.16	-.31
Not sure	-1.21 <sup>i</sup>	.20	-1.60	-.82
Other	-1.25 <sup>b</sup>	.38	-1.98	-.51

Note.

<sup>a</sup> (1 = native, 2 = non-native).<sup>b</sup> (1 = non-STEM, 2 = STEM).<sup>c</sup> (1 = male, 2 = female, 3 = other).<sup>d</sup> (1 = 18-23, 2 = 24-29, 3 = 30-35, 4 = 36-41, 5 = 42-47, 6 = above 47).<sup>e</sup> (1 = community/tech, 2 = 4-year).<sup>f</sup> (1 = does allow, 2 = does not allow, 3 = does not have a policy, 4 = not sure, 5 = other).<sup>g</sup> =  $p < .05$ .<sup>h</sup> =  $p < .01$ .<sup>i</sup> =  $p < .001$ .**Table 3**

Multiple regression results of ChatGPT use for programming and factors.

Measure	Estimate	SE	95% of CI	
Intercept	2.50 <sup>i</sup>	.22	2.07	2.93
First language <sup>a</sup>	.64 <sup>b</sup>	.23	.18	1.10
Major <sup>b</sup>	.66	.09	.47	.84
Gender <sup>c</sup>				
Female	-.37 <sup>b</sup>	.10	-.55	-.18
Other	-.51 <sup>b</sup>	.20	-.90	-.13
Age <sup>d</sup>				
24-29	.20	.11	-.02	.42
30-35	.17	.14	-.12	.45
36-41	.37	.19	-.004	.74
42-47	-.12	.25	-.62	.37
Above 47	.64 <sup>b</sup>	.26	.12	1.16
Education <sup>e</sup>	.40	.10	.20	.60
Institution <sup>f</sup>				
Does not allow	-1.40 <sup>i</sup>	.19	-1.78	-1.01
Does not have a policy	-.64 <sup>b</sup>	.20	-1.04	-.25
Not sure	-1.34 <sup>i</sup>	.19	-1.71	-.97
Other	-1.49 <sup>i</sup>	.35	-2.18	-.81

Note.

<sup>a</sup> (1 = native, 2 = non-native).<sup>b</sup> (1 = non-STEM, 2 = STEM).<sup>c</sup> (1 = male, 2 = female, 3 = other).<sup>d</sup> (1 = 18-23, 2 = 24-29, 3 = 30-35, 4 = 36-41, 5 = 42-47, 6 = above 47).<sup>e</sup> (1 = community/tech, 2 = 4-year).<sup>f</sup> (1 = does allow, 2 = does not allow, 3 = does not have a policy, 4 = not sure, 5 = other).<sup>g</sup> =  $p < .05$ .<sup>h</sup> =  $p < .01$ .<sup>i</sup> =  $p < .001$ .

the majority of students (66.8%) reported never using ChatGPT for computer programming, which might be attributed to the relative frequency of writing for students across the disciplines, while computer programming is primarily limited to STEM courses. Other contributing factors to low usage for computer programming could include a lack of awareness of ChatGPT's capabilities in programming support or perceived inadequacies in the AI's programming support. The low frequency of daily use for specific academic activities may signal underlying anxiety about the effectiveness, appropriateness, or ethical implications of using AI in these academic domains (Draxler et al., 2023; Firat, 2023), but also reflects the frequency of those activities in general across the curriculum.

#### Research Question 2: What factors are associated with students' use of ChatGPT for general tasks, writing, and computer programming?

The reference groups in each regression table (**Tables 1-3**) for first language, major, gender, age, type of institution, and institutional policy are the following respectively: "native English speakers," "non-STEM," "male," "18-23," "community/technical universities," and "allow the use of ChatGPT." For all three tasks, major, gender, age group, type of institution, and institutional policy were significant factors that influenced the use of ChatGPT. STEM majors were more likely to frequently use ChatGPT for general and academic tasks than non-STEM majors (see **Tables 1-3**). For all three tasks, males were more likely to frequently use ChatGPT than those in other gender groups. Those who reported that their institution allows the use of ChatGPT were more likely to frequently use ChatGPT for general and academic tasks than those who reported otherwise. Those in four-year institutions were more likely to frequently use ChatGPT for general and academic tasks than those in community or technical universities.

For general task ( $F = 14.20, p < .001$ , R-squared = .17) and writing ( $F = 9.30, p < .001$ , R-squared = .12), those in age groups 30-47 were more likely to frequently use ChatGPT than those in the youngest age group, 18-23. For computer programming ( $F = 14.87, p < .001$ , R-squared = .18), those in the age group above 47 were more likely to use ChatGPT than those in the youngest group. For writing and computer

programming, non-native English speakers were more likely to use ChatGPT than native English speakers. However, for general tasks, being a native English speaker was not a significant factor that influenced the use of ChatGPT.

**Research Question 3: What are the common concerns among students regarding the use of ChatGPT in their course and professional work?**

According to the thematic analysis of the open-ended responses, the most prevalent concerns about using ChatGPT pertained to ethics, quality, and opportunities. Other concerns included accessibility and skepticism regarding ChatGPT being too good to be true. Some participants indicated they had no concerns about using ChatGPT (see Table 3 in the Supplementary File for the coding scheme).

### 5.1. Ethics

Concerns related to ethics in using ChatGPT center around plagiarism and cheating. Students feared unintentional plagiarism and worried that relying on ChatGPT might compromise the originality of their work, leading to potential academic penalties (e.g., “I would be afraid that it would cause an increased instance of accidental plagiarism”). Non-native English speakers find ChatGPT helpful but fear punishment from their institutions. A non-native English speaker shared, “Since I am not sure of my school’s stance on the software I don’t want to use it too frequently where I might get in trouble. But I find it can be really helpful ...”

The anxiety about unintentional plagiarism and fear of punishment from institutions underscore a conflict between traditional academic values and the disruptive nature of AI technology like ChatGPT. This tension reflects a complex societal struggle to redefine ethics in the face of emerging technologies (Olcott et al., 2015), revealing the need for a reevaluation of academic guidelines and policies in the generative AI era as well as establishing more clear AI policy for institutions (Chan, 2023).

### 5.2. Quality

Students’ concerns about quality collectively imply a critical stance among students toward the integration of AI in academic contexts. Students were concerned about losing their creativity, a concern that was particularly pronounced among those in fields where personal voice and creativity are more central (non-STEM majors). For example, one student in Communications shared their concern about how ChatGPT can devalue their writing and the writing of others in their field. Students in STEM majors were particularly concerned about accuracy, “accuracy matters in my field, and I’m not always confident in the accuracy of information provided by ChatGPT.”

Furthermore, students’ concern about inherent bias in ChatGPT’s output due to its training on large datasets reflects their awareness of the limitations and potential ethical implications of AI. The data used to train AI can produce discriminatory results and be harmful (Akgun & Greenhow, 2021, pp. 1–10; Gašević et al., 2023), and students are well aware of these risks of AI. Students recognize that generative AI is not neutral and that it can perpetuate existing societal biases, leading to outputs that may be discriminatory or offensive.

ChatGPT is trained on a massive dataset of text and code, which means that it can inherit the biases that exist in that data. This could lead to ChatGPT generating text that is discriminatory or offensive.

### 5.3. Opportunities

The concerns regarding opportunities center on issues of the learning process and the future of job markets. These concerns reveal a complex interplay between AI technology and personal development as learners and humans. Students worried that reliance on ChatGPT could hinder critical thinking skills and viewed a “too comfortable” learning process as detrimental to academic growth. Indeed, previous studies have shown

that students value deep engagement in the learning process (e.g., Lumpkin et al., 2015) and this engagement leads to better learning outcomes (Cho et al., 2017; Vos et al., 2011). One non-native English speaker stated the fear of ChatGPT making writing skills obsolete, the skills they put efforts to master: “I have spent a lot of time refining my writing style, and ChatGPT may make that skill obsolete.”

Students in computer science-related fields expressed concerns about job loss due to the advancement of generative AI. For example, CS majors shared apprehensions about their future job prospects such that “ChatGPT has the potential to lessen the value of entry-level programmers.” The concerns of students in CS-related fields about job security echo a wider societal debate about the impact of AI and automation on employment. Students’ concerns about their job security can lead them to leave the fields, as studies have found that employees’ perceptions of their jobs being threatened by technology can lead to job departure (e.g., Brougham & Haar, 2020).

The mixed views among students in humanities fields about the threat of automation to their careers highlight a dichotomy in perceptions of AI’s capabilities. While some students fear that AI could automate aspects of their work (e.g., “I’m concerned that it could automate parts of my career ... it could replace the need for writers”), others maintain that the unique qualities of human creativity and authenticity are irreplaceable by AI (e.g., ChatGPT is “soulless”).

### 5.4. Accessibility

Indeed, those students expressing accessibility concerns about ChatGPT’s cost or connection issues with older AI models came from the lowest family income group, between \$0-\$50,000. One such student voiced their worry that “in the future it might be more expensive to use this product.” Another student highlighted potential limitations of the older version of ChatGPT:

“If using the 3.5 model, being unable to connect to the internet, or finetune it causes major issues.”

### 5.5. Skepticism

The skepticism expressed by some students about the safety of their personal data when using ChatGPT reveals their deep mistrust of the mechanisms (and/or entities) behind AI technologies. Some students were skeptical, “ChatGPT is too good to be true.” Other students expressed concerns about unauthorized access, data misuse, and surveillance as consequences of using ChatGPT:

“That everythings [everything is] being recorded and its [it’s] being sent to the government. There’s also the concern that what is said in the conversation can be used against me in whatever situation.”

Furthermore, the fears about potential cybersecurity threats, such as viruses or cybercrimes, indicate an awareness of the vulnerabilities inherent in digital technologies. This AI skepticism comes not only from people’s lack of knowledge of AI but also from the gap between the users’ expectations and what the system currently offers (Chen et al., 2022).

### 5.6. No concern

Students who expressed no concern over AI perceived ChatGPT not as a threat but as a beneficial and augmentative tool, reflecting a more optimistic and pragmatic approach to generative AI integration in education. This view indicates an acknowledgment of the potential of AI to complement human effort, rather than replace it, in the pursuit of knowledge and efficiency, though also perhaps a lack of understanding of the true potential of generative AI. For example, one shared “I feel chat GPT [ChatGPT] is just an enhancement on search engine technology we already have. It just makes gathering the information from multiple sources highly more efficient.” A non-native English speaker stated that they utilize ChatGPT to “make sure my sentences are

grammatical or to check if what I am saying is ok." Some students implied that their confidence in using ChatGPT stemmed from their knowledge of "how" to use ChatGPT.

The contrasting views between those concerned about using ChatGPT and those confident in its usage may reflect existing societal inequities and digital divides. Students who reported confidence in using ChatGPT and leveraging its affordances might come from higher-income backgrounds, as people from higher-income backgrounds tend to have higher digital literacy and self-efficacy compared to those from lower-income backgrounds (e.g., Bailey et al., 2015; Wong et al., 2015).

#### Research Question 4: Does sentiment toward ChatGPT use vary based on student characteristics?

There was little variation in sentiment scores across different majors, first languages, genders, and types of schools attended (see Table 4 in the Supplementary File). However, the relationship between income groups and sentiment scores introduces a socioeconomic dimension to the perception of ChatGPT (see Fig. 1). The trend of less negative sentiment scores in higher income groups compared to lower income groups could reflect varying levels of access to and familiarity with technology like ChatGPT. Students from higher-income backgrounds might have more exposure to and comfort with using advanced technologies, potentially leading to more positive perceptions or less skepticism about AI. The gradual increase in minimum sentiment scores from lower to higher income categories (except for the extreme income categories of "no income" and "above \$250,000") suggests an incremental improvement in attitudes towards ChatGPT as income rises, possibly due to better resources, education, or technological exposure. Indeed, research has shown that students from higher income groups have more exposure to technology as well as more resources (e.g., better equipment, parent support with technology; Aguilar et al., 2020; Katz, Moran, & Ognanova, 2019). In addition, lower-income students may have had, or be aware of, the use of AI for policing purposes or the biases embedded in generative AI, which would contribute to an increased negative perception overall. The unequal power relationships, contextual uses, and access disparities within society shape the diffusion and implementation of ChatGPT (Kranzberg, 1986; Warschauer, 2004).

## 6. Discussion

Our analysis of student use and perceptions regarding ChatGPT in U.S. higher education reveals the complex interplay between technological advancement and social, political, and economic structures. Grounded in the critical theory of technology, this study highlights how technology is not neutral but is deeply embedded in and shaped by these structures. Factors related to students and their social structures, including

institutional policy, type of institution, and gender, were significant factors influencing students' use of ChatGPT. This aligns with the critical theory perspective that technology both affects and is affected by the societal framework within which it operates.

Students in different groups and contexts may have varying needs for effectively utilizing this new technology. Therefore, deployment should be conducted in a manner that supports these needs to ensure generative AI is implemented equitably to benefit a diverse student body (Abdaljaleel et al., 2023). Furthermore, technology is not merely a tool but is deeply embedded in social and power structures, as evidenced by students' concerns about the ethical implications of AI use, the transformation of the learning process, and future employment. These concerns highlight the influence of societal values and norms on individual's technology adoption and use.

### 6.1. Use of ChatGPT

Our results indicate that ChatGPT has penetrated U.S. higher education, with over half of the students using it for general purposes and writing at least monthly. Our findings suggest that a dichotomizing approach of either using AI or completely banning it in higher education institutions is unrealistic, given ChatGPT's widespread adoption (Petricini et al., 2023). Artificial intelligence is not "better" than human intelligence—it is both less and more than human intelligence—and in education, we need to draw on its strengths while recognizing its limitations (Cope et al., 2021). It is essential and timely for institutions to establish and communicate clear policies regarding the use of ChatGPT as institutional policy significantly influences students' use of ChatGPT; currently, most students reported uncertainty about their institution's policy on ChatGPT. Institutions, educators, and researchers should explore ways to ethically integrate generative AI, utilizing its capabilities as a tool to enhance learning.

The affordances of ChatGPT in supporting those who most need it are evident, particularly among non-native English speakers who reported using ChatGPT more frequently for writing than native speakers. Such support is crucial in academic and professional settings for those struggling with English writing (Jacob et al., 2023; Tseng & Warschauer, 2023; Warschauer et al., 2023). Indeed, our thematic analysis revealed that non-native English speakers use ChatGPT to enhance grammar and coherence. Non-native English speakers, who may face challenges in producing coherent and grammatically correct text, can experience writing anxiety and low self-efficacy (Kara, 2013; Medve & Pavičić Takač, 2013). Generative AI has applications from planning to revision in the writing process and may improve not only the ultimate quality of the writing product but also increase students' self-efficacy for writing. This support in the writing process is beneficial not only for non-native English speakers but also for individuals with language or learning disabilities (Tate et al., 2023).

### 6.2. Concerns and sentiment

A primary concern among participants was the fear of being accused of cheating for using generative AI, especially relevant for non-native speakers who are much more likely to be falsely identified as producing AI-generated text (Liang et al., 2023). Such concerns revolve around being flagged by AI detection software used by institutions, which deters students from using generative AI. This reinforces the need for clear guidelines on the ethical use of generative AI. For example, institutions could require students to disclose generative AI use and limit the use of generative AI to brainstorming and editing, or certain types of assignments. Institutions should address challenges such as the misuse of generative AI while allowing students who need it most to benefit from generative AI (Cotton et al., 2023).

Further, students' fear of unintentional cheating highlights the importance of providing training in ethical AI use and AI literacy (Petricini et al., 2023). Prior research indicates students' desire for AI

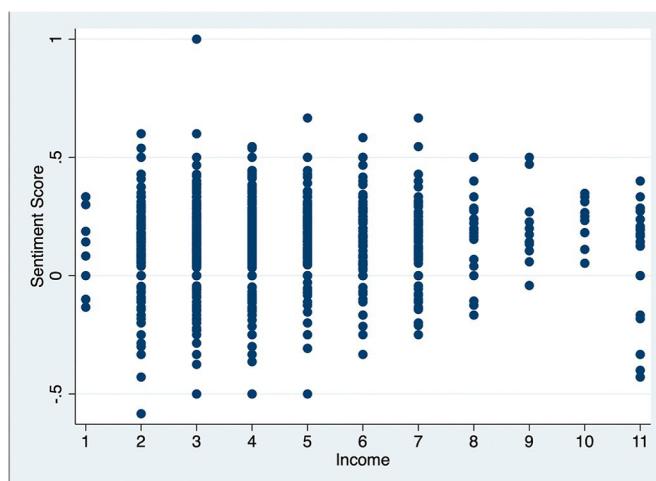


Fig. 1. Scatter plot of sentiment score per income level.

training even before the launch of ChatGPT (Sit et al., 2020; Wood, Ange, & Miller, 2021). There are AI literacy frameworks that can be adopted to train students and instructors. For example, Warschauer et al. (2023) developed an AI literacy framework that includes five elements—understand, access, prompt, corroborate, and incorporate—that can guide students and instructors in using generative AI to support learning. Students are well aware of generative AI's limitations, such as inaccuracies and biases in data. With proper training, students can utilize the affordances of this new technology tool to promote their learning and become managers of the tool instead of passive users.

Students in computer science-related fields expressed concerns about job security, highlighting two common types of concerns: insecurity about job continuity and overall future job existence (Nam, 2019). The impact of generative AI on employment is still uncertain; it may lead to job displacement, creation, or shifts (Budhwar et al., 2023). It is evident, however, that this new AI technology will significantly affect jobs. Thus, stakeholders need to consider how these changes, especially in computer science fields, may unfold and prepare students accordingly. Doing so will mitigate the job insecurities of students in CS fields. For example, adding a curriculum that integrates AI as a tool can be beneficial, as future CS jobs will most likely increasingly involve generative AI.

The accessibility concerns of students from the lowest income groups, who also expressed more negative sentiments about using ChatGPT, suggest that income inequality is extending to generative AI use, perpetuating the digital divide. Issues such as WiFi problems with the free version of ChatGPT and concerns about future costs of using ChatGPT reflect the broader accessibility challenges these students face with technology. These difficulties often stem from their K-12 experiences, where low-income families typically have limited access to the internet, devices, and digital skills (Aguilar et al., 2020). Our findings indicate that while new technologies can reduce inequality, they also have the potential to make the “rich get richer” and exacerbate the digital gap (Warschauer et al., 2023).

### 6.3. Future directions

Surprisingly, students in their 30s–40s were more likely to use ChatGPT frequently than those in the younger groups. This result is unexpected, as younger adults are generally perceived as being most open to new technologies (Sun & Ye, 2023). However, our results align with Draxler et al. (2023), who found that U.S. adults in middle-aged groups used large language models more frequently than younger adults. As our findings indicate that students express fear of being punished for using ChatGPT, it could be that older students have more confidence in using this new technology appropriately, owing to their greater experience in academic or professional settings compared to the youngest group. Furthermore, the assumption that older adults have a fear of technology and possess fewer skills in using it could be a stereotype that needs to be challenged. Our findings warrant further investigation into the relationship between age and the use of generative AI.

## 7. Implications and conclusion

Our study underscores the multifaceted role of ChatGPT in U.S. higher education. Our findings affirm that technology, specifically ChatGPT, is deeply intertwined with social structures, transcending its function as a mere academic tool. ChatGPT's impact on learning processes, ethical considerations, and the job market is reflective of its interaction with cultural, social, and institutional factors, resonating with Warschauer's (1998, 2004) ecological system perspective. Students' interactions with ChatGPT are not merely shaped by these societal, cultural, and institutional factors but also reflective of them. The diverse utility of ChatGPT among different student demographics, including its role as a support for non-native English speakers, emphasizes the technology's potential as an important educational tool within

this complex ecosystem.

The concerns related to ethics and job displacement parallel the historical transformative impacts of print and digital literacy technologies on writing and authorship. Generative AI, like its predecessors, is reshaping notions of learning and authorship in contemporary education. Moreover, our findings on the digital divide reveal the continuation of unequal power relationships and access disparities. Addressing this divide is pivotal to prevent exacerbating existing inequalities in educational access and quality, ensuring that generative AI tools like ChatGPT are integrated equitably.

The integration of generative AI in education should be conducted in a thoughtful manner, acknowledging the benefits as well as its limits while examining its impact on existing societal structures. To navigate these challenges, educational institutions should develop and enforce policies and guidelines on the use of generative AI that are context-specific. Complementing this with targeted training for both students and educators is crucial to promoting AI literacy and ethical AI use. Doing so is one of the essential steps in ensuring that this remarkable advancement enriches the educational landscape by complementing human creativity while addressing the inherent challenges posed by such disruptive technologies.

## 8. Limitations

This study has several limitations. First, all answers the participants provided in the survey were self-reported. Therefore, the answers might have been affected by the limitations of self-reported data, such as social desirability bias. Second, the participants of the study were registered survey takers of a research panel service. As a result, the participants may share common characteristics, such as a certain level of technology skills required to use and access a survey platform. Third, this study is based on a cross-sectional survey, and we do not have knowledge of how the participants' use and perception of ChatGPT evolved over time.

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## Statement

The conduct of this research has been approved by the University of California Irvine's Institutional Review Board with ID 3544. During the preparation of this work the authors used ChatGPT in order to edit the grammar of the paper. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

## CRediT authorship contribution statement

**Clare Baek:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tamara Tate:** Writing – review & editing, Writing – original draft, Funding acquisition, Formal analysis, Conceptualization. **Mark Warschauer:** Writing – review & editing, Writing – original draft, Funding acquisition, Formal analysis, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.caai.2024.100294>.

## References

Abdaljaleel, M., Barakat, M., Alsafni, M., Salim, N. A., Abazid, H., Malaeb, D., et al. (2023). Factors influencing attitudes of university students towards ChatGPT and its usage: a multi-national study validating the TAME-ChatGPT survey instrument. *Preprints*. <https://doi.org/10.20944/preprints202309.1541.v1> [Epub ahead of print].

Aguilar, S. J., & Baek, C. (2020). Sexual harassment in academe is underreported, especially by students in the life and physical sciences. *PLoS One*, 15(3), Article e0230312.

Aguilar, S. J., Galperin, H., Baek, C., & Gonzalez, E. (2020). When school comes home: How low-income families are adapting to distance learning. <https://doi.org/10.35542/osf.io/su8wk>

Akgun, S., & Greenhow, C. (2021). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI and Ethics*.

Amoozadeh, M., Daniels, D., Niam, D., Chen, S., Hilton, M., Ragavan, S. S., & Alipour, M. A. (2023). Trust in generative AI among students: An exploratory study. *arXiv preprint arXiv:2310.04631*.

Baidoo-Anu, D., & Ansah, L. O. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of AI*, 7(1), 52–62.

Bailey, S. C., O'conor, R., Bojarski, E. A., Mullen, R., Patzer, R. E., Vicencio, D., ... Wolf, M. S. (2015). Literacy disparities in patient access and health-related use of internet and mobile technologies. *Health Expectations*, 18(6), 3079–3087.

Bin-Nashwan, S. A., Sadallah, M., & Bouteraa, M. (2023). Use of ChatGPT in academia: Academic integrity hangs in the balance. *Technology in Society*, 75, Article 102370.

Biswas, S. (2023). Role of ChatGPT in computer programming. *Mesopotamian Journal of Computer Science*, 2023, 9–15.

Bordt, S., & von Luxburg, U. (2023). Chatgpt participates in a computer science exam. *arXiv preprint arXiv:2303.09461*.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.

Brougham, D., & Haar, J. (2020). Technological disruption and employment: The influence on job insecurity and turnover intentions: A multi-country study. *Technological Forecasting and Social Change*, 161, Article 120276.

Brynjolfsson, E., Li, D., & Raymond, L. R. (2023). Generative AI at work (No. w31161). National Bureau of Economic Research.

Budhwar, P., Chowdhury, S., Wood, G., Aguinis, H., Bamber, G. J., Beltran, J. R., ... Varma, A. (2023). Human resource management in the age of generative artificial intelligence: Perspectives and research directions on ChatGPT. *Human Resource Management Journal*, 33(3), 606–659.

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. *International journal of educational technology in higher education*, 20(1), 38.

Chen, X., Bear, E., Hui, B., Santhi-Ponnusamy, H., & Meurers, D. (2022). Education theories and AI affordances: Design and implementation of an intelligent computer assisted language learning system. In *International conference on artificial intelligence in education* (pp. 582–585). Cham: Springer International Publishing.

Cho, M. H., Kim, Y., & Choi, D. (2017). The effect of self-regulated learning on college students' perceptions of community of inquiry and affective outcomes in online learning. *The Internet and Higher Education*, 34, 10–17.

Cope, B., Kalantzis, M., & Searsmith, D. (2021). Artificial intelligence for education: Knowledge and its assessment in AI-enabled learning ecologies. *Educational Philosophy and Theory*, 53(12), 1229–1245.

Cotton, D. R., Cotton, P. A., & Shipway, J. R. (2023). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education & Teaching International*, 1–12.

Creely, E. (2024). Exploring the role of generative AI in enhancing language learning: Opportunities and challenges. *International Journal of Changes in Education*.

Creswell, J. W. (1999). Mixed method research: Introduction and application. In T. Cijek (Ed.), *Handbook of educational policy* (pp. 455–472). San Diego, CA: Academic Press.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori, & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209–240). Thousand Oaks, CA: Sage.

Draxler, F., Buschek, D., Tavast, M., Ha'ma"lainen, P., Schmidt, A., Kulshrestha, J., & Welsch, R. (2023). Gender, age, and technology education influence the adoption and appropriation of LLMs. *arXiv preprint arXiv:2310.06556*.

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71, Article 102642.

Eisenstein, E. L. (1980). *The printing press as an agent of change* (Vol. 1). Cambridge University Press.

Faruk, L. I. D., Rohan, R., Ninrutsirkun, U., & Pal, D. (2023). University Students' Acceptance and Usage of Generative AI (ChatGPT) from a Psycho-Technical Perspective. In *In Proceedings of the 13th International Conference on Advances in Information Technology* (pp. 1–8).

Füllerer, T., Fischer, C., Alekseeva, A., et al. (2023). ChatGPT in education: Global reactions to AI innovations. *Scientific Reports*, 13(1), Article 15310. <https://doi.org/10.1038/s41598-023-42227-6>

Feenberg, A. (1991). Critical theory of technology: An overview. *Information technology in librarianship: New critical approaches*.

Firat, M. (2023). What ChatGPT means for universities: Perceptions of scholars and students. *Journal of Applied Learning and Teaching*, 6(1).

Frey, C. B., & Osborne, M. (2024). Generative AI and the future of work: A reappraisal. *Brown Journal of World Affairs*, 30(1).

Ga'sevi'c, D., Siemens, G., & Sadiq, S. (2023). Empowering learners for the age of artificial intelligence. *Computers in Education: Artificial Intelligence*, 4, Article 100130.

Gmyrek, P., Berg, J., & Bescond, D. (2023). *Generative AI and jobs: A global analysis of potential effects on job quantity and quality* (Vol. 96). ILO Working Paper.

Habib, S., Vogel, T., Anli, X., & Thorne, E. (2024). How does generative artificial intelligence impact student creativity? *Journal of Creativity*, 34(1), Article 100072.

Hsu, H. T., & Lin, C. C. (2022). Extending the technology acceptance model of college learners' mobile-assisted language learning by incorporating psychological constructs. *British Journal of Educational Technology*, 53(2), 286–306.

Jacob, S., Tate, T., & Warschauer, M. (2023). Emergent AI-assisted discourse: Case study of a second language writer authoring with ChatGPT. *arXiv preprint. arXiv:2310.10903*.

Kara, S. (2013). Writing anxiety: A case study on students' reasons for anxiety in writing classes. *Anadolu Journal Of Educational Sciences International*, 3(1), 103–111.

Katz, V. S., Moran, M. B., & Ognyanova, K. (2019). Contextualizing connectivity: How internet connection type and parental factors influence technology use among lower-income children. *Information, Communication & Society*, 22(3), 313–335.

Kayali, B., Yavuz, M., Balat, S., & Çalis,an, M. (2023). Investigation of student experiences with ChatGPT-supported online learning applications in higher education. *Australasian Journal of Educational Technology*, 39(5), 20–39.

Kranzberg, M. (1986). Technology and history: "Kranzberg's laws". *Technology and culture*, 27(3), 544–560. Chicago.

Kwarteng, M. A., Ntisful, A., Botchway, R. K., Pilik, M., & Kominkov'a Oplatkov'a, Z. (2020). Consumer insight on driverless automobile technology adoption via twitter data: A sentiment analytic approach. In *In Re-imagining diffusion and adoption of information technology and systems: A continuing conversation* (pp. 463–473). Springer International Publishing.

Lazaroiu, G., & Rogalska, E. (2023). How generative artificial intelligence technologies shape partial job displacement and labor productivity growth. *Oeconomia Copernicana*, 14(3), 703–706.

Liang, W., Yuksekogul, M., Mao, Y., Wu, E., & Zou, J. (2023). GPT detectors are biased against non-native English writers. *arXiv preprint arXiv:2304.02819*.

Lumpkin, A., Achen, R. M., & Dodd, R. K. (2015). Student perceptions of active learning. *College Student Journal*, 49(1), 121–133.

Medve, V. B., & Pavicic Takač, V. (2013). The influence of cohesion and coherence on text quality: A cross-linguistic study of foreign language learners' written production. In *Second Language learning and teaching* (pp. 111–131). Berlin, Heidelberg: Springer Berlin Heidelberg.

Monika, M., & Suganthan, C. (2024). A study on analyzing the role of Chatgpt in English acquisition among ESL learners during English language classroom. *Bohdí International Journal of Research in Humanities, Arts and Science*, 8(2), 75–84.

Nam, T. (2019). Technology usage, expected job sustainability, and perceived job insecurity. *Technological Forecasting and Social Change*, 138(January), 155–165.

Olcott, D., Carrera Farran, X., Gallardo Echenique, E. E., & González Martínez, J. (2015). Ethics and education in the digital age: Global perspectives and strategies for local transformation in Catalonia. *RUSC Universities and Knowledge Society Journal*, 12(2), 59.

Peer, E., Rothschild, D., Gordon, A., Evernden, Z., & Damer, E. (2022). Data quality of platforms and panels for online behavioral research. *Behavior Research Methods*, 54(4), 1643–1662.

Peng, S., Kalliamvakou, E., Cihon, P., & Demirer, M. (2023). The impact of ai on developer productivity: Evidence from github copilot. *arXiv preprint arXiv:2302.06590*.

Petricini, T., Wu, C., & Zipf, S. T. (2023). *Perceptions about generative AI and ChatGPT use by faculty and college students*. EdArXiv. <https://doi.org/10.35542/osf.io/jym44>

Resnick, M. (2024). Generative AI and creative learning: Concerns, opportunities, and choices. *An MIT Exploration of Generative AI*.

Shaikh, S., Yavuz, S. Y., Klimova, B., & Pikhart, M. (2023). Assessing the usability of ChatGPT for formal English language learning. *European Journal of Investigation in Health, Psychology and Education*, 13(9), 1937–1960.

Shoufan, A. (2023). Exploring students' perceptions of ChatGPT: Thematic analysis and follow-up survey. *IEEE Access*, 11, 38805–38818.

Sit, C., Srinivasan, R., Amlani, A., Muthuswamy, K., Azam, A., Monzon, L., & Poon, D. S. (2020). Attitudes and perceptions of UK medical students towards artificial intelligence and radiology: a multicentre survey. *Insights into imaging*, 11, 1–6.

Skeen, S. J., Jones, S. S., Cruse, C. M., & Horvath, K. J. (2022). Integrating Natural Language Processing and interpretive thematic analyses to gain human-centered design insights on HIV mobile health: Proof-of-Concept analysis. *JMIR Human Factors*, 9(3), Article e37350.

Smolansky, A., Cram, A., Raduescu, C., Zeivots, S., Huber, E., & Kizilcec, R. F. (2023). Educator and student perspectives on the impact of generative AI on assessments in higher education. In *Proceedings of the tenth ACM conference on learning@ scale* (pp. 378–382).

Sun, E., & Ye, X. (2023). Older and fearing new technologies? The relationship between older adults' technophobia and subjective age. *Aging & Mental Health*, 1–8.

Surameery, N. M. S., & Shakor, M. Y. (2023). Use chat gpt to solve programming bugs. *International Journal of Information Technology and Computer Engineering*, 31, 17–22.

Tate, T., Doroudi, S., Ritchie, D., & Xu, Y. (2023). Educational research and AI-generated writing: Confronting the coming tsunami. *edarxiv.org*. 2023 <https://edarxiv.org/4mec3>.

Tiwari, C. K., Bhat, M. A., Khan, S. T., Subramaniam, R., & Khan, M. A. I. (2024). What drives students toward ChatGPT? An investigation of the factors influencing adoption and usage of ChatGPT. *Interactive Technology and Smart Education*, 21(3), 333–355.

Tseng, W., & Warschauer, M. (2023). AI-writing tools in education: If you can't beat them, join them. *Journal of China Computer-Assisted Language Learning*. <https://doi.org/10.1515/jcCALL-2023-0008>

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2), 273–315.

Vos, N., Van Der Meijden, H., & Denessen, E. (2011). Effects of constructing versus playing an educational game on student motivation and deep learning strategy use. *Computers & Education*, 56(1), 127–137.

Warschauer, M. (1998). Researching technology in TESOL: Determinist, instrumental, and critical approaches. *Tesol Quarterly*, 32(4), 757–761.

Warschauer, M. (1999). *Electronic literacies: Language, culture, and power in online education*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Warschauer, M. (2004). *Technology and social inclusion: Rethinking the digital divide*. MIT press.

Warschauer, M., Tseng, W., Yim, S., Webster, T., Jacob, S., Du, Q., & Tate, T. (2023). The affordances and contradictions of AI-generated text for writers of English as a second or foreign language. <https://doi.org/10.2139/ssrn.4404380>.

Wingo, N. P., Ivankova, N. V., & Moss, J. A. (2017). Faculty perceptions about teaching online: Exploring the literature using the technology acceptance model as an organizing framework. *Online Learning*, 21(1), 15–35.

Wong, Y. C., Ho, K. M., Chen, H., Gu, D., & Zeng, Q. (2015). Digital divide challenges of children in low-income families: The case of Shanghai. *Journal of Technology in Human Services*, 33(1), 53–71.

Wood, E. A., Ange, B. L., & Miller, D. D. (2021). Are we ready to integrate artificial intelligence literacy into medical school curriculum: students and faculty survey. *Journal of medical education and curricular development*, 8, 23821205211024078.

Zhang, T., Li, B., Milman, A., & Hua, N. (2021). Assessing technology adoption practices in Chinese theme parks: Text mining and sentiment analysis. *Journal of Hospitality and Tourism Technology*, 13(1), 195–213.

Zhou, E., & Lee, D. (2024). Generative artificial intelligence, human creativity, and art. *PNAS nexus*, 3(3), Article pgae052.

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