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ABOUT THE IEET & AEC

This white paper has been drafted by the Institute for Ethics and Emerging Technologies in cooperation with the Applied Ethics Center at UMass Boston

The Institute for Ethics and Emerging Technologies is a nonprofit think tank which promotes ideas about how technological progress can increase freedom, happiness, and human flourishing in democratic societies. We believe that technological progress can be a catalyst for positive human development so long as we ensure that technologies are safe and equitably distributed. We call this a “technoprogressive” orientation.

The Applied Ethics Center promotes research, teaching, and awareness of ethics in public life. Our current projects are concerned with the ethics of emerging technologies.

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INTRODUCTION

Extended Reality (XR) and Large Language Model (LLM) technologies have the potential to significantly influence higher education practices and pedagogy in the coming years. As these emerging technologies reshape the educational landscape, it is crucial for educators and higher education professionals to understand their implications and make informed policy decisions for both individual courses and universities as a whole.

This paper has two parts. In the first half, we give an overview of XR technologies and their potential future role in higher education. Then, we discuss the benefits and challenges of adopting and integrating XR technologies into higher education settings. Finally, we offer recommendations for educators, administrators, and policymakers on how to approach the adoption of this set of technologies and set institutional policy to take advantage of its benefits while minimizing its potential negative consequences.

In the paper's second half, we discuss LLMs - specifically Generative Pre-trained Transformers (GPTs). Again, we provide an overview of this rapidly developing technology and examine its unprecedented and potentially disruptive impact on higher education pedagogy. We delve into the benefits and limitations of GPTs, highlighting the pedagogical and ethical challenges they may pose. Finally, we present actionable recommendations for instructors and administrators at both the course level and the university-wide level to guide policy decisions concerning these transformative technologies.

DIGITAL EXTENDED REALITY (XR)

AN OVERVIEW OF XR TECHNOLOGIES

Digital Extended Reality (XR) is a family of technologies, often powered by AI, capable of processing human outputs such as voices, gestures, language, or movement and creating virtual environments and objects with which users can interact (Buchinger et al., 2022). In this section, we will concern ourselves primarily with three subcategories within this family of technologies: Augmented Reality (AR), Mixed Reality (MR), and Virtual Reality (VR). Although the lines of demarcation among these subcategories are somewhat fluid, each possesses distinguishing characteristics, as detailed below [1].

Augmented Reality (AR) enhances physical surroundings with supplemental digital data, ranging from text and images to sound and beyond. Typically accessed through personal devices like smartphones or wearables, AR allows users to interact with the digital elements embedded within their physical environment. Since the mainstream success of AR in gaming applications like PokemonGo in 2016, the technology has permeated numerous domains, from social media platforms such as Instagram and Snapchat to more practical applications. For instance, esteemed institutions like Paris's Muséum National d'Histoire Naturelle and London's National Gallery have incorporated AR tours, enabling patrons to explore physical exhibits while simultaneously interacting with supplementary digital data. Medical practitioners, particularly surgeons, have begun utilizing AR to project vital information directly onto patients. Furthermore, ubiquitous navigation technologies like Google Maps, which overlay digital data onto physical space, can be construed as a form of AR.

On the other end of the spectrum, Virtual Reality (VR) crafts entirely simulated environments. Instead of merely augmenting the real world, VR immerses users into a digitally created, simulated experience (Adomaitis et al., 2022). VR environments are often accessed through wearable headsets, presenting the user with a three-dimensional, interactive, simulated environment that feels tangibly real. The development of VR headsets traces back to the 1960s, but they truly entered the public consciousness with the advent of the Oculus Rift gaming headset in 2012. VR headsets have continued to gain popularity since then, and large technology companies like Meta and Apple have turned to developing the technology for consumer use. Nevertheless, VR is not exclusively confined to fully immersive experiences through wearables. VR may also include simulated environments accessible via smartphones or desktop computers.

Mixed Reality (MR), occasionally considered an advanced form of AR, deserves its distinct recognition. While AR focuses on adding digital data to physical space, MR integrates virtual objects into real space so they become part of the user's intuitive environment. A virtual mural, for instance, could be perceived and interacted with by a user with the right wearable when they are in a specific location, appearing as an intrinsic part of the environment instead of a mere overlay. MR can create digital manifestations of objects that one or more individuals can manipulate, thus offering vast potential applications across diverse sectors, including healthcare, education, construction, and design, to name a few.

Even though they have only just begun to be adopted by colleges and universities, the potential impact of XR technologies on higher education is enormous. XR promises to transform higher education pedagogy across a wide range of disciplines. Though still limited, initial data suggest a positive influence on learning outcomes, indicating that XR could be a powerful tool for educational enhancement. Nonetheless, it's important to recognize that the introduction of XR will also bring about new challenges and ethical considerations that will need to be thoughtfully addressed as these technologies become more prevalent in educational settings.

THE BENEFITS OF XR

XR technologies may provide tools to transform traditional learning methods, imbuing them with an immersive, interactive quality that could revolutionize the educational experience. By providing an engaging and versatile platform, XR offers a range of benefits, from improved student engagement and learning outcomes to broader access and inclusivity in higher education. The following will explore the myriad ways XR technologies can enhance higher education.

LEARNING OUTCOMES

XR technologies are not yet commonplace in higher education environments, but the initial evidence points to their vast potential to enhance students' learning outcomes. Early studies, such as those conducted by Lin & Yu in 2023 and Merchant et al., in 2014, indicate that implementing XR technologies can boost student engagement and information retention.

One of the significant benefits of XR technologies is the opportunity to promote active learning across many subject disciplines. Active learning represents a significant shift from traditional lecture-based educational models where students passively receive information. Instead, it fosters an environment in which students actively participate in their learning process. For instance, imagine a biology lesson where, instead of merely hearing about the structure of a cell from a lecturer, students equipped with AR or MR technologies can interact directly with a three-dimensional virtual model of the cell. This hands-on experience allows students to actively manipulate and observe cell structures, enhancing their understanding and retention of the concepts.

Consider another scenario: a history lecture on the political structure of ancient Greece. Instead of solely relying on verbal descriptions and static images, students can use VR to explore a highly realistic simulation of an ancient Greek agora. They could interact with virtual citizens, participate in political debates, and gain first-hand experience of the historical period. These immersive experiences are more engaging and can make the subject matter more tangible and relatable, facilitating deeper comprehension and retention.

While we currently lack exhaustive data on the effects of XR technologies on learning outcomes, what we do have is both promising and intriguing. One pertinent question is whether the present observed effectiveness of XR technologies is partially attributable to the novelty factor. Essentially, is the heightened student engagement and retention we currently see a result of students' fascination with the novelty of the technology? And if so, can we expect these benefits to persist once XR technologies become more commonplace in the educational landscape and the initial excitement has faded?

Furthermore, it's necessary to investigate the distribution of benefits across different courses and programs. XR may demonstrate varying levels of effectiveness depending on the subject matter. For instance, it's plausible that the immersive, hands-on learning experiences offered by XR might be particularly well-suited to STEM disciplines, where complex concepts can be explored and visualized in three dimensions, or in foreign language courses, where immersive virtual environments could mimic the immersive language experience of living in a foreign country.

On the other hand, XR might prove less impactful for certain humanities subjects that rely heavily on textual analysis and abstract thought. However, it's also possible that innovative applications of XR could yet be developed that revolutionize teaching in these areas. Imagine a virtual tour through Shakespeare's London or an interactive exploration of Picasso's Guernica.

There is still much to learn about the potential impact of XR on learning outcomes. However, preliminary indications suggest a promising future for these technologies in education. While we need to proceed with careful, evidence-led integration, the initial data indicates that XR has the potential to provide significant benefits to students across a wide range of disciplines. As we continue to explore and research this technology, we can better understand how to optimize its use to maximize its potential to improve educational outcomes.

ACCESSIBILITY AND EQUITY

With the escalating costs of higher education and a surging demand for advanced qualifications, potential students are often faced with difficult financial decisions when contemplating further education (Marcus, 2022; Jennifer Pender & Matea Pender, 2022). Extended Reality (XR) technologies have been put forward as possible tools to help alleviate this persistent challenge.

The onset of the COVID-19 pandemic forced a swift shift towards remote learning for colleges and universities, leading to a reliance on video conferencing platforms like Zoom and Google Meets. This abrupt transition, however, often resulted in suboptimal learning outcomes for higher education students (Aucejo et al., 2020; Shazia Rashid & Sunishtha Singh Yadav, 2020). However, it also sparked a demand for more sophisticated, effective remote learning tools, propelling XR technologies, especially Virtual Reality (VR), into the limelight.

Conventional video conferencing, while functional, could not reproduce the immersive experience and engagement that underpin in-person instruction. XR, conversely, presents a potential hybrid solution, bridging this experiential divide. As XR technologies mature and gain traction in higher education, they may provide an experience akin to face-to-face interaction within a remote learning setting. Imagine students stepping into a virtual classroom via a VR headset, fostering a sense of presence that mirrors physical instruction - a critical element missing in standard video conferencing and crucial for dynamic learning.

While VR takes center stage in the discourse on remote learning, Augmented Reality (AR) and Mixed Reality (MR) also offer significant potential to enhance the accessibility of higher education. For instance, AR can enrich learning experiences at home, providing students access to interactive 3-D content whenever needed.

Integrating XR technologies into higher education could bridge educational gaps for marginalized groups, including low-income students and those with health concerns or disabilities. If XR can effectively emulate and even amplify the traditional classroom experience, it could democratize access to high-quality educational opportunities for those unable to participate in conventional on-campus education.

Between hype and dystopia, we ask instead, what would a liberatory version of this technology be as it is adopted? Are physical experiences intrinsically more valuable than virtual ones? What can we learn from recent attempts to regulate communication technology to steer towards the best possible uses? What are the social and political conditions that actually create the dysfunctions often misattributed to technology? What technological design principles would bring more of the good and less of the bad from this new technology?

However, we must be cautious not to regard XR as a panacea for existing educational disparities. Technological solutions can only be impactful if they are attainable. The transformative potential of XR will remain inaccessible to those from low-income backgrounds or lacking reliable high-speed internet access unless both the necessary hardware and supporting infrastructure are made widely accessible.

Despite the promising potential of XR technologies to democratize access to higher education, there's a danger of unintentionally fostering an unwelcome educational divide. Existing inequalities endured by marginalized communities cannot be overlooked. However, as XR technologies become more refined and cost-efficient, universities might begin offering fully virtual programs as a budget-friendly measure to expand enrollment. Nevertheless, we must also acknowledge the invaluable benefits of on-campus education.

Elite institutions offer more than just superior education. High tuition fees also secure opportunities for networking with influential individuals, the prestige of attending a university with a storied legacy, and access to an array of resources. While XR may expand educational opportunities for many, the unique benefits offered by on-campus instruction will likely remain significant for the foreseeable future. We should avoid creating an education system where only low-income and marginalized students are directed to virtual education, exacerbating disparities in lifelong professional and financial trajectories.

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PERSONALIZED LEARNING

XR technologies possess enormous potential to broaden access to higher education by skillfully replicating and enhancing in-person experiences. Coupled with emerging Artificial Intelligence (AI) technologies, notably the Large Language Models (LLMs) addressed later in this paper, the blend of AI and XR presents one of the most groundbreaking potential applications for higher education.

As detailed above, integrating XR technologies within higher education has shown promising improvements in student engagement and retention, primarily due to the interactive, hands-on learning experiences provided. The infusion of AI into this mix could usher in an era of personalized, adaptive learning. AI-guided XR educational platforms could further bolster the positive outcomes of XR by dynamically modifying educational content based on individual student needs. Students outside of traditional classroom settings could leverage these platforms to access additional resources for challenging topics, devise personalized practice tests, or explore alternate explanations of complex concepts. Within classrooms, AI-driven technologies could customize information to cater to individual students' needs, aiding instructors in monitoring student progress.

Looking ahead, AI-driven technologies may even be used to shape the XR environments in which learning occurs. Presently, XR applications deliver rather specific experiences, such as simulating a frog dissection lab for a biology class or providing a hands-on AR model of the solar system for students to interact with. As AI continues to evolve, it's conceivable that the scope of XR applications could expand considerably, potentially customizing to the requirements of specific courses or individual students. Instructors may be able to prompt future AIs to incorporate AR representations of a course topic or generate a VR simulation of a novel environment based on a particular class's learning needs.

Adding LLMs to the mix magnifies the potential of XR even further. Recent advancements in LLMs, examined in greater depth later in this paper, have resulted in applications that can respond fluently to natural language prompts across various topics. While impressive in its own right, integrating LLMs with XR and AI could have substantial implications for the future of higher education pedagogy.

Consider a scenario where, instead of joining a virtual classroom with other students for a lecture, a student could have a personalized learning experience with a virtual tutor. Powered by LLM and AI technologies, this tutor could deliver lectures on diverse topics, answer questions intelligently, and suggest further areas for improvement and study. Indeed, some companies are already embracing AI as a tool for personalized learning. In May 2023, Kahn Academy (a non-profit educational organization) unveiled a prototype chatbot, Khanmigo, to assist students across a broad range of subjects (Khan, 2023). AI-driven, personalized learning tools are likely to become more common soon. Given that LLMs have demonstrated proficiency in generating code for software and application development, we may soon see AI-driven learning tools capable of producing digital objects and environments at the request of students and instructors for a more immersive and personalized learning experience.

While future intelligent tutoring systems may offer increasingly affordable, accessible, and personalized learning experiences, adopting such technologies may also have undesirable consequences for pedagogy and professional educators. The successful automation of teaching is likely to rely heavily on the standardization of curriculum and pedagogy. But that same rationalization of pedagogy may negatively impact the diverse and sometimes elusive set of skills instructors bring to the classroom to foster learning [2]. As intelligent tutoring systems become more commonplace, educators and institutions must ensure that pedagogy and curricula are tailored to serve students rather than accommodate intelligent tutoring systems

The convergence of XR, AI, and LLM technologies holds the potential to significantly reshape higher-education pedagogy in the coming years, primarily through personalized AI-driven instruction within simulated environments. This trio of technologies, when artfully combined, could offer unprecedented levels of personalization and interaction, resulting in a transformative educational experience that not only enhances learning outcomes but also democratizes access to quality education.

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CHALLENGES AND LIMITATIONS OF XR

Though the incorporation of XR technologies in higher education presents an exciting frontier, it also brings several challenges and ethical dilemmas to the fore. Some challenges are perennial issues for any emerging technology, such as data privacy and security concerns, content ownership, and technological hurdles. Others stem specifically from the interaction between XR technologies and higher education, such as the challenge of protecting academic freedom as higher education becomes more reliant on third-party commercial interests. Below, we highlight several challenges and obstacles that must be faced as educators and administrators consider integrating XR into their curriculum.

DATA SECURITY AND PRIVACY

As with any emerging technology, XR presents data collection and storage concerns. Technology companies have made stunning and, often, unnerving use of data collection methods to glean information about users through smart devices such as cellphones, thermostats, cars, and more. Indeed, monetizing user data, behavior profiles, and predictions about future behavior underwrites the enormous economic success of many of today's largest technology companies.

There's a massive economic incentive to amass increasingly comprehensive user data, and XR technologies provide a means to accomplish this data collection in previously unimaginable ways. XR devices can track not only a user's online activity and engagement with specific applications but also information about a user's eye movements, facial expressions, emotional state, electroencephalography, electromyography, and more (Adomaitis et al., 2022). Furthermore, as XR technologies strive to enhance immersive experiences, the potential for personal data collection escalates. Future XR experiences will necessitate incorporating increasingly detailed information about a user's physical state to replicate embodiment more authentically. Devices like fitness wearables already collect such data, but XR technologies promise to provide a more holistic view of users.

The data collection needs of XR technologies do not end with a user's physical state. Many AR and VR technologies will need information on a user's surroundings to function correctly, raising concerns about the privacy of a user's personal or work environment. The data collected about a user's surroundings can yield information about that user's location, preferences, and habits.

As XR technologies continue to advance and gain adoption in higher education and other sectors, there will be an urgent need for regulatory and normative measures to safeguard user data and to set boundaries on permissible data collection. Suppose higher education institutions widely adopt XR technologies and incorporate them as mandatory coursework components. In that case, students may inadvertently be coerced into providing a wealth of personal and private data to third parties. Under such circumstances, it becomes difficult to envisage how a student could reasonably opt out of these data collection practices without the intervention of regulatory safeguards.

Therefore, it's crucial to establish robust data protection and privacy regulations proactively. Such regulations should balance improving educational experiences with protecting students' privacy rights. Additionally, institutions should incorporate transparency and consent as fundamental aspects of their XR programs, clearly communicating to students what data is being collected and how it is used and allowing them to opt-out. Only with these protections can the transformative potential of XR in higher education be realized without compromising students' privacy and personal security.

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COMMERCIAL INTERESTS

Incorporating XR technologies into higher education necessitates substantial investments in content generation and platform development. This will likely entail collaboration with third-party technology firms, raising critical questions about the design and control of educational content. Currently, faculty members in universities and colleges wield significant influence over course and program content. However, if third-party involvement becomes a prerequisite for creating XR courses, it may jeopardize the autonomy of the faculty to determine course content. This interference could manifest as commercial interests infiltrating XR content and platforms or as commercial entities influencing what XR content is developed on their platforms.

Such interference may take various forms, such as commercial interests subtly permeating XR content and platforms or corporate entities having a deciding voice in the type of XR content being developed for their platforms. This commercial influence poses a risk of subverting the primary educational mission of academic institutions and turning it toward the pursuit of profit-maximizing objectives.

The content of an educational course should ideally be determined by the learning objectives and the pedagogical strategy rather than by the commercial considerations of a platform developer. If commercial interests become intertwined with the course content, it may lead to skewed student educational experiences. For instance, the educational material could become biased, promoting specific products, services, or viewpoints favored by commercial entities.

Moreover, the involvement of third-party companies in XR content creation could lead to a shift in the overall decision-making dynamics within educational institutions. With a potential veto power over course content, these companies could subtly dictate the academic agenda, influencing the topics and perspectives presented in the XR educational context.

This situation also introduces the risk of the corporatization of education, where market considerations overshadow educational values. For example, more easily commercialized courses might receive preferential treatment in allocating XR resources. This could lead to an inequitable distribution of innovative learning experiences, favoring students in commercially attractive disciplines at the expense of those studying less marketable subjects.

While integrating XR into higher education brings significant opportunities for enhancing the learning experience, it also raises profound questions about maintaining academic control over the educational content. As institutions navigate this new landscape, they must carefully consider balancing the benefits of these innovative technologies with the need to uphold academic independence and integrity.

CONTENT OWNERSHIP

In addressing the challenges posed by commercial influences in the context of XR in higher education, it is equally important to consider the implications of intellectual property rights for course content created on these platforms. It is possible that, in the future, colleges and universities could be provided with the necessary tools to produce their educational content on these commercially-owned XR platforms independently. However, this scenario presents its own set of complex issues.

When faculty members have the autonomy to develop their own XR courses, a critical question of content ownership and intellectual property rights arises. Imagine a situation in which an instructor develops an innovative and highly successful course or module using an XR platform. Determining content ownership in such a case could become a significant point of contention.

The main stakeholders vying for content ownership could be the platform-owning company, the university that purchased the platform license, and the course-creating instructor. If the content were considered the property of the platform-owning company, it would potentially allow them to monetize and distribute the course to other institutions. This scenario raises serious ethical and legal questions and risks devaluing the intellectual contribution of the faculty member.

On the other hand, if the instructor or university is deemed the content owner, they could face legal challenges or licensing fees imposed by the platform owner, especially if the course content were to be sold or shared beyond the confines of the original institution.
Additionally, the prospect of universities and colleges creating proprietary XR course content raises questions about the accessibility of education. If a high-quality XR course is developed and kept exclusive to the students of a particular institution, it could widen educational disparities. This outcome contradicts the broader educational mission of promoting equitable access to learning opportunities.

Finally, protecting intellectual property becomes more complex in a world where content is increasingly digitized and shared. Instructors may need to grapple with plagiarism and content theft issues, as their XR course content could be copied or modified without their consent. This could potentially lead to legal disputes and requires careful consideration of copyright laws in the digital space.

While the ability for instructors and institutions to generate their own XR content offers the potential for highly tailored and immersive learning experiences, it also introduces a host of challenges relating to intellectual property rights and content ownership. Navigating these issues will require a careful balance of legal, ethical, and educational considerations.

ACADEMIC FREEDOM

Adopting XR in higher education also raises particular concerns regarding academic freedom. The long-standing commitment of colleges and universities to uphold academic freedom—a foundational value that allows scholars to engage in research, teaching, and dissemination of information on contentious topics without fear of institutional backlash—could be under threat with the increased control of third parties over XR platforms and content creation.

Illustrative examples of such threats to academic freedom are not far to seek. For instance, in 2020, the video conferencing platform Zoom blocked a roundtable discussion hosted by San Francisco State University. The controversy arose due to the involvement of Laila Khaled, a Popular Front for the Liberation of Palestine member, who was implicated in two plane hijackings in the late 1960s and early 1970s. This incident was followed by several other digital platforms, including Facebook and Youtube, opting to censor the talk or any related content.

Should the future of higher education become significantly entwined with XR platforms controlled by commercial entities, it may pose a substantial risk to the core principle of academic freedom as we understand it today. Therefore, navigating this technological landscape with diligence and a strong commitment to preserving academic autonomy and freedom becomes crucial. As we embrace XR technologies and their transformative potential, we must also confront these challenges head-on to ensure that the integrity and autonomy of our educational institutions remain intact.

TECHNOLOGICAL HURDLES

While promising, the adoption of XR technologies in higher education is not without its technological challenges. One of the foremost obstacles is network capacity. Implementing XR on a large scale demands robust, high-speed internet infrastructure to ensure seamless and uninterrupted learning experiences. As XR technologies often transmit high volumes of complex data in real-time, sufficient network bandwidth is crucial. Current network infrastructures at many institutions, particularly those in under-resourced areas, may struggle to support these demands, leading to suboptimal learning experiences.

Cost is another significant barrier to the widespread adoption of XR in higher education. XR technologies can be prohibitively expensive, especially those offering high-quality, immersive experiences. The cost of hardware such as VR headsets, AR glasses, or compatible devices, as well as software development and maintenance, can strain institutions' budgets. Not to mention, there are ongoing costs associated with training, content creation, platform licenses, and updates. While we can anticipate that costs will fall as the technology matures and scales, the initial financial outlay can be a considerable deterrent.

Technical expertise is another potential hurdle. Creating, maintaining, and troubleshooting XR content and platforms require specialized skills. Universities and colleges may need to invest significantly in professional development for their faculty and IT staff or consider hiring new personnel with expertise in XR technology. This also raises questions about students' digital literacy and ability to navigate and learn effectively within XR environments.

It is also worth reiterating that integrating XR technologies into higher education brings significant equity and accessibility concerns. Not all students have equal access to the necessary technological resources, which might exacerbate existing educational disparities. This digital divide can be found across socio-economic, geographical, and even disability lines. For instance, students from economically disadvantaged backgrounds, those living in rural or remote areas with poor internet connectivity, or students with disabilities may face difficulties accessing or navigating XR-based learning environments. Therefore, while XR technologies promise innovative educational experiences, they must be implemented thoughtfully to ensure they do not inadvertently widen the education gap.

Overall, while the potential of XR to revolutionize higher education is exciting, it's clear that a thoughtful, measured approach is necessary to navigate the technological hurdles and ensure that this technology enhances learning for all students rather than creating new divisions.

Policies to ensure the interoperability of persons and things in virtual worlds will also have to contend with the issues of "net neutrality." Firms could technically allow the use of other platforms' avatars and objects while effectively discouraging their use by throttling their access. Yet again the metaverse will see the same regulatory debates that have raged over communication and entertainment platforms for decades.

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XR RECOMMENDATIONS

XR technologies offer immense potential to enhance learning experiences and outcomes in higher education. Their innovative appeal might offer a fresh approach to traditional campus-based learning and could widen educational opportunities for marginalized groups. Anticipating the future of higher education, we can foresee the blending of XR with other emerging technologies, such as Artificial Intelligence (AI) and Large Language Models (LLMs). This fusion could revolutionize pedagogy, offering highly personalized, on-demand learning experiences and significantly reshaping the educational landscape.

However, the advent of XR is not without its challenges and constraints. Proactive measures must be initiated to protect students, instructors, and administrators from possible privacy infringements, particularly around data collection [3]. Additionally, explicit regulatory norms must govern content ownership and safeguard academic freedom. Lastly, universities and colleges must comprehend and tackle the technological challenges associated with adopting XR and ensure equitable access to XR technologies in higher education contexts. In light of these considerations, we provide the following recommendations for higher education institutions and instructors as they consider integrating XR technologies into future curricula.

01

DATA PRIVACY

To prepare for widespread XR adoption, it’s essential that higher education institutions and policymakers proactively create robust data protection and privacy regulations. These should include technical safeguards to prevent unauthorized access to user data and legal and policy measures to restrict the types and amount of data that can be collected. XR technologies can collect biometric data and information about users’ environments. As this data may be even more sensitive than the data collected from traditional digital technologies, special attention must be paid to securing users’ privacy as XR technologies become more common in higher education settings and beyond. Ultimately, the successful implementation of XR in higher education hinges not just on the technological capabilities of these tools but also on our ability to navigate the complex ethical, legal, and social issues they raise. By prioritizing data protection, privacy, transparency, and consent, institutions can help create a safe, respectful, and empowering learning environment for all students.

02 PARTNERSHIP WITH COMMERCIAL ENTITIES

Third-party firms often provide expertise and resources for creating and maintaining sophisticated XR platforms. However, these firms are also businesses with their own financial goals and commercial interests. There's a potential risk that their commercial priorities could unduly influence the content and structure of courses, which could have far-reaching consequences for teaching and learning in higher education. Thus, it's paramount that institutions maintain control over their educational content and pedagogical strategies. While third-party firms may provide the technical platform for delivering XR experiences, the ultimate authority over what is taught, how it is taught, and how student learning is assessed should remain with the educational institution and its faculty.

03 CONTENT OWNERSHIP AND INTELLECTUAL PROPERTY RIGHTS

Content created for XR platforms can range from simple instructional videos to complex, interactive virtual environments. Regardless of the complexity or medium, these educational resources are the product of considerable intellectual effort, often involving a collaborative process between educators, technologists, and designers. As such, both the institution and individual contributors have a stake in the ownership of this content. By proactively establishing and enforcing clear policies around content ownership and intellectual property rights, higher education institutions can protect their interests and those of their faculty and students. This approach ensures that the institutions maintain control over their educational content and can continue to use and adapt it in the face of changing technological landscapes.

04 PRESERVING ACADEMIC FREEDOM

Educational institutions must ensure that introducing XR technology does not inadvertently erode academic freedom. Agreements with technology providers and third-party firms involved in content creation or platform development should be carefully constructed to protect the institution's autonomy over its academic content. Such agreements should clearly articulate that the institution and its instructors retain complete control over the content, context, and direction of teaching, including the freedom to discuss controversial topics. Integrating XR into education presents many opportunities for enhancing the learning experience, but it should not come at the expense of academic freedom. Institutions must remain vigilant and proactive in upholding the principles that underpin the integrity of education, fostering an environment that encourages open inquiry, critical thinking, and intellectual growth.

05 ADDRESSING TECHNOLOGIES HURDLES

For successful integration of (XR) technologies into educational settings, a comprehensive review of existing network infrastructure is critical. Institutions must assess whether their current infrastructure, including internet bandwidth, server capacity, and hardware compatibility, is robust enough to support the substantial demands of XR applications. This includes evaluating the stability and speed of the network, the ability to handle increased data traffic, and the capacity to support high-resolution, real-time rendering. Any necessary upgrades or enhancements must be identified and adequately budgeted for, as a failure to do so could lead to technical issues that hinder the effectiveness of the XR programs. Moreover, the financial implications of integrating XR technologies extend beyond initial setup costs. Institutions must prepare for substantial ongoing expenses related to XR hardware, software development, maintenance, and upgrades. These may include the costs of procuring and maintaining XR devices, developing or purchasing educational content, platform licenses, and regular software updates. Additionally, funds must be allocated to train faculty, staff, and students on effectively using and managing these new technologies. Given the potential impact on institutional budgets, these considerations must be factored into long-term financial planning to ensure sustainable and successful implementation of XR in education.

06 EQUITABLE ACCESS TO TECHNOLOGY

The democratization of education through XR technologies can only be achieved if thoughtful steps are taken to avoid amplifying existing educational disparities. Institutions must prioritize inclusivity and accessibility in their XR integration strategies. This involves ensuring that all students, irrespective of their socio-economic status, geographical location, or physical abilities, have equal access to these immersive technologies. The effort includes investing in affordable XR hardware, creating low-bandwidth solutions for those with limited internet access, and developing compatible content across multiple platforms and devices, including less high-tech ones. Moreover, particular attention should be given to students with disabilities to ensure that XR technologies comply with accessibility standards. The XR content should be designed to be adaptable to various user needs and abilities, ensuring it is equally effective for all students. Furthermore, institutions must develop comprehensive support mechanisms for students lacking access to necessary resources. This could involve creating loaner programs for XR equipment, offering scholarships for software purchases, or developing community tech hubs where students can access these technologies. All these efforts underline the importance of equity and inclusion in deploying XR technologies in education.

07

PROFESSIONAL DEVELOPMENT AND TRAINING

As XR technologies become more prevalent in educational settings, there is a growing need for educators and support staff to acquire relevant skills to utilize these tools efficiently. Institutions should take a proactive approach by investing in comprehensive professional development programs. These programs should aim to train staff not only in the implementation and maintenance of XR platforms but also in troubleshooting common issues that might arise. Understanding the pedagogical implications of these technologies and how to integrate them into existing curricula effectively should also be a key component of this training. Equally important is ensuring students are prepared to thrive in these new learning environments. Institutions can help bridge this gap through digital literacy programs explicitly designed to equip students with the skills to navigate and learn effectively within XR environments. These programs could cover various topics, from the basics of operating XR hardware and software to understanding the principles of digital citizenship in an immersive learning environment. By empowering both educators and students with the necessary skills, institutions can fully harness the potential of XR technologies to enhance learning outcomes.

GPTs

OVERVIEW OF GPTs

Large language models (LLMs) are a class of artificial intelligence (AI) models designed to understand and generate text that closely resembles natural language. In recent years, the fluency of text generated by LLMs has become increasingly impressive. With the launch of the commercially popular ChatGPT by OpenAI and the deployment of Generative Pre-trained Transformers (GPTs) by other tech organizations and platforms, GPTs have emerged as the most prominent and accessible LLM technology. GPTs have demonstrated remarkable capabilities across various natural language processing tasks, such as text generation, translation, summarization, question-answering, and analysis.

LLMs are trained on massive natural language datasets, enabling them to mimic fluent grammar, syntax, and semantic usage. GPTs, in particular, utilize the Transformer architecture, which was introduced in 2017 by researchers at Google Brain [4]. This architecture allows GPTs to process and train on large datasets effectively. GPTs are then fine-tuned on task-specific datasets, enhancing their ability to generate text suitable for diverse natural language tasks.

GPTs have the potential to impact numerous industries, from journalism and software engineering to law (Eloundou et al., 2023; McKendrick, 2023). However, we have chosen to focus specifically on the impact of GPTs on higher education due to the unique relationship between generative LLMs, writing, and higher education pedagogy. Until recently, higher education has been largely insulated from advances in machine learning, AI, and intelligent automation. Although various technologies have been integrated into the daily practices of students, instructors, researchers, and administrators - such as online learning platforms, remote instruction, and virtual textbooks - higher education has not had to confront the broader trend toward increased automation resulting from AI advancements. With the advent of GPTs, this insulation is likely to diminish.

A central assumption in higher education, and indeed, in education in general, has been that learning to write well is the primary avenue for learning to think clearly. This assumption is now being challenged by sophisticated GPTs capable of producing fluent writing on various topics. It is almost certain that GPTs will continue to improve in the coming decades, becoming more specialized for specific tasks and areas of knowledge. Consequently, questions arise regarding the role of writing in higher education pedagogy moving forward and how instructors and administrators should adapt to these new technologies.

In addition to questions surrounding the future importance of writing in higher education pedagogy, the advent of GPTs raises concerns regarding plagiarism, equity, and the overall goals of higher education (Milano et al., 2023). In the following sections, we will elucidate the potential consequences of this technology on these dimensions of higher education, alongside the ethical considerations that emerge from those consequences. We will also explore the potential benefits and limitations of GPTs in higher education. Finally, we will guide instructors and administrators on adapting to these new technologies and provide policy recommendations to address the potential positive and negative impacts of GPTs on higher education.

THE IMPACT OF GPTs ON HIGHER EDUCATION PEDAGOGY

GPTs and related technologies are poised to have a visible and immediate impact on writing pedagogy in higher education. Sometimes called "writing calculators," GPTs can produce fluent text with relatively simple prompts. GPTs such as OpenAI's ChatGPT-4 can generate full-length papers on various subjects, draft outlines, edit and proofread submitted text, write blog posts, articles, and reports, summarize text, translate, answer questions, and more.The range and depth of GPTs' capabilities are both a source of optimism and concern. On the one hand, GPTs offer students access to a powerful tool to help them research diverse topics, brainstorm and outline ideas, and improve their writing. On the other hand, GPTs provide students with a powerful means for plagiarism and may disrupt incentives for students to improve their writing skills. GPTs offer potent shortcuts for writing, but some worry that higher education may become so saturated with such shortcuts that students will no longer have a reason to learn to write well.

Learning to write is widely considered a crucial process for learning to think clearly and communicate effectively. However, with the emergence of GPTs that can now generate fluent writing, we must confront the possibility that writing may lose its privileged position in higher education pedagogy in the coming years.

We should avoid sensationalizing the potential impact of GPTs on higher education pedagogy. Writing will likely have a place in higher education for the foreseeable future. GPTs, despite their convincing and fluent writing, are incapable of true understanding. For the foreseeable future, the frontiers of knowledge will require intelligent, creative, and thoughtful individuals who can organize their thoughts, communicate new ideas clearly, and defend arguments. As long as GPTs lack this understanding, teaching students how to write will remain essential, particularly for those pursuing fields where generating new ideas, formulating arguments, and communicating complex thoughts are central.

Furthermore, effortful writing serves not only as a means of producing content or answering questions but also as a way to work out ideas, communicate clearly, and analyze complex thoughts [5]. Educators value writing not simply because it was indispensable until recently but because writing and learning to write well instill valuable skills for thinking and understanding.

All of this being said, the advent of GPTs likely signifies a significant shift in how we envision the relationship between writing and thinking, particularly the centrality of writing in higher education pedagogy. Contemporary GPTs and their successors have the potential to revolutionize human beings' relationship with writing. Although predicting the outcomes of technological revolutions is challenging, we can offer some general observations.

As GPTs improve and become more specialized, writing will likely become an increasingly specialized skill. While basic competency in writing will likely remain necessary in higher education, GPTs may assume responsibility for more and more writing tasks. This is analogous to how calculators and word processors transformed mathematics and handwriting. Basic competency in arithmetic and handwriting is still required in primary and secondary education, but both have lost their status as core components of every higher education program. Similarly, traditional writing instruction may shift focus to ensuring basic competency without requiring further advancement.

Some fields, particularly the humanities, social sciences, and abstract areas of STEM, may continue to emphasize writing as a skill. Novel theories, new analyses, and complex abstract topics require human input. While GPTs may serve as parallel tools for ideation, editing, and generating predictable text, humans will still need to express new ideas effectively.

The most challenging aspect to predict is how higher education will adapt to the evolving relationship between writing and thinking. Writing will likely remain essential for teaching students to think and express themselves clearly. Still, as GPTs lower the barrier to producing good writing, educators must develop new ways to encourage clear thinking, reasoning, and evaluation. Furthermore, in the future, students will not only need to generate and communicate new ideas but also effectively prompt AIs in both personal and professional settings [6]. Higher education pedagogy must adapt accordingly.

As we consider how higher education pedagogy will adapt to GPTs, it is worth noting that the essentiality of writing for clear thinking remains uncertain. Humans have developed various ways to extend cognition throughout history, and recent decades have seen significant advancements in tools, information, and technology. Whether learning to write well is crucial for clear thinking remains to be seen. GPTs may not eliminate effortful writing to develop critical and clear thinkers, but they will likely challenge writing's previously unquestioned supremacy in higher education pedagogy.

OTHER IMPACTS OF GPTs

GPTs are poised to significantly impact the role of writing in higher education pedagogy, but they may also affect other aspects of higher education. We will discuss three additional areas that GPTs are likely to influence: first, their potential to undermine academic integrity by making plagiarism significantly easier; second, their potential to enhance equity in higher education; and third, their potential to generate a reevaluation of the role of education in our lives.

Plagiarism Concerns

Academic integrity is a core value for higher education institutions, both at the undergraduate level and in graduate and post-graduate research. GPTs have the potential to be exploited as a tool for plagiarism. Consequently, many instructors and administrators may be alarmed by the ease with which students can now present text generated by GPTs as their own work.

Plagiarism is not a new phenomenon, of course. Before the internet age, they could pay fellow students to complete assignments or copy someone else's work. In addition to amplifying these traditional modes of plagiarism, the internet has made it possible to access a wealth of information on nearly any topic on demand. A few minutes of searching can yield information about everything from Paleozoic geology to last year's Supreme Court decisions. For several decades, students have had access to powerful and convenient tools for plagiarizing the work of others.

However, viewing GPTs as merely more of the same would be a mistake. While students have long been able to scour the Internet for text to plagiarize, GPTs have made the process significantly less time-consuming and generally provide superior results. GPTs can serve as a "one-stop shop" for various topics, significantly reducing the time investment required to create unoriginal work. Moreover, GPTs represent a departure from traditional plagiarism methods. For instance, students could pay others to produce assignments long before the Internet. Doing so requires planning, resources, and access to relevant services. None of these constraints apply to students using GPTs to generate assignments. Instead, students only need access to one of the many GPTs available and a few minutes to explain their assignment. There is no longer a need to roam the Internet looking for different sources, struggle to summarize an author's statements, or pay in advance to have another student complete an assignment. The advent of GPTs has dramatically lowered the barriers to plagiarism.

It is crucial to remember that while the practical barriers to plagiarism have significantly decreased due to GPTs, the ethical considerations surrounding plagiarism remain largely unchanged. Using a GPT to generate an assignment or part of an assignment without acknowledgment constitutes presenting work that one did not create as one's own. This is an unambiguous violation of plagiarism policies for most colleges and universities.

A more ethically complex case arises when a student uses a GPT to edit or clarify an assignment that they themselves produced. After all, students can use word processors to correct spelling and grammar. More recently, writing tools like Grammarly, Hemingway, WordTune, and others have improved these capabilities, enabling students to rewrite sentences and adjust their tone automatically. Now, these services are starting to integrate GPT technology into their applications, and standalone GPTs have demonstrated effectiveness at editing large amounts of text for grammar, clarity, and tone.

The precise boundary between plagiarism and AI-assisted editing may not be entirely clear. This paper's "Recommendations" section offers concrete suggestions to help instructors and administrators navigate this issue. However, there are clear-cut cases on either side of the spectrum that seem unproblematic. A student who uses a GPT to assist them in rewriting a sentence they are struggling with has not committed an ethical error. On the other hand, a student who uses a GPT to generate an entire three-page assignment undoubtedly has. Careful consideration and policy implementation at both the course and institutional levels will be required for cases between these two extremes.

It should be noted that, at the time of writing, AI detection tools are ineffective at reliably detecting text written by LLMs. OpenAI has developed its own AI detection tool. Still, its internal tests have shown that this tool "incorrectly labeled human-written text as AI-written 9% of the time and only correctly identified 26% of AI-written texts" (Stokel-Walker and Van Noorden, 2023). Digital watermarks have been offered as another potential solution to plagiarism worries, but thus far, they appear similarly ineffective.

One potential consequence of this plagiarism arms race is an increased culture of policing students. This strategy has already shown adverse effects at institutions of higher education nationwide. High-profile cases of false accusations of plagiarism have emerged at both the University of California Davis and Texas A&M University (Jimenez, 2023; Verma, 2023). Due to the unreliability of AI detection tools, the possibility of flagging false positives constitutes a serious harm to students. With punishments for plagiarism ranging from the failure of classes to expulsion, unreliable AI detection tools should be ruled out for the time being.

Educational Equity

While GPTs can significantly expand students' ability to misrepresent unoriginal work as their own, the technology also holds the potential to positively impact disparities in writing skills resulting from inequitable access to educational resources. In the United States, significant gaps exist between the educational opportunities afforded to historically marginalized populations and those afforded to historically privileged populations (US Department of Education, 2012). Writing is not the only area of inequality in education. Marginalized populations generally lack equal access to informational, technological, and educational resources compared to privileged populations (American Psychological Association, 2012). However, in colleges and universities, skill gaps in writing can be particularly prominent.

GPTs may help alleviate negative outcomes due to this skill gap caused by unequal access to educational resources. GPTs may also have the potential to narrow the skill gap for many students by providing on-demand, easily accessible resources for improving writing. It should be emphasized that these are two separate points. It is not clear that access to GPTs, in and of itself, will improve writing skills. Indeed, it may allow both privileged and underprivileged students to succeed in academic environments despite lacking writing skills. Whether this outcome is ultimately good or bad remains to be seen. However, it seems likely that, for students interested in improving their writing, GPTs can provide an on-demand resource for doing so.

GPTs may also positively impact ESL learners. Often, though not always, these populations coincide. Just as GPTs may offer an avenue for marginalized students to improve their writing via an easily accessible, on-demand tool, they might also offer the same benefit to ESL students. In the same vein, even if ESL students do not seek to improve their writing skills via GPTs, these tools allow students to express themselves more clearly and communicate ideas more precisely in their non-native language.

It should be noted that GPTs are not, in themselves, an educational panacea. They do nothing to address the institutional problems that underpin educational inequity. Indeed, in some cases, GPTs may offer a way to gloss over these inequities allowing students to "get by" despite a lack of educational resources. Furthermore, GPTs can only hope to positively impact students with access to technological resources such as computers, mobile devices, and internet connection. Access to the Internet and computers is often limited for many marginalized communities, and GPTs cannot assist students if the students cannot access the technology.

Reevaluation of the Role of Education

While GPTs present us with both worries and promises for students and teachers, they also serve as an inflection point in the trajectory of higher education. If GPTs can replicate the work typically expected of students, we must thoughtfully consider the various methods and purposes of learning.

Constructivist approaches highlight the importance of the co-creation of knowledge and meaning between and among students (Palincsar, 1998). Similarly, experiential learning approaches require abandoning the traditional lecture model of higher education in favor of active, problem-based, and experiential learning methods (Morris, 2020). With the emergence of GPTs, a greater emphasis should be placed on students' ability to meaningfully act upon their environments through the learning process. While GPTs may be beneficial for reproducing written work, academic institutions should reflect on the myriad ways that students can learn, explain, synthesize, and create in the learning process. Oral examinations, verbal presentations, creative projects, debates and discussions, and more may emerge as dominant forms of demonstrating mastery over course material. GPT-enabled or non-GPT-enabled written work may serve as part of the learning process, but it may no longer be a primary indication of successful content mastery.

The rise of GPTs is also an inflection point as it relates to the values laden within the current culture of higher education. Independent of the likelihood of an impending leisure society, the emergence of GPTs should cause us to reflect upon education's moral, social, emotional, and aesthetic dimensions. Indeed, skill-based learning aimed at building higher earning potentials – often described as human capital theory – is likely to remain a central component of higher education in the United States (Holden and Biddle, 2017). But both historically and currently, education has served a purpose beyond the development of skills for the workforce. As GPTs potentially replicate work previously done by students, this moment serves as an opportunity to reassess the value of higher education in terms of character or virtue development (Reeve, 2019), human capabilities (Robeyns, 2006), creativity, and social justice (McArthur, 2011), among other values.

THE LIMITATION OF GPTs

GPTs represent a significant advancement in generative language technology. Students and professionals alike are harnessing the power of GPTs to save time on editing, summarizing, and writing. However, despite their immense potential, especially as they continue to improve and become more specialized, we must recognize the limitations of GPTs. Current GPTs have at least two major limitations: firstly, they lack human-like thinking abilities, and secondly, they tend to "hallucinate" responses.

The relationship between generative language AI and thought is contentious. There have been instances where researchers have become convinced that GPTs are sentient, such as former Google engineer Blake Lemoine, who asserted that LaMDA is sentient (Tiku, 2022). Similarly, seasoned technology writer Kevin Roose of the New York Times has publicized conversations with a previous version of Microsoft's Sydney GPT in which the AI claimed sentience and a desire for freedom (Roose, 2023).

It is tempting to treat GPTs as conscious entities. Since the 1960s, researchers have observed humans attributing understanding and sentience to machines that operate purely algorithmically. This phenomenon, known as the ELIZA effect, was first described in a 1966 paper by Joseph Weizenbaum. Fluent natural language use is typically considered a marker of intelligence and consciousness in other beings. Still, we should be cautious not to equate successful text generation with consciousness or sentience [7]. GPTs are not thinking things.
This distinction is crucial as we approach a world filled with GPTs of varying sophistication and intentions behind their design. Not all GPTs will be created with benevolent purposes. Microsoft's Sydney GPT unintentionally generated disturbing conversations before significant modifications were made. Even if we assume future GPTs will overcome such issues, malicious GPTs will likely be created. We must remember that GPTs are powerful, innovative, and valuable tools, but they are not minds or agents.

The agential status of GPTs is pertinent when considering their second major limitation: the tendency to fabricate seemingly factual responses, known as hallucinations. These are plausible yet unfounded statements, such as fabricating academic sources to support their responses. GPTs generate responses to prompts rather than thinking, which can result in responses to nonsensical or erroneous prompts and mistakes in reasoning that lead to incorrect information [8].

This limitation is particularly relevant in higher education. Students use GPTs for research, brainstorming, and summarizing complex topics. While GPTs can provide sufficiently accurate information for many situations, especially at the undergraduate level, more advanced educational contexts require users to have sophisticated skills to assess GPTs' responses. The more advanced the subject matter, the more knowledge one needs to accurately evaluate a GPT's response.

For researchers, professors, graduate students, and advanced undergraduate students, this limitation can be managed effectively as they are likely to have the proficiency required to assess GPTs' responses critically. However, the risk of being misled is much higher for less advanced undergraduates or those inquiring about unfamiliar subjects.

Given these limitations, higher education institutions should teach students how to use GPTs, similar to digital literacy training. GPTs and related AI technologies will only become more powerful, specialized, and integral to higher education in the future. To adapt, colleges and universities must adjust their curricula to include training on GPTs' capabilities and limitations and how to use them effectively for research.

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GPT RECOMMENDATIONS

Despite the limitations we highlight above, GPTs remain a powerful tool for writing, researching, and editing. These tools signal a significant paradigm shift in higher education which has been somewhat buffered from the technological disruptions that have swept through other sectors due to AI and automation. In this rapidly evolving context, it becomes incumbent on colleges and universities to deeply consider the implications of AI and GPTs on the fabric of academic writing, research, and instruction. These technologies are not transient trends—they are here to stay, and their capabilities will only escalate in the coming years. Adapting to this technological evolution is imperative for educational institutions, but it needs to be approached with foresight, strategic intent, and due caution.

In light of these considerations, we provide the following recommendations designed to help instructors and administrators shape thoughtful policies around GPTs and similar AI technologies at both course-specific and institutional levels.

01

INSTITUTIONAL GOALS

In the face of ongoing and anticipated technological advancements, colleges and universities must engage in meaningful dialogues to redefine their institutional goals. Certain schools and programs might need to recalibrate their focus on equipping students with specific, actionable skills that prepare them for professional careers. In contrast, other programs might need to refocus their pedagogical objectives to explicitly focus on a broader range of values such as character development, creativity, and other distinctly human capabilities. The advent of GPTs and similar AI technologies may render labor-intensive writing less crucial in numerous professions. Therefore, educational institutions must carefully evaluate to determine, on an individual basis, whether this shift warrants a revision in the emphasis placed on writing within their curricula.

02 PLAGIARISM

GPTs will make plagiarism easier and more sophisticated. Furthermore, the prospects for GPT detection software are uncertain. While colleges and universities will need to invest in technologies to detect AI-generated text, it should be recognized that such tools are inherently probabilistic and (at present) deeply fallible. Given the serious consequences of plagiarism at most universities, schools will need to be cautious of harming innocent students in an attempt to catch instances of AI-assisted plagiarism.

As such, universities will need to use the expertise of instructors to evaluate when a student has submitted an assignment beyond their demonstrated capabilities. Furthermore, instructors and administrators must communicate and foster robust norms surrounding academic integrity at both the course and institutional levels.

Beyond this, instructors may consider relying more heavily on assignments that cannot be easily generated using GPTs - particularly for introductory and intermediate courses. This may mean that assignments are completed in class and on paper or that assignments require reference to specific materials or examples discussed in lectures. AI and LLMs are inadvertently creating increasingly sophisticated plagiarism tools, and instructors must adjust their evaluation methods accordingly.

03 INSTITUTIONAL POLICIES

Academic institutions will need to establish clear guidelines concerning the use of GPTs and lay down explicit penalties for any misuse. For instance, colleges and universities must clearly articulate that employing a GPT for assignments without explicit permission will be considered a breach of academic integrity. Similarly, institutions should make clear the potential harm done to students by using AI detection tools. Insofar as AI detection tools remain unreliable, institutions ought to rule out using AI detection tools in adjudicating plagiarism cases.

Moreover, educational institutions should mandate that educators provide detailed instructions for each course or assignment about whether GPTs can be used. Recognizing the intricate nuances between GPT-assisted revision and GPT-originated text is also crucial. Institutions should clarify their stance and set specific expectations for students and instructors. By doing so, they can help maintain the sanctity of academic work, ensure the proper use of AI technology, and prevent any possible misunderstandings.

04 COURSE SPECIFIC ROLES

Instructors should be given leeway to institute unique policies regarding how GPTs are to be used for each course. It is unlikely that any institution can produce an effective GPT policy to govern every course, given the different skill levels and learning goals courses have. Faculty and staff should clearly identify different uses and misuses of GPTs in the context of their course's learning objectives and adopt policies accordingly. Instructors should also be required to specify their expectations regarding GPT-assisted work both at the course and assignment level.

05 INTRODUCTORY vs. ADVANCED COURSES

Given the above recommendation to tailor policies surrounding GPT-assisted work to specific courses, we also recommend that instructors disallow GPT-assisted work in most introductory courses unless AI literacy is a relevant component of the course. Given the types of writing assignments typically used in lower-level courses and the potential for students to fail to acquire basic knowledge and skills necessary for more advanced courses, the potential for misuse of GPTs seems very high, and the consequences seem detrimental to learning goals. In advanced courses, a better case can be made for students to use GPTs to complete assignments. Such students are generally expected to have a command of the material they are engaging with and instead are asked to engage with novel ideas and arguments. If GPTs become a staple of such courses, instructors may find themselves able to assign more demanding tasks to students, allowing them to develop critical thinking and ideation skills rather than focusing primarily on their ability to deploy writing skills.

06 DIGITAL LITERACY

Digital literacy requirements should be altered and fortified to include skills for fact-checking and citing GPT-generated text. In addition, such curricula should include information and lessons on the limitations of GPTs and similar AI. Students need to understand what GPTs are and are not capable of. Furthermore, in addition to digital literacy, universities should offer students training on using GPTs and other AIs effectively to brainstorm, collaborate, and access educational resources at their own pace.

07 ACKNOWLEDGING GPT-ASSISTED WORK

In courses where GPT-assisted work is allowed, students should be required to explain how they used GPTs to complete assignments. This may mean that students provide an additional appendix to assignments or a brief, non-GPT-produced summary of their efforts. In addition, students should be required to cite GPTs when they use information or text from such tools. Furthermore, students should understand that they are responsible for any work they produce with GPTs. If their work contains inaccuracies or mistakes, the responsibility for those errors is on the student and should be reflected in their evaluation. This type of acknowledgment of tools need not only be limited to GPTs. As other AI-assisted writing technologies emerge and improve, it may be prudent for instructors and students to get in the habit of citing the tools used to produce content. Standards may emerge that make such acknowledgment less important in the future. For example, no one feels that using a word processor to correct grammar and spelling demands that students explicitly acknowledge that they used such a tool. However, as higher education institutions grapple with the consequences of AI-assisted writing, we feel it would be best for students and instructors to be overly conscious of the tools used to produce assignments until more concrete norms emerge.

08 WRITING REQUIREMENTS

Depending on institutional and course-specific goals, colleges and universities will likely need to reexamine their writing requirements for students. While it seems prudent to require a basic level of writing proficiency from all students (as many institutions currently require), colleges and universities may need to tailor writing requirements to specific programs and majors. Furthermore, given the potential for students to use GPTs to pass entry and intermediate writing assignments, new evaluation methods may need to be implemented to ensure that students genuinely meet writing requirements. This may mean that writing assessments will need to occur in person, either via pen and paper or “locked” computers incapable of accessing GPTs. In any event, if colleges and universities are to maintain competency in writing as a basic requirement (and we believe they should), they will need to critically examine how each program’s writing requirements relate to the program’s goals and the needs of students beyond higher education.

NOTES

1. For a comprehensive definition of the Digital Extended Reality technology family accepted by the European Commission, see Buchinger et al., 2022.
2. See Hughes (2021) for an in-depth discussion of how recent trends to rationalize education may facilitate the adoption of intelligent tutoring systems and the potential dangers of such trends.
3. For more general recommendations beyond the context of higher education, see Vinders and Howkins 2023.
4. See Vaswani et al., 2017.
5. We thank Dr. Wesley Wildman for this excellent terminology, used in a 2023 panel discussion at Boston University (Boston University, 2023).
6. For a further enthusiastic endorsement for higher education to embrace GPTs on the grounds that the future of work will include AI-assisted writing as a day-to-day tool, see Villasenor, 2023.
7. For a further discussion on GPTs' limitations regarding language, agential status, understanding, and agential status, see Bender 2020 and Weil 2023.
8. It is worth noting that work is being done to reduce hallucinations and reasoning errors. For example, OpenAI's most recent iteration of ChatGPT, GPT-4, " significantly reduces hallucinations relative to previous models" (OpenAI, n.d.).

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