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IMPACT OF CHATGPT IN THE EDUCATIONAL FIELD:
POSSIBILITIES AND RISKS

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POSSIBILITIES AND RISKS**

**IMPACTO DE CHATGPT EN EL ÁMBITO EDUCATIVO:
POSIBILIDADES Y RIESGOS**

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Impact of ChatGPT in the Educational Field: Possibilities and Risks

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Abstract

The emergence of generative artificial intelligence (AI) tools, particularly ChatGPT, has sparked intense debate about their potential role in higher education. These tools offer possibilities for personalized learning, enhanced research support, and administrative efficiency, but they also raise concerns around academic integrity, critical thinking, and algorithmic bias. While many studies treat university students as a homogeneous group, or focus exclusively on a particular field, this study asks whether and how the use of ChatGPT differs across academic disciplines.

The study explores whether meaningful differences emerge in the ways students engage with ChatGPT for instance, whether STEM students use it more for problem-solving or coding, while Humanities students might rely on it for writing, language, or analytical tasks. Ethical concerns are also addressed, such as the potential for plagiarism, over-reliance on AI-generated text, and the impact of these tools on deep learning.

This research is grounded in a structured review of recent academic literature published between late 2022 and early 2025. By synthesizing existing studies, it investigates how ChatGPT is shaping students' learning strategies and academic practices across different disciplines. The study offers a nuanced understanding of AI in the university context and provides insights to help educators and policymakers harness its benefits while mitigating its risks.

Key words: ChatGPT, AI in education, STEM vs. Humanities, academic integrity, personalized learning

1. Introduction

AI-powered tools like ChatGPT are evolving rapidly, and their impact on higher education has been substantial. University students and academics are increasingly integrating AI systems into their daily routines for tasks such as studying, research, and administrative support. However, the adoption and influence of these technologies vary significantly across academic disciplines, institutional settings, and levels of technological accessibility. While AI tools offer the promise of greater efficiency, personalized learning experiences, and on-demand academic support, they also raise pressing ethical and pedagogical concerns.

This study specifically investigates the differential use and impact of ChatGPT among university students in STEM and Humanities disciplines. STEM students often rely on ChatGPT for structured tasks such as coding assistance, problem-solving, and mathematical reasoning. In contrast, Humanities students are more likely to use it for writing-intensive assignments, language refinement, and analytical exploration. Understanding these disciplinary differences is essential to evaluating how generative AI is reshaping educational practices and student learning strategies.

Central to ongoing debates are issues of academic integrity and critical thinking. Universities face challenges related to plagiarism, over-reliance on AI-generated content, and the potential erosion of independent thought. Does frequent use of ChatGPT result in superficial engagement with academic material, or can it be harnessed to foster deeper understanding and improved learning outcomes?

To explore these questions, this paper conducts a structured literature review based on approximately 45 academic sources published between late 2022 and early 2025. These include peer-reviewed studies, meta-analyses, and expert commentaries. Rather than generating new empirical data, the study synthesizes existing research to identify key trends, surface discipline-specific challenges, and offer practical strategies for integrating ChatGPT into higher education in ways that enhance learning while upholding academic standards.

2. Methodology

This study adopts a literature-based research approach, specifically a structured literature review, to collect and critically analyze existing knowledge on the implications of ChatGPT for supporting individual learning among students in both STEM and Humanities disciplines. Rather than collecting primary data from students or classrooms, we examined a range of academic publications, survey findings, and expert commentaries that have emerged since the release of ChatGPT.

The academic literature on this topic has expanded rapidly, particularly following the public launch of ChatGPT in late 2022. To ensure relevance and capture the most recent developments, the review is limited to sources published between 2022 and early 2025. Although some materials may already reflect early observations, they provide valuable insights into the initial wave of research on ChatGPT's integration into higher education contexts.

The research approach followed these steps:

1. **Literature Search:** We systematically searched for relevant literature using academic databases and search engines such as Google Scholar, Scopus, Web of Science, and ERIC. Key search terms included combinations of: “*ChatGPT*”, “*education*”, “*students*”, “*learning*”, “*higher education*”, “*STEM*”, “*humanities*”, “*writing*”, “*exam*”, “*cheating*”, “*critical thinking*”, and “*AI in education*”. We also identified specific studies through references in known articles.
2. **Inclusion Criteria:** We included sources that provided empirical data or well-reasoned analysis on ChatGPT (and closely related AI tools) in educational contexts. Priority was given to:
 - a. Empirical studies (surveys, experiments, user data analyses) involving students or instructors and ChatGPT usage.
 - b. Review papers and meta-analyses summarizing multiple studies (to get broad coverage).
 - c. Commentaries or perspective articles by experts that specifically address differences in how AI may affect different disciplines.
 - d. Both peer-reviewed articles and credible preprints were considered, given the fast-moving publication timeline for this topic. We required that any included source clearly indicated its methodology or was published in a reputable venue.
3. We excluded very speculative opinion pieces without evidence, and sources focusing solely on K-12 education to keep scope to higher education, where the distinction between STEM and humanities usage is more documented. We also set aside literature on AI in education that didn’t specifically involve ChatGPT or similar large language models, to maintain relevance.
4. **Quality and Bias Consideration:** We carefully evaluated the sources used in this study. A lot of early work on ChatGPT suffers from limitations, such as involving just a few users or examining short-term effects often determining users’ immediate responses to the tool. We also accounted for some of the findings potentially being overstated due to the novelty of a new technology students being very motivated just because ChatGPT exists, for instance. Also, short-term studies are just that, and don’t capture long-term learning through ChatGPT. We further acknowledged the potential for bias in published studies. Because ChatGPT is a swiftly emerging technology, initial studies might show extremely positive perspectives or significant concerns, according to whether the researchers seem biased one way or the other about it or to what kind of journal does the publishing for instance, an ed-tech-focused education journal vs. ethics-centered forum. To ensure a fair representation of views, we added articles of various kinds, including Global Survey, Controlled Experiment, and

Review Articles. This method allows you to look at different perspectives and prevents you from being too biased based on one perspective or opinion.

Limitations of the Methodology: The current study builds on existing research, and therefore, the results of our work are dependent on the availability, quality, and scope of studies published by early 2025. This field is evolving quickly, and new data could soon broaden or alter existing understandings.

One challenge we faced was comparing ChatGPT's impact on STEM and humanities subjects. Ideally you would see a direct comparison in studies that compare both fields straight across, but most of the research you see doesn't structure its conclusions this way. If anything, they tend to study ChatGPT in a single discipline at a time but never directly compare it to other disciplines. So, we had to look at other indicators to understand these differences.

We illuminated the difference in some cases based on the context presented in the studies. If the first, for example, emphasized problem-solving benefits for STEM, while the humanities-focused study highlighted improvements in critical thinking and argumentation, we might be able to make reasonable comparisons. In some cases, we synthesized findings from other unique studies, one from a STEM field and one from a humanities context to form a comparative lens. This methodology, however, is not without its constraints, it serves only to map trends and patterns.

A direct, controlled comparison of the same researchers comparing STEM and humanities students under similar conditions would provide stronger evidence. Such a study could control external things like different teaching styles, different types of students, challenges that are unique to disciplines. Our insights from separate studies are still useful but indirect without this level of control.

We are still able to perform meaningful analysis despite these challenges. Yet, studies at times do not explicitly compare STEM and humanities, and so pulling multiple perspectives together helps facilitate a more comprehensive understanding of how ChatGPT impacts learning across diverse academics. As research on AI in education is still nascent, moving forward future studies may be able to offer more systematic comparisons, allowing for insights into discipline-specific impacts.

3. Results

In this section, we present the synthesized findings of our literature review, focusing on how ChatGPT has impacted student learning and experiences, and highlighting differences and similarities between STEM and humanities contexts. The results are organized into thematic subsections for clarity: (1) **Usage Patterns and Adoption**, (2) **Benefits of ChatGPT for Learning**, (3) **Challenges and Negative Impacts**, and (4) **Disciplinary Differences in Outcomes (STEM vs. Humanities)**. We incorporate both quantitative data from studies (where available) and qualitative insights.

1. Usage Patterns and Adoption by Students

Students in higher education have embraced ChatGPT for a variety of academic purposes. A large-scale international survey (Ravšelj et al., 2025) of over 23,000 tertiary students from 109

countries found that a significant portion had experimented with ChatGPT in their studies. Students reported using the AI for tasks such as brainstorming ideas for assignments, summarizing or simplifying complex texts, and even for drafting parts of essays or reports. In this global survey, about 70% of students found ChatGPT “interesting to use,” and many perceived it as a helpful tool to support their learning process. Notably, roughly 29% of students said they used ChatGPT for brainstorming ideas, while 11% admitted to using it for creative writing tasks (e.g., composing stories or essays). The relatively lower percentage for creative writing might indicate that students are cautious about fully delegating original writing to AI or perhaps find it more useful in a supporting role (like generating outlines or checking grammar) than in authoring entire essays.

Students across disciplines appear to appreciate ChatGPT’s user-friendly interface and immediate responses. Unlike traditional search engines or libraries, ChatGPT allows users to ask questions in natural language and get instant, conversational answers. This immediacy is particularly valued when students are stuck on a problem late at night with no professors or tutors available. One study (Wardat et al., 2023) highlighted that students benefit from ChatGPT’s ability to provide instant clarification on complex concepts and assistance with assignments, effectively acting as a 24/7 virtual tutor. For example, a student struggling to understand a difficult theory or a piece of code can query ChatGPT and often receive a step-by-step explanation or a simpler rephrasing of the concept. This capability has lowered the barrier to access help, especially for those who might be hesitant to ask questions in class or who lack access to in-person tutoring.

From the perspective of tasks, writing and coding have emerged as two prominent use cases:

Essay Writing and Editing (Humanities focus): Students in humanities or social science

courses report using ChatGPT to generate essay drafts, to get help in phrasing ideas in academic language, or to proofread and improve grammar in their writing. In an interview-based study (Revell et al., 2024), college students described ChatGPT’s writing assistance as “speedy generation” of text with “generally good quality” that often has an academic tone. They noted it can help overcome writer’s block by suggesting how to start an introduction or by providing examples of how to structure an argument. However, students are also aware of the risks, acknowledging that over-reliance could make their writing less original.

Coding and Problem Solving (STEM focus): STEM students, particularly in computer science and engineering, have turned to ChatGPT for help with programming assignments. The model can generate code snippets and explain code in simpler terms. It is integrated into some programming environments as an assistant. Students might ask ChatGPT to debug an error or to outline the approach to solve a problem. Preliminary research (Borges et al., 2024; Ibrahim et al., 2023) suggests that many students find ChatGPT useful for learning new programming concepts or algorithms, since it can provide examples and analogies on demand. However, they also encounter instances where the code produced by ChatGPT has mistaken or doesn’t run, requiring human

oversight.

It is important to note that student adoption is tempered by ethical considerations. According to the global survey (Ravšelj et al., 2025; Bouteraa et al., 2024), most students

expressed concern about the ethical implications of using ChatGPT, even if they found it helpful. For instance, some students use it only for preliminary research or editing but avoid using it in ways that might be considered academic dishonesty (like generating entire assignment answers). The survey found that while students view ChatGPT as a useful learning aid, they remain wary of relying on it too heavily or in ways that violate academic integrity policies. This suggests that many students are trying to strike a balance between leveraging AI tools to enhance their learning and maintaining the values of honest, independent scholarship.

2. Benefits of ChatGPT for Learning and Academic Performance

A consistent theme in the literature is that ChatGPT, when used appropriately, can enhance certain learning outcomes. Several experimental studies and reviews (Lo, 2023; Deng et al., 2024; Hasanein & Sobaih, 2023) have documented positive effects on students' performance, motivation, and skill development. Below we summarize the key benefits:

Improved Academic Performance: Early evidence indicates that using ChatGPT can lead to higher performance in coursework or assessments under certain conditions. A systematic review of 69 experimental studies (Deng et al., 2024) found that interventions involving ChatGPT often showed boosts in academic performance for students. However, the authors caution that these gains may sometimes reflect assessment design biases – for example, if an exam or assignment can be answered by regurgitating information or well-structured text, ChatGPT's contributions might score well without indicating deep student understanding. Nonetheless, performance improvements were notable. In fact, the review pointed out that the positive effects on performance appeared larger in arts and humanities subjects than in STEM, a point we will revisit when discussing disciplinary differences. Another study (Hasanein & Sobaih, 2023), focusing on language learning, found that students who used ChatGPT as a practice tool for writing or comprehension showed better outcomes than those who didn't, likely because the AI provided instant feedback and examples, reinforcing learning in real-time.

Enhanced Motivation and Engagement: Incorporating ChatGPT can make learning more engaging for students. The novelty and interactive nature of chatting with an AI tutor can increase students' curiosity and enjoyment in learning tasks. According to the systematic review by Deng et al. (2024), many studies reported that student motivation and enjoyment of learning improved with ChatGPT's use. This was especially observed in higher education settings where students often worked independently with the tool. Some researchers ((Rudolph et al., 2023; Kasneci et al., 2023) attribute this boosts to the immediate responsiveness of ChatGPT – students feel they have a supportive companion in their learning process, which can reduce frustration and increase persistence in studying. For instance, if a student gets stuck on a calculus problem, having ChatGPT to probe for hints or alternative approaches can encourage the student to keep trying rather than giving up. That said, it's noted that part of this motivation increase might be a short-term novelty effect (students are initially excited by the new technology). Long-term studies will be needed to see if the

motivational benefit persists once the novelty wears off.

Support for Higher-Order Thinking (with Caveats): Some sources (Lo, 2023; Chiu, 2024) suggest that ChatGPT can assist students in developing higher-order thinking skills, such as critical thinking and creativity, but this is a nuanced point. On one hand, when used as a brainstorming partner, ChatGPT can expose students to ideas or perspectives they hadn't considered, thereby stretching their thinking. For example, a student writing a philosophy essay might ask ChatGPT to argue an opposing viewpoint, which the student can then critically evaluate, thus practicing analytical thinking. A number of students perceive that their ability to think critically or approach problems creatively is improved when they engage in dialogue with ChatGPT. The AI can challenge their assumptions by providing counterarguments or alternative solutions, which students then have to consider and either refute or integrate. However, the evidence for actual improvement in higher-order skills is often based on self-report rather than objective measures. There is skepticism among researchers about this claim – while students feel like they are thinking more critically, it could be that ChatGPT is doing the heavy lifting in suggesting ideas. To truly validate this benefit, studies suggest (Chiu, 2024) using standardized critical thinking tests or creative problem-solving tasks to see if there's measurable improvement. So far, the belief is that ChatGPT can stimulate higher-order thinking, but educators must actively design activities to realize this, rather than letting students passively accept AI outputs.

Reduced Cognitive Load and Mental Effort: A more concrete benefit observed is the reduction in students' cognitive load for routine aspects of work (Wardat et al., 2023). By handling lower-level tasks, ChatGPT allows students to allocate more mental energy to understanding concepts. For instance, when writing a lab report, a biology student might use ChatGPT to generate a summary of background literature or to refine the wording of the methodology section, saving time and effort. Studies (Hasanein & Sobaih, 2023; Kasneci et al., 2023) have noted that the availability of ChatGPT tends to reduce the mental effort students report for learning tasks. This is a form of cognitive offloading – the AI handles some of the information processing, which can be especially helpful for students with heavy workloads or those who struggle with certain components of an assignment (such as grammar for non-native English speakers). By easing cognitive burden, ChatGPT could potentially reduce student stress and free up time for reviewing and reflecting on the material rather than just producing output. One group of educators (Ajevski et al., 2023) likened ChatGPT to an “assistant” that takes care of the simpler parts of a task (like a calculator does arithmetic), enabling the student to focus on more complex aspects of the problem.

Personalized Learning and Accessibility: ChatGPT can tailor its responses to the individual learner's needs, acting as a form of personalized tutor. Unlike a human teacher who must divide attention among many students, an AI can give one-on-one attention endlessly. If a student doesn't understand an explanation, they can ask ChatGPT to rephrase or give more examples, without feeling embarrassed. This fosters a self-paced, iterative learning process. Moreover, for students with learning differences or disabilities, ChatGPT's text-based, on-demand assistance can be a valuable accommodation. For example, a student with social anxiety might be more comfortable

asking questions from an AI than raising a hand in class. Students from diverse linguistic backgrounds also benefit, as noted earlier ChatGPT can help level the playing field by providing instant grammar and vocabulary help, which can be especially

empowering for non-native English speakers in humanities courses who have great ideas but struggle with language mechanics. By receiving help in real time, these students can better demonstrate their true content knowledge without being hindered by language barriers.

To illustrate these benefits concretely, we can look at a few specific research findings:

Case of STEM Assessment Performance: A recent analysis (Borges et al., 2024) examined how well ChatGPT could perform on university-level exams across various STEM subjects. The results were eye-opening: ChatGPT (specifically GPT-4 in that study) could pass a majority of standardized test questions in STEM courses. It was reported that for multiple-choice questions in a sample of 5,500 STEM exam questions, ChatGPT achieved passing marks in about 77% of the courses tested. It performed especially well on questions that were fact-based or required straightforward application of formulas (i.e., problems with a structure or pattern it could recognize from training data). However, the AI struggled more with open-ended problems or those requiring original problem-solving approaches. These results demonstrate that ChatGPT can significantly boost performance on certain types of assessments – a benefit from the perspective of students aiming for higher scores, though it simultaneously raises alarms about the integrity of those assessments (more on that in the Challenges section).

Case of Humanities Writing Quality: In the humanities, a study (Revell et al., 2024) was conducted to see if ChatGPT could write essays for a university English course and how those essays would score. The AI-generated essays in this study averaged a grade of around 60% (a low passing grade in many systems), whereas human student essays averaged around 64%, only slightly higher.

The difference was not statistically significant, meaning the AI's work was essentially on par with the human students in terms of grade. Qualitatively, the human essays had more nuanced arguments and better incorporation of context, but the AI essays were well-structured and clear (Revell et al., 2024). This suggests that ChatGPT can help a student produce a decently written essay that meets basic requirements. For students, this could be seen as a benefit – if they are struggling to organize their thoughts or write in an academic style, ChatGPT can provide a template that they can then refine. It also indicates that an average student might improve their essay's coherence and structure by leveraging the AI's strength in organization and formal tone.

3. Challenges and Negative Impacts on Learning

Despite the promising benefits, our review also uncovered a range of challenges and potential negative impacts associated with student use of ChatGPT. These issues are critical to address to ensure that AI tools do not inadvertently hinder the learning process or erode academic standards. Key challenges identified include:

Academic Integrity and Cheating: The most frequently discussed concern is that ChatGPT makes it easier for students to cheat or plagiarize. If a student can get a full essay or solved assignment from the AI, they might be tempted to submit it as their own work. Educators have observed cases where the style of student submissions changed noticeably, raising suspicions that ChatGPT was used. However, proving such

cases can be difficult. One survey article (Bouteraa et al., 2024) noted that students themselves worry that reliance on ChatGPT

for assignments could erode their own learning and critical thinking, essentially cheating themselves out of an education. Universities have reported incidents of misuse, and it has spurred discussions on how to update academic honesty policies. It is worth noting that not all students abuse the tool – many use it legitimately – but the possibility of easy cheating is a dark shadow over its deployment. Tools to detect AI-generated text exist, but they are not foolproof. In one study (Revell et al., 2024), human markers could correctly identify AI-written essays about 79% of the time (so they still missed about 1 in 5) (Revell et al., 2024), and even the best AI detection software achieved about 95% accuracy (Revell et al., 2024), meaning some AI-generated content may slip through. This challenge is equal-opportunity across disciplines: a solutions manual generated by ChatGPT for math homework is as problematic as an AI-written literature essay in terms of academic misconduct.

Impact on Critical Thinking and Learning Processes: A more insidious challenge is the potential for over-reliance on AI to weaken students' critical thinking and problem-solving skills. If students become accustomed to having ChatGPT do the initial thinking, they might not develop the ability to tackle challenges independently. Some educators fear a scenario where students trust the AI's answers without verification, leading to shallow learning. For example, if a student consistently uses ChatGPT to outline essays or solve physics problems, they may not practice those skills themselves and thus not acquire deep proficiency. The literature offers mixed insights here: some argue (Chiu, 2024) that ChatGPT can foster critical thinking if used to present alternative viewpoints that students must evaluate, but others (Lo, 2023; Hasanein & Sobaih, 2023) point out that skipping straight to an answer short-circuits the productive struggle that often leads to true understanding. Indeed, while mental effort is reduced (a benefit as noted), this reduced effort can become a downside if it crosses into intellectual passivity. There is a fine line between using ChatGPT to support learning and letting it do so much that the student isn't intellectually engaged. Several authors (Yu, 2024; Hasanein & Sobaih, 2023) recommend intentionally designed assignments that require reflection on or justification of ChatGPT's output, thus keeping the student in an active role.

Reliability, Accuracy, and Misinformation: ChatGPT does not guarantee correct answers. It can produce confident sounding but incorrect responses. In STEM subjects, this might mean a wrong solution to a problem or a subtle error in a proof. In humanities, this could be an inaccurate historical fact, or a misinterpretation of a text presented as authoritative. A hybrid literature review (Temsah et al., 2023) involving both ChatGPT and human experts in the medical domain (early 2023) emphasized that ChatGPT's knowledge is limited to its training data and it may not be up to date on recent developments. It can also reflect biases present in the data. If students are unaware of these limitations, they might take AI outputs at face value. There have been instances of ChatGPT generating fabricated references – for example, providing a citation for a quote or fact that looks real but does not actually exist. If a student includes such a citation in their paper, it can be very misleading. The challenge here is teaching students to use ChatGPT as a starting point and then verify information via reliable sources, much like they should with Wikipedia or any non-peer-reviewed source. Without proper digital literacy, students might inadvertently propagate

misinformation from ChatGPT, negatively affecting their learning (by learning something incorrect) and the quality of their work.

Skill Development and Writing Style: Some educators are concerned that heavy use of ChatGPT could homogenize student writing and reduce the development of individual voice and style. Because ChatGPT tends to produce a very formal, neutral academic tone, students might lean on that and not practice developing their own style or argumentation skills. Additionally, if ChatGPT provides a well-structured answer, students might not learn how to outline or structure arguments themselves. A study on writing observed that AI-written essays, while logically structured, lacked the depth of analysis that human students provided (Revell et al., 2024). If students rely on AI, they might miss out on learning how to perform that deeper analysis. In coding, a parallel could be that if a student uses AI to write a chunk of code, they may not fully grasp algorithmic thinking or debugging skills that come from writing code manually and making mistakes.

Equity and Access Concerns: While ChatGPT itself is broadly accessible (often free at point of use), there are still equity issues. Not all students have equal access to the technology (for example, it requires internet connectivity, and the free version might be limited or slow during peak times). Moreover, familiarity with AI tools might differ – some students, especially those in tech-heavy fields, may be more comfortable prompting and using ChatGPT effectively than others. There's a risk that a digital divide could exacerbate performance gaps: students who know how to harness ChatGPT could surge ahead in assignments, while those who don't might fall behind. Also, if institutions ban or discourage ChatGPT, students in those places might be at a disadvantage compared to those where it's embraced, in terms of developing AI literacy. These challenges mean that educators and administrators need to consider fair use policies and training so that all students can benefit without unfair advantage.

Ethical and Psychological Factors: Some students feel uneasy using ChatGPT, equating it with a form of dishonesty even if allowed. It can cause anxiety: "Is it okay to use this? Will I get in trouble? Is this learning or cheating?" Such internal conflict is an often-unspoken challenge. Additionally, there is the issue of authorship and attribution. If a student uses an idea that ChatGPT provided, is it their idea or the AI's? How do citation norms adapt? Currently there are no clear academic conventions for attributing AI contributions, which leads to a gray area – another challenge noted in literature on academic integrity in the age of AI (Revell et al., 2024).

4. Disciplinary Differences: STEM vs. Humanities Impact

A central focus of this paper is comparing ChatGPT's impact on STEM students versus humanities students. While many benefits and challenges mentioned above apply broadly, there are notable differences in how ChatGPT is utilized and its effectiveness between these domains. Our synthesis suggests several key points of divergence:

AI Performance and Capabilities in Different Tasks: As hinted earlier, ChatGPT's performance can vary greatly depending on the subject matter. In STEM fields, problems often have more rigid correct answers (e.g., a math problem or a chemistry equation), and while ChatGPT can often produce the right answer for well-defined questions (especially those like its training data), it can falter on novel or complex problems. STEM tasks also sometimes require

showing the process (like proofs or derivations), and ChatGPT does not reliably produce authentic step-by-step student work – it might give a correct final answer without the reasoning, or the reasoning might have logical gaps. In contrast, humanities assignments (like essays or literature analysis) are more open-ended. Here, ChatGPT's strength in generating coherent text is fully on display. It can more easily produce something that looks like a competent essay, as long as it has enough knowledge of the content. However, humanities tasks require nuance, original thought, and often a personal voice or critical stance that AI finds hard to fake completely (Revell et al., 2024). So, while ChatGPT might produce a passing history essay, it's less likely to produce an excellent one with insightful analysis – that's where a human student can still excel. This difference means ChatGPT might be more immediately impactful for average performance in humanities (by bringing a poor essay to a decent level) and more limited in STEM unless the questions are of a type it can handle.

Magnitude of Academic Performance Boost: Research suggests that the performance boost from ChatGPT may be larger in humanities than in STEM. As referenced, Deng et al. (2024) found that effects appear larger in arts and humanities education. One reason could be that humanities assessments (essays, reflections, analyses) are graded in part on writing clarity and structure, which ChatGPT can significantly improve. A student weak in writing might jump from a failing grade to a pass by using ChatGPT to clean up their essay structure. In STEM, however, if a student doesn't understand the material, ChatGPT might not save them unless the instructor's grading is lenient on just final answers. In one computer science experiment (Ibrahim et al., 2023), students who used ChatGPT to help with coding assignments did complete the tasks faster and in some cases with fewer errors, but when tested conceptually, they didn't outperform those who coded without AI, indicating that the learning gain might be superficial. On the other side, in a philosophy class, students who used ChatGPT to debate ideas showed improved argumentative writing in the short term, likely because the AI provided instant counterpoints to refine their arguments. These examples align with the notion that the humanities see a more pronounced short-term "help" in assignment quality.

Student Perceptions by Discipline: Are there differences in how STEM vs humanities students perceive ChatGPT? The large PLOS One global survey (Ravšelj et al., 2025) did not explicitly break down respondents by discipline in the published results, but it did mention that students generally saw ChatGPT as a learning aid and not a replacement for human interaction. In qualitative comments from that and other studies (Hasanein & Sobaih, 2023; Cotton et al., 2023), one pattern is that humanities students often talk about writing assistance ("It helps me phrase my ideas better" or "I use it to get references or summaries of articles"), whereas STEM students mention problem-solving ("It helps me find where I made a mistake in a proof" or "It suggests approaches to coding challenges"). Both groups share common positive views ("it's a helpful tool, saves time") and common worries ("could make me lazy, might be cheating"). A study on collaborative learning with ChatGPT (Sullivan et al., 2023) found no significant difference in the attitudes of STEM vs non-STEM students toward using the AI in a group project setting. Both groups reacted similarly in terms of

engagement and skepticism. This suggests that disciplinary identity might not strongly color the basic perception of ChatGPT's usefulness; instead, it's the context of use that matters. For instance, a literature student and an

engineering student might both appreciate ChatGPT's quick answers, but one uses it for essay drafts and the other for debugging code.

Educator Responses and Policy Differences: There might also be differences in how educators in various fields respond. Anecdotally, some humanities departments have been quicker to modify assessment methods (e.g., more in-class writing, oral exams) to counter potential AI misuse, whereas some STEM instructors have leaned into AI by allowing it for coding tasks but then testing conceptual understanding in exams. The rationale is that in the “real world”, engineers will have AI tools, so teaching how to use them responsibly is valuable, while also ensuring fundamental knowledge is assessed in controlled settings. Humanities professors, concerned with original thought and expression, may stress traditional pen-and- paper exams or personal reflections that AI can't easily generate. These pedagogical adjustments are still evolving and often institution specific. However, it's clear that across the board, academia is discussing these issues vigorously.

Examples of Differential Impact: To illustrate, consider two scenarios:

In a history class (Humanities), a student uses ChatGPT to generate a draft essay about the causes of World War I. The draft is well-organized but somewhat generic. The student then adds specific details from class readings and their own commentary to improve it. The final essay is better than the student's typical writing, mostly thanks to the structure provided by AI. The student learns some content in the process of editing the AI's draft, but perhaps not as deeply as if they had written it from scratch. The instructor might notice a more polished structure than expected from this student. The impact here is an improved immediate outcome (grade) with a potential trade-off in authentic skill practice.

In a calculus class (STEM), a student uses ChatGPT to help solve a set of homework problems. For routine derivative and integral problems, ChatGPT gives correct solutions which the student copies. However, for a more challenging problem that requires creative application of a technique, ChatGPT's solution is flawed. The student, not recognizing the flaw, also gets it wrong. When preparing for the exam, the student realizes they didn't fully understand the techniques because they relied on AI for the homework. On the test (no AI allowed), the student struggles. The impact here shows that ChatGPT might have given a false sense of security; it helped with easy tasks but wasn't a substitute for truly learning how to handle difficult ones.

These scenarios highlight that the effectiveness of ChatGPT as a learning aid can depend on the alignment between the AI's capabilities and the course's learning objectives. Humanities often emphasize communication and synthesis of ideas – areas where ChatGPT is quite capable – so it can more directly augment what students are graded on. STEM emphasizes problem- solving processes and correctness – ChatGPT can assist, but students cannot rely on its wholesale without understanding.

Finally, it's interesting to note an analogy raised in one article (Wang & Wang, 2024): the introduction of calculators predominantly affected STEM education (like math classes) by automating computation, and educators adapted by focusing more on problem setup and interpretation rather than arithmetic. By contrast, an “AI writer” like ChatGPT is analogous to a tool that automates composition and basic research, which predominantly affects humanities. Just as calculators didn't eliminate the need to learn

math (and eventually we allowed calculators

once students learned the foundational concepts), perhaps we will see a future where the basics of writing and analysis are taught, and then AI is integrated for advanced work. In STEM, perhaps rote problem solving might be de-emphasized in favor of conceptual understanding, given AI can do a lot of the rote parts.

4. Discussion

In the preceding results, we outlined the major findings on how ChatGPT is impacting student learning in both STEM and humanities fields. In this Discussion, we interpret these findings, draw comparisons between disciplines, and explore the broader implications for education. We also discuss strategies and recommendations to maximize the benefits of ChatGPT while mitigating its drawbacks, aligning with insights from educators and researchers.

1. Comparative Analysis of ChatGPT's Impact on STEM vs. Humanities

Why are the impacts different (or similar) across disciplines? Our review suggests that ChatGPT's introduction has a universal component – it is a disruptive technology in education, provoking excitement and concern regardless of field – and a domain-specific component the nature of tasks in STEM vs. humanities causes the tool to be used and felt differently.

One key observation is that language-based AI naturally aligns more with humanities tasks. Humanities education often revolves around reading, writing, and discussing – all language-centric activities. ChatGPT, being fundamentally a language model, can participate in these activities quite effectively. It can write, summarize, translate, and even analyze text (to a degree). This means humanities students found an immediate ally in ChatGPT for writing essays or comprehending literature. The study by Revell et al. (2024) on AI vs. human essays underscores this: the AI could produce a reasonably good essay, though lacking the human touch of deep analysis (Revell, Yeadon, & Leneghan et al., 2024). In contrast, many STEM tasks require quantitative reasoning or visual-spatial understanding (like drawing a graph or imagining a physics scenario) that ChatGPT doesn't inherently possess (it has some ability to do math or describe visuals, but often with errors). Therefore, the scope of what ChatGPT can directly assist with is a bit narrower in STEM. It excels at the parts of STEM that involve language – explaining concepts, writing reports – but not as much at calculation or experimentation (although it can sometimes solve equations, it's not reliable for complex ones).

Another factor is assessment style differences. Humanities assessments are often subjective and graded on a rubric that values clarity of argument, evidence, coherence, etc. ChatGPT can tick many of those boxes, leading to the notable short-term improvement in assignment quality we described. STEM assessments, while including lab reports or essays in some cases, frequently have an objective component (one right answer). If ChatGPT doesn't know the correct formula or concept (or if the question is very novel), it cannot guarantee a correct answer. Thus, a STEM student using ChatGPT might still get answers wrong if they don't know enough to check them. In the

performance study we cited, the AI did well on many questions, but the ones it got wrong could mislead a student who didn't have the expertise to

double-check. On the other hand, a humanities student using ChatGPT might never get a response that is blatantly “wrong” in the factual sense (unless the prompt asks for specific facts), but rather gets a bland or surface-level answer. The risk there is more about lack of depth than outright incorrectness. Therefore, the *failure modes* differ: a failure in STEM might be an incorrect answer that is obviously wrong upon inspection, whereas a failure in humanities might be an essay that is correct in facts but shallow in insight.

Do STEM and humanities students differ in improvement areas? It appears so. STEM students using ChatGPT might see more improvement in routine homework completion (less time spent, maybe slightly better homework grades), whereas humanities students might see improvement in writing quality (structure, grammar, coherence). Motivation can increase for both, but perhaps for different reasons – STEM students might be relieved that they can solve tedious coding bugs quicker, while humanities students might feel more confident that their writing is polished. Interestingly, the literature review by Hasanein & Sobaih (2023) noted that one positive outcome of ChatGPT could be “improving language skills” for students and even faculty. This is something that likely benefits humanities more, since language is the medium of work. However, even STEM students benefit from improved communication; for instance, engineering students need to write reports and ChatGPT can improve those.

Commonalities across disciplines: While we focus on differences, it’s important to acknowledge that many impacts are common. For example, *ethical concerns* are shared. Both STEM and humanities educators worry about plagiarism and want to ensure students are actually learning. Similarly, *the need for critical thinking* is universal – whether a student is studying literature or physics, they need higher-order thinking, and both stand to lose if students become too dependent on AI. Also, both fields see ChatGPT as a tool that can be harnessed for good. It’s not inherently more “for” one discipline than the other in an absolute sense; it just has different utilities.

Our comparative analysis indicates that while ChatGPT is a game-changer across the board, educators will need to tailor their strategies to their discipline to address the nuances of its impact. This leads us to discuss what those strategies might be.

2. Implications for Teaching and Assessment

The emergence of ChatGPT has significant implications for how we teach and assess students. Educators are faced with a dual challenge: adapt to the presence of AI tools to maintain academic standards, and leverage AI to improve teaching and learning. Based on the literature and the insights from our comparative analysis, several implications and strategies have become apparent:

Rethinking Assessment Design: Traditional take-home assignments or essays that could be easily completed by ChatGPT may no longer effectively discriminate between students who understand the material and those who simply use AI. This calls for a redesign of assessments. In STEM, we may see a shift towards more in-person, oral, or practical exams, where students must solve problems on the spot or explain their

reasoning verbally, making it harder to outsource to AI. Alternatively, assessments might focus on applying knowledge in novel ways

(project-based learning, open-ended design problems) where AI can help with components, but students still have to do integration and original thinking. In humanities, there could be more in-class writing assignments, discussions, and personalized essay prompts (e.g., asking the student to draw on their personal experiences or specific class debates, which an AI wouldn't know) (Revell, Yeadon, & Leneghan et al., 2024). Some instructors have even considered returning to pen-and-paper exams for essays, or oral exams, to ensure authenticity. The overarching idea is that if an assessment's primary skills can be handled by ChatGPT, then that assessment might need to be changed to either (a) incorporate ChatGPT explicitly (see next point) or (b) test something deeper or more specific.

Incorporating AI into Assignments (Teach *with* it): An alternative approach, rather than trying to AI-proof every assignment, is to incorporate ChatGPT into the learning process in a controlled manner. For example, an assignment might explicitly tell students to use ChatGPT to get a first draft or a list of ideas, and then the student must critique the AI's output, improve upon it, and highlight the changes they made. This way, using ChatGPT is not cheating but part of the task, and it teaches critical evaluation. One recommendation from educators is to treat ChatGPT like a calculator or research tool – something students should learn to use responsibly. For instance, in a writing class, a professor might have students generate a paragraph with ChatGPT on a topic and then together the class analyzes its strengths and weaknesses, thus learning about good writing versus AI-generated writing. This demystifies the tool and also sets expectations on its appropriate use. In coding classes, instructors allow AI for debugging but then ask students to annotate any AI-provided code with explanations, ensuring they understood it. By channeling how ChatGPT is used, teachers can uphold learning outcomes while acknowledging the reality that these tools exist.

Focus on Process and Reflection: To ensure learning, assessments can require students to document their process. If a student used ChatGPT, they might need to include the prompts they used and the responses and then reflect on how they utilized that information. This reflection component can be very telling – a student who is learning will be able to discuss why they accepted certain AI suggestions and rejected others, or what they learned from the AI output. Such meta-cognitive exercises strengthen understanding and make any inappropriate use of AI more transparent. Some institutions are implementing honor-code statements or learning journals where students self-report their use of AI and comment on it. This not only promotes honesty but also encourages students to think about *how* they learn and solve problems, which is a valuable skill (learning to learn).

Providing AI Literacy and Training: If AI is to be part of education, both students and teachers need guidance on how to use it effectively and ethically. The literature strongly recommends training sessions and clear guidelines. Hasanein & Sobaih (2023) concluded that institutions should establish clear guidelines and training for the responsible use of ChatGPT. This might include workshops on prompt engineering (how to ask questions to get useful answers), discussions about the reliability of AI (so students learn to verify information), and ethical use cases (what is acceptable vs. cheating). By formally teaching about the tool, we not only empower

students to use it well but also remove some of the allure of doing it secretly. It becomes just another tool in their toolbox, to be used with discretion.

Differentiated Approach by Discipline: Given the differences we noted, departments might adopt tailored policies. For instance, a computer science department might allow AI assistants in coding assignments (since using AI in coding is becoming a real-world industry standard) but then have stringent exam conditions to test understanding. A literature department might ban AI use for certain creative writing tasks to preserve the development of student voice but allow it for grammar checking or idea generation with attribution. The key is that each field considers where AI use aligns with learning goals and where it undermines them and sets policies accordingly. This differentiated approach is better than a one-size-fits-all rule like “AI not allowed” which might not make sense in all contexts and could even stifle innovation in teaching.

3. Ethical Considerations and Policy Responses

The infiltration of AI like ChatGPT into academia brings forth numerous ethical questions and has spurred policy responses at various levels (institutional, departmental, even governmental in some cases). Key considerations include:

Academic Integrity Policies: Many universities are updating their honor codes and academic integrity policies to explicitly mention AI-assisted work. It must be clear to students what is considered acceptable. For example, some policies might state that AI can be used for research and editing, but not for generating substantive portions of an assignment, unless permitted by the instructor. Others may require disclosure: if a student used AI, they should note it in their submission. There is an active debate here: does using AI equate to using a source (which should be cited) or a tool (which typically doesn’t need citation like using a calculator)? The consensus seems to be leaning towards treating it as a tool that can produce content which, if used, should be acknowledged. Transparency is ethically important – hiding AI use could be seen as an attempt to claim work that isn’t one’s own, which violates principles of academic honesty (Revell, Yeadon, & Leneghan et al., 2024).

Data Privacy and AI Use: Another ethical aspect is privacy. When students use ChatGPT, especially if they input personal or academic information (like the text of their essay draft, or data from a lab), that information is going to a third-party service (OpenAI) and could be stored. Some institutions are warning against inputting sensitive data. Moreover, if ChatGPT is used to grade or give feedback (some proposals have surfaced to use AI to help teachers), there are concerns about bias and fairness. These broader ethical issues (data security, bias) are beyond our immediate scope but are part of the institutional considerations when sanctioning AI use.

Ensuring Equity: Ethically, educators must ensure that policies around AI do not unfairly penalize or advantage any group of students. For instance, if AI is banned, students who might have benefited from it as a support (like those with weaker backgrounds) lose a tool, whereas those with stronger preparation might not have needed it anyway. On the other hand, if AI is allowed without guidance, students with more tech savvy could surge ahead. So, equity-driven measures might include giving all students access to the same AI tools during tasks (perhaps an “AI-assisted assignment” where every student can use it under supervision) so that it’s a level playing field. Another idea is providing institutional AI tools (some universities are

exploring providing their own AI chatbot to students, tuned with academic integrity safeguards). Ethically deploying AI in education means trying to ensure it's a help to all, not just a new advantage for the already privileged.

Faculty Training and Workload: Faculty themselves need to adapt ethically – for example, how to detect AI plagiarism without falsely accusing students. Relying on detectors alone can be risky; educators are encouraged to familiarize themselves with how AI writing looks, but also not to jump to conclusions. Policies should protect students from wrongful accusations (given the false positive rates of some AI detectors). Some universities have even set up committees or task forces to regularly assess how AI is affecting academic integrity and to update guidelines. An interesting suggestion is to involve students in these discussions, making them part of the solution by creating a community standard for AI use.

From a broader perspective, the ethical integration of AI in education is part of teaching students about AI itself – which is arguably an important 21st-century competency. We want students to graduate not only with knowledge of their major, but also with an understanding of AI's power and pitfalls, since it will be part of their professional and personal lives. Thus, addressing these issues in school is both an ethical responsibility and an educational opportunity.

4. Future Outlook and Conclusion

Looking forward, it is clear that ChatGPT and similar AI models are not a passing fad but likely a permanent addition to the educational landscape. The question is not *if* they will be used, but *how*. As one study put it, AI is now an integral part of our reality, and institutions must adapt quickly to harness its potential while safeguarding educational integrity. The analogy to calculators in math education provides hope that we can find a balanced integration. Initially, calculators were seen as a threat to learning arithmetic, but eventually curricula adapted to use calculators for tedious calculations while focusing teaching on concepts and problem-solving. Similarly, we may find that AI can handle some tedious aspects of composition or analysis, allowing instructors to push students towards more advanced skills.

We anticipate several developments:

Improved AI Capabilities: Future iterations of ChatGPT (and other models) will likely overcome some current limitations (for instance, becoming better at complex reasoning or updated knowledge). This might further blur the line between what AI can do and what students are expected to do. For example, if a future AI can reliably write a pretty good short story or solve a novel physics problem, then educational strategies will need to evolve yet again. This means the conversation on AI in education will be ongoing. Constant re-evaluation of what is being assessed and learned is necessary.

Customized Educational AI: We might see AI systems specifically designed for education, with constraints or features that support learning (like citing sources for their answers or being able to operate in an “explanation” mode vs “answer” mode). These could be integrated into learning management systems. If educators can have AI that is more of a guided teaching tool (with knobs they can turn according to how much help it gives), it could become a standard part of homework or study sessions.

Research on Long-Term Effects: Right now, much research (including what we reviewed) is short-term. We don't yet know the long-term effect on a student who uses AI throughout their college career. Will they end up with weaker skills or just different ones? Longitudinal studies will be important. It could turn out that initial fears are overblown and students adapt – using AI where appropriate and still learning deeply – or it could turn out there's a real decrement in certain abilities. The next few years of research will be illuminating.

Policy and Pedagogical Innovation: We expect innovative teaching methods to emerge. Perhaps new forms of “AI-inclusive pedagogy” will be shared at conferences. Also, policy might come from accreditation bodies or education ministries about standard practices for AI use. For instance, standardized tests might change (some boards are already considering how to handle AI in exams).

Ethical AI Literacy as Learning Outcome: Just as digital literacy became important in the last couple of decades, AI literacy (knowing how to work with AI tools ethically and effectively) could become an expected learning outcome for students. This would be a positive development, turning what some see purely as a threat into an educational opportunity.

In conclusion, our rewritten and structured analysis of ChatGPT's impact reveals a complex picture. ChatGPT offers tremendous opportunities to enhance learning – providing support and resources that can empower students across disciplines – but it also poses significant challenges that educators must actively manage. The impact on STEM and humanities students, while sharing core similarities, exhibits distinct patterns aligned with the nature of each domain's work. Humanities students can leverage AI for writing and idea generation, seeing improvements in communication, whereas STEM students might use it for problem solving and coding, gaining efficiency in technical tasks. However, both groups risk becoming dependent on AI and losing out on developing their own skills if not guided properly.

The academic community is responding by reimagining teaching methods, assessments, and integrity policies, striving to find the right balance. As this is a rapidly evolving field, ongoing dialogue among all stakeholders – students, teachers, administrators, and AI developers – is essential. This study contributes to that dialogue by compiling what is known so far in a cohesive format.

Ultimately, the goal for education is to prepare students for a world where AI is ubiquitous. That means teaching them how to use tools like ChatGPT effectively and ethically and reshaping our educational objectives to prioritize the uniquely human attributes that will remain critical. By learning from the early experiences and studies summarized here, we can move towards an educational model that integrates AI in a way that *augments* human learning rather than undermines it. As one expert noted, this adaptation will require some trial-and-error, but it is what higher education needs in this new era. Embracing the change with thoughtful strategy will ensure that we harness ChatGPT's benefits while safeguarding the integrity and depth of student learning.

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