# Forward: Special Issue - Human-AI Symbiosis: Ethical, Skill-Based, and Philosophical Implications in Higher Education

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The special issue of the International Journal of Emerging and Disruptive Innovation in Education: VISIONARIUM, sponsored by The College of Arts and Humanities at Lindenwood University, addresses the intricate dynamics of Human-AI Symbiosis in higher education. This edition focuses on the ethical, skill-based, and philosophical implications of Generative Artificial Intelligence as it integrates with human capabilities within educational frameworks. The issue draws on Dov Seidman's philosophy that "how we do things matters more than what we do," therefore, the manner in which we accomplish activities is of greater significance than the activities themselves. The articles within this issue do not merely speculate on the potential of AI in education; they provide a deep dive into the necessary ethical frameworks, underscore the irreplaceable value of human skills, and consider the philosophical challenges posed by this technological integration.

Articles in this issue explore various themes, emphasizing the critical nature of human skills such as empathy, ethical judgment, and nuanced understanding, which are deemed indispensable even in an AI-driven educational landscape. Furthermore, the issue examines the concept of 'Fearing the Other', analyzing how AI might either perpetuate or alleviate deeply ingrained biases and fears within educational environments. Insights on the potential uses of AI to develop human and power skills like creativity, leadership, and teamwork are also discussed, highlighting their importance in the rapidly evolving educational sector.

This issue presents a range of interdisciplinary perspectives, shedding light on AI's diverse impacts across different academic disciplines. It challenges existing paradigms and encourages a reevaluation of the boundaries between human creativity and algorithmic precision. Readers are invited to critically engage with the content, reflecting on the broader implications for the future of education in an AI-enhanced world. The academic community is encouraged to navigate this new terrain with knowledge, guided by ethical considerations, and inspired by the boundless possibilities of collaboration between human and artificial intelligence.

In synthesizing these diverse perspectives, the issue aims to contribute to the academic discourse and impact practical AI implementations in educational settings globally. As we move forward, the insights from this issue should inform ongoing dialogues and initiatives, ensuring AI enhances educational outcomes while preserving the essential human interactions that underpin effective learning environments. The commitment to continuous inquiry and ethical consideration is pivotal as we collectively explore the future of education in an AI-augmented reality. This journey promises to transform educational landscapes while adhering to the values that define our humanity.

The first paper by Col. Mayer in this special issue addresses the critical need for higher education institutions to maintain a balance between cultivating human skills and enhancing AI literacy. Amidst a landscape increasingly influenced by artificial intelligence, the emphasis remains on the continuing importance of human skills such as creativity, critical thinking, and

ethical judgment, which are beyond AI's capability to replicate. The necessity for graduates to develop a foundational understanding of AI to stay competitive in the workforce is stressed, highlighting the dual need to preserve humanistic education while integrating technical competencies that meet evolving job market demands and the expanding role of AI in various professional sectors.

The second paper by Vosevich and Hutson explores the role of human creativity within the realm of generative AI, positing that human influence remains a subtle yet powerful force even in seemingly autonomous AI-generated content. This examination is crucial to understanding the philosophical concept of 'Absent Presence', especially in the arts and humanities. By drawing on examples from literature and art, such as Shakespeare's *The Winter's Tale* and Van Gogh's empty chair paintings, the paper argues for the indispensable value of human input in training AI models, highlighting the irreplaceable human touch in an era of digital replication and AI-driven creativity.

Building on the importance of human creativity, a case study by Lively demonstrates the practical application of this concept within the field of education. In a web design class, students utilize AI tools to create text, images, and code, adapting to dynamic changes in client requirements and emulating real-world scenarios. This approach not only showcases the adaptability and problem-solving required in today's digital workspace but also underscores the importance of maintaining human oversight over AI processes, reinforcing the human element in technology-driven domains.

Following this, Hutson offers an enlightening perspective on integrating neurodivergent individuals in the development and application of AI technologies within educational settings. The paper highlights the unique abilities that neurodivergent individuals bring to AI development, such as enhanced pattern recognition and innovative problem-solving, often overlooked in traditional training paradigms. This inclusion promotes a more ethical, inclusive, and effective use of AI in education, enriching its role and broadening inclusivity to reflect the true diversity of human intelligence.

Ghaith's paper addresses the significant role of AI in the preservation of cultural heritage, exploring how technologies like machine learning algorithms, digital twinning, and predictive maintenance can enhance the accuracy and efficiency of conservation efforts. However, it also acknowledges the ethical dilemmas these technologies pose, such as the risks of inauthentic restoration and the potential perpetuation of existing biases, advocating for a balanced approach that emphasizes the need to maintain the irreplaceable human element in these processes.

Ceballos and his team assess the effectiveness of MedMicroMaps, a digital tool designed to aid in the differential diagnosis of infectious diseases. This study, tested among second-year medical students, explores how multimedia resources like animations, illustrations, and case-based tutorials influence learning outcomes across various instructional settings. The research highlights the role of innovative educational technologies in enhancing medical education, particularly in adapting to changes brought about by the COVID-19 pandemic, and underscores



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the need for thoughtful alignment of these tools with teaching strategies to maximize their educational potential.

Lastly, Begemann's analysis delves into the integration of AI in video game development, tracing its evolution from philosophical musings to contemporary applications in game design through advanced algorithms like ChatGPT, Midjourney, and Stable Diffusion. The paper uses Marxism, Psychoanalysis, and Cultural Studies to explore the implications of AI in the game development pipeline, discussing how AI can democratize the creative process and potentially alter the labor structure within the industry. This discussion not only enhances understanding of AI's role in content creation but also stimulates ongoing dialogue on the need for ethical frameworks in the rapidly evolving digital landscape.

As we conclude this forward to the special issue, it is essential to reflect on the transformative journey that lies ahead in the realm of Human-AI Symbiosis within higher education. This issue brings together a diverse spectrum of perspective that explores the dynamics between GAI and human interaction within educational contexts. The topics covered in this issue range from the ethical implications and irreplaceable value of human skills to the philosophical considerations of AI as a partner and potential disruptor in educational paradigms. Each contribution meticulously examines different aspects of AI integration—from cultivating human and power skills to navigating the challenges posed by biases and the philosophy of 'Fearing the Other.' Such examinations are crucial as they provide scholarly insights that foster a deeper understanding of how AI can be harnessed to enhance educational outcomes while critically maintaining the human touch that is so vital to the learning process. The relevance of this special issue extends beyond academic discourse; it serves as a beacon for policymakers, educators, and technologists to collaboratively forge pathways that leverage AI's capabilities responsibly. The insights provided herein aim to inspire further research, encourage the development of innovative educational tools, and promote a balanced discourse on the ethical use of AI in education.

In synthesizing these diverse perspectives, this issue not only contributes to the academic landscape but also seeks to influence practical implementations of AI in educational settings globally. As we move forward, let us carry the knowledge and questions posed in this issue into our ongoing dialogues and developments, ensuring that AI serves as a catalyst for educational enhancement rather than a substitute for the genuine human connections that underpin effective learning environments. Thus, with a commitment to ongoing inquiry and ethical consideration, the contributions of this special issue invite readers to engage deeply, reflect critically, and envision the future of education in an AI-augmented world. Together, we embark on this continuing journey of exploration, poised to transform educational landscapes while upholding the values that define our humanity.



 

# Thriving in an AI-Dominated World: Why Higher Education Must Produce Graduates who are uniquely human and technically competent

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## Abstract

In an era where artificial intelligence (AI) increasingly influences various sectors, higher education institutions (HEIs) face the critical challenge of equipping graduates with both AI competencies and essential human skills. This article delves into the evolving job market landscape, highlighting the dual demand for technological prowess and uniquely human capabilities among employers. It advocates for educational strategies that integrate AI familiarity with the development of critical human skills, positioning such an approach as vital for preparing a future workforce capable of thriving in an AI-dominated environment. The discourse underscores the necessity for graduates to be both "uniquely human" and technically proficient, emphasizing that while employers prize soft skills like creativity, critical thinking, and collaboration—which AI cannot replicate—they also require graduates to be technologically adept to enhance job performance through AI tools. This dual competency is identified as crucial for career success in a dynamic, automated work context. Moreover, the article discusses educational methodologies that effectively incorporate AI tools without compromising the development of vital human skills, suggesting a balanced curriculum that fosters both sets of skills. Such a curriculum ensures that students are prepared to excel in a workforce where AI complements human capabilities. Recommendations for curriculum enhancements are provided to equip students with the necessary skills to navigate and excel in a future where AI and human collaboration are commonplace. This scholarly contribution outlines a roadmap for HEIs to recalibrate their program offerings, ensuring that graduates are well-prepared to enter a workforce where being technically adept and possessing robust human skills are both equally imperative, thus fostering a workforce that is not only proficient but also adaptable and innovative in an AI-driven world.

**Keywords:** *Artificial intelligence, Human skills, Higher education, Workforce preparation, Curriculum enhancement*

## 1. Introduction

Even though we live in a world increasingly reliant on technology, there are many indications that employers value human skills. This often cited by advocates of liberal arts education to demonstrate the employment-related relevance of studying the liberal arts, along with the other benefits of studying the liberal arts, and to defend the liberal arts at a time when liberal arts disciplines are being cut by many higher education institutions (HEI). On the other hand, we hear from technology advocates that artificial intelligence (AI) will soon be taking over many work-



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related tasks and transforming the characteristics of many jobs. Therefore, they argue, a key component of employability is a basic level of AI literacy. This creates a dilemma for HEIs: should they invest in developing their students' uniquely human skills or should they focus on preparing them to develop and work with AI. This debate, like others related to higher education, is based on a false dilemma. For the foreseeable future, AI will not be able to replicate uniquely human skills. This means that human skills are important, and HEIs should prioritize their development. It is also true that AI use will be widespread in the workplace. To prepare students for this environment, HEIs should ensure that students graduate having had some experience using AI tools. This article shares insights from employers and others on current needs in terms of employee skill sets as well as projections on what skills employees will need to thrive in the future of work. These insights demonstrate why HEIs will need to take a balanced approach when designing student experiences to ensure that they promote the development of human skills and skills associated with the use of AI tools.

**2. Scope of the article**

Higher education has many forms and fulfills many purposes. Higher education offerings can be online, in-person, or a combination of both, as well as synchronous or asynchronous. Educational programs include professional degrees, graduate degrees, bachelor's degrees, associate degrees, and certificate programs. All of these forms of higher education are valuable, and they are undertaken by people at different stages of life for different reasons.

Higher education also has many purposes. Robert Vischer, president of the University of St. Thomas, highlights one of the purposes of higher education that is often neglected. He writes: "higher education must also reclaim responsibility for the whole person, guiding and supporting our students as they prepare for meaningful, morally responsible lives" (Vischer, 2023). As Vischer points out, higher education should foster the holistic development of students as humans and as citizens. Another purpose of higher education is to prepare students for employment, and Vischer also recognizes this need when he writes that a role of colleges and universities is "to prepare our students for the workforce as efficiently as possible" (Vischer). Preparing students for employment aligns with survey results that identify student motivation for pursuing higher education. The 2023 National Alumni Career Mobility Annual Report lists "career success" as the top motivation for students pursuing degrees (59%) followed closely by "intellectual development" (55%) with "required for my career aspirations" (41%), and "financial gain" (39%) as other top motivations (Lightcast, 2023).

This article will focus on bachelor's degree programs and why they must incorporate the development of human skills and familiarity with AI to prepare students to succeed in the workforce. One reason for focusing on the bachelor's degree is that despite the increasing popularity of skills-based hiring, a report from Georgetown's Center on Education and the Workforce, After Everything: Projections of Jobs, Education, and Training Requirements

through 2031, projects that in 2031, 42% of jobs will require a bachelor's degree or higher (Carnevale et al, 2023). The ideas in this article, however, will be relevant to other forms of higher education and other purposes. For example, it is possible to infuse the development of human skills or AI familiarization in all levels of education. Also, many of the attributes relevant to employability are also essential for navigating the world as a member of a community and to live, as Vischer proposes, "meaningful, morally responsible lives" (Vischer, 2023). Human skills are essential for interacting with neighbors and other community members, and we use AI applications frequently in our personal lives.

**3. Employer demand for human skills**

Despite the increased use of technology in the workplace, employers continue to seek applicants with human skills. Human skills, also called soft skills, durable skills, and power skills, are uniquely human skills, unable to be replicated by technology, which are essential to performing work-related tasks. Studies and surveys of employers consistently identify human skills as necessary for success in the workforce, even for jobs with primary responsibilities related to technology. In "Shifting Skills, Moving Targets, and Remaking the Workforce," it is noted that "Digital jobs don't just demand programming skills. These technical jobs now demand a balance of soft skills as well" (Sigelman, 2022). The report, which scans millions of job advertisements every day, lists teamwork, collaboration, communication skills, problem solving, and creativity as human skills required for digital jobs such as mobile application developers, web developers, computer programmers, UI/UX designers/developers, and computer specialists (Sigelman, 2022). This is counter to the view that those who occupy these roles do not interact with others and focus on just the technical aspects of their work. In addition to technical expertise, these technical roles require human skills.

Many of the human skills listed in the Shifting Skills report were also identified by employers as important in the Association of American Colleges & Universities (AAC&U) report, "How College Contributes to Workforce Success: Employer Views on What Matters Most." Ninety-three percent of employers in the AAC&U survey rate the ability to work effectively in teams as very important or important, 95% rate critical thinking skills as very important or important, 93% rate ethical judgment and reasoning as very important or important, and 92% rate creative thinking as very important or important. In terms of communication, 90% rate the ability to communicate through writing as very important or important, 93% rate the ability to communicate through speaking and presentation skills as very important or important, and 89% rate the ability to communicate/work with people from different cultural backgrounds as very important or important (AAC&U, 2021). While it is often reported that technical skills enhance employability, employers are also seeking applicants with human skills.

The two reports above highlight current demand for human skills, but it is also projected that human skills will remain in high demand for the foreseeable future. In the "After Everything:



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Projections of Jobs, Education, and Training Requirements through 2031," it is noted that: "The skills most needed in the decentralized and distributed workplace of the future are the high-level cognitive skills most often learned in postsecondary education and training" (Carnevale et al, 2023). These high-level cognitive skills, which overlap with lists of human skills and include strategic thinking, creativity, and interacting with others, will be important to accomplishing the missions of organizations of the future due to their decentralized and distributed structures. The report notes: "Jobs that rely heavily on interpersonal skills—such as education and personal care jobs—or jobs that require a high degree of creativity are at the lowest risk from automation. Musicians, artists, and dancers are examples of jobs that require creativity, but creativity is also found in jobs that require broad strategic thinking" (Carnevale et al, 2023). Even with projections of advancing technological capabilities, creativity, an essential human skill, is likely to be more important than ever.

In another report focused on the future of work and informed by a survey of 18,000 people in 15 countries, researchers propose: "The need for manual and physical skills, as well as basic cognitive ones, will decline, but demand for technological, social and emotional, and higher cognitive skills will grow" (Dondi et al, 2021). This is because technology will be able to perform many of the manual and physical tasks that humans perform now, and it will also be able to perform tasks requiring basic cognitive skills such as scheduling, responding to basic customer requests, and even summarizing documents. What will be in demand from employers will be higher cognitive skills such as "creativity, critical thinking, decision making, and complex information processing" (Dondi et al, 2021). The report offers the following advice to job seekers: "in a labor market that is more automated, digital, and dynamic, all citizens will benefit from having a set of foundational skills that help them fulfill the following three criteria, no matter the sector in which they work or their occupation: add value beyond what can be done by automated systems and intelligent machines, operate in a digital environment, [and] continually adapt to new ways of working and new occupations" (Dondi et al, 2021).

The foundational skills mentioned in the McKinsey report are divided into four categories: cognitive, interpersonal, self-leadership, and digital. The first three categories are comprised mostly of human skills, but human skills are also included in the digital category (i.e., digital ethics and digital collaboration). In the cognitive category, some of the skills listed are "structured problem solving, logical reasoning, understanding biases, storytelling and public speaking, creativity and imagination, and adopting a different perspective." The interpersonal category includes "empathy, humility, resolving conflicts, and collaboration." The self-leadership category includes "self-control and regulation, driving change and innovation, and coping with uncertainty" (Dondi et al, 2021). It is interesting to note that a report focused on the future of work places so much emphasis on human skills of the type that undergraduate degree programs are designed to develop.



 

Human skills enable people to perform activities and complete tasks that technology is unable to complete. Multiple reports suggest that human skills are important in the present and will continue to be important in the future, which means that they should be embedded in bachelor's degree programs and other educational programs. As much as the continued importance of human skills is a reason to cheer for advocates of the liberal arts, this not enough to ensure success for students in the current or future workplace. Students will also need to be technically competent. An article from the Quality Assurance Commons captures this need well: "Employability skills will evolve to encompass a blend of technical and soft skills that enable individuals to work effectively alongside AI, leverage its capabilities, and contribute value in areas where human traits and judgment are essential" (Quality Assurance Commons, 2023). To thrive in the workforce, students will need to possess both human skills, which allow them to perform tasks that technology is unable to perform, as well as technical skills that enable them to leverage AI to improve their efficiency and effectiveness. The next section highlights the importance employers place on technical skills.

**4. Employer Demand for Technical Skills**

It is not surprising that technical skills are important, yet they are not important in the way that many think. There is some debate regarding whether everyone needs to know how to code, but where there is consensus is that people will need to know how to work with AI. The title of an article by Karim Lakhani, "AI Won't Replace Humans — But Humans With AI Will Replace Humans Without AI," reflects the relationship between workers and technology that will be most common as people who use AI will be much more efficient and effective than those who do not. In many ways this resembles knowledge of how to use a web browser and the internet in the way that it helped enhance human capabilities, but it is different in significant ways. AI will be integrated into how we work and will be used to complete some tasks on its own and assist with others. AI will be a tool that we work with rather than as a resource, which is how we have used the internet. Like internet use, however, AI use will be widespread across many types of jobs. Lakhani recognizes this point when he writes that, "You need to understand the machine learning stuff and the AI stuff, not because you're going to become an AI engineer or an AI scientist, but because that is now going to be a critical table stakes for you to understand how business works" (Lakhani, 2023). This requirement goes beyond those seeking MBAs, as he was referring to in his article, but also for most who will be entering the workforce over the next decade, as suggested by employer views described below.

Because of AI's ability to perform many routine tasks, employers are now prioritizing human skills with 59% responding in a 2023 Cengage Group Employability Survey that, "the growth of AI has prompted them to prioritize different skills when hiring, with 66% saying they are now looking for 'uniquely human' skills" (Cengage Group, 2023). But employers also express the need for employees who are able to use AI as a tool in the workplace with 79% of employers in the same survey responding that, "employees could benefit from training on working alongside



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AI and other new technologies in their current roles" (Cengage Group, 2023). What this survey demonstrates is that human skills are important given that AI will be used to complete routine tasks, but that employers also value the ability to work with AI. Recent graduates also recognize this need as the same survey shows that 52% of recent graduates question how prepared they are for the workforce due to AI, and 65% are eager for "training on working alongside AI" (Cengage Group, 2023). Both employers and recent graduates recognize the importance of being able to work with AI.

Although they value the ability to work with AI, employers note a gap in what they need and the skillsets their teams possess. A Multiverse survey of business leaders found that 45% identified AI "as their most significant skill gap (Multiverse, 2023)," and 49% percent think that this skill gap will have a very negative or somewhat negative impact on their business (Multiverse, 2023). To address this gap, employers will need to establish training in their organizations, but it would also help if students were familiar with and had used AI tools when they enter the workforce. This will give them an advantage when seeking employment and will allow them and their organizations to be more successful as 69% of leaders surveyed believe that AI will increase workplace productivity and enhance the customer experience, and 68% believe that AI will improve decision-making and business strategies (Metaverse, 2023). Because of the expected benefits of AI use, organizations that do not effectively use it will be left behind. The same can be said for employees who are not able to effectively use AI.

Current job advertisements demonstrate the benefit of having experience using AI tools. An evaluation of job postings on Linkedin found that "LinkedIn job posts that mention AI or GAI have seen 17% greater application growth over the past two years than job posts with no such mentions" (Linkedin, 2023). The Linkedin report also found "74% of executives believing that GAI [generative AI] will benefit their employees, and 47% of professionals globally believing that AI will help them move their careers forward by providing faster access to knowledge and insights" (Linkedin, 2023). The importance of broader digital skills is reflected in the Shifting Skills Moving Targets report, which was mentioned in the previous section. It highlights the importance of digital skills for nondigital occupations that traditionally would have relied mostly on human skills. These occupations include advertising sales representative, merchandiser, financial services sales agent, insurance sales agent, and marketing assistant/associate (Sigelman et al, 2022). This suggests that many jobs will require at least basic digital skills, especially skills associated with AI use. The AAC&U survey also provides support for this view as it shows that 91% of employers view digital literacy as very important or somewhat important for college graduates they seek to hire (AAC&U, 2021). In fact, the report notes that between 2018 and 2020 digital literacy became one of the top five outcomes ranked by employers, demonstrating the increasing importance of ensuring graduates possess the skills to use digital tools. What is apparent is that both human skills and technical skills are very important in the current job market.

Despite the clear benefits of AI, there also concerns. A survey from portal26, State of Generative AI 2023, found that while 82% of C-suite and tech leaders believe generative AI will give them a competitive advantage, 73% have already had generative AI misuse incidents. Additionally, while 84% of these leaders have already invested in generative AI, or plan to do so, 85% have concerns about privacy and security associated with generative AI use (portal26, 2023). Having experience using AI in their course of study will strengthen students' employability and will allow them to help employers use AI tools to benefit their organizations while also mitigating the risks associated with using these tools, especially the ethical risks.

There are also indications that being able to use AI and other digital skills will be important in the future. In looking out to 2030 to consider the characteristics of the future of work, a McKinsey study shows the potential impact of growth in generative AI: "Workers will need to gain proficiency with these tools and, importantly, use the time that is freed up to focus on higher-value activities. When managers automate more of their administrative and reporting tasks, for example, they can spend more time on strategic thinking and coaching. Similarly, researchers could speed up projects by relying on automation tools to sort and synthesize large data sets" (Ellingrud et al, 2023). This points to the need to produce graduates who have human skills related to thinking and interacting with others, but who are also able to create additional time to employ these skills by using AI to automate the completion of certain tasks and support project completion. Employees will only have these additional opportunities to employ human skills if they are able to use AI. The McKinsey report also predicts that AI and other forms of automation will enable greater productivity. It notes that generative AI "has the potential to increase US labor productivity by 0.5 to 0.9 percentage points annually through 2030" and that "[a]ll types of automation could help drive US productivity growth to 3 to 4 percent annually" (Ellingrud et al, 2023). To achieve the promise of greater productivity, organizations will need teams and will seek job applicants who have the skills to employ AI and other technology.

The current and future job market requirements to use AI and other technologies are why the QA Commons considers digital literacy to be one of the eight essential employability qualities that "ensure a learner's preparedness for educational attainment, greater economic mobility, and prosperity - regardless of industry or discipline" (QA Commons, 2022). It defines digital literacy as follows:

- "Possessing the ability to use various digital platforms and applications aligned to job functions"
- "Displaying the ability to use digital platforms and applications to find, evaluate, create, and communicate information"
- "Responsibly using digital platforms and applications for their intended use and protection of private information" (QA Commons, 2022).



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To strengthen their students' employability, HEIs should have a type of developmental goal that addresses digital skills, especially AI-related skills.

**5. What does this mean for higher education institutions?**

The feedback from employers about current and future skill requirements is good news for those who advocate for the importance of human skills. Human skills are essential now and will remain so in the future, but this is not an either/or situation; it is a both/and situation. Skills related to AI, and the digital skill set of which they are part, are also important, even for non-technical jobs. This means that the graduate of the future needs to have a solid foundation of both human skills and technical skills to strengthen their employability and enable their success in the workforce. This advice to lawyers illustrates the balanced development that those entering the workforce require: "while AI may reduce demand for some junior lawyer positions, the legal profession involves complex reasoning and relationship-building that human experts still excel at. So rather than avoid law altogether, future lawyers should utilize AI tools while focusing on the uniquely human aspects like advocacy and negotiation that machines can't replicate" (Minevich, 2023).

Many HEIs currently have learning outcomes that resemble the types of human skills that employers are seeking and are attempting to develop in their teams. To more closely align current learning outcomes with human skills related to employability, HEIs and employers should communicate frequently through direct contact and through advisory boards at the institutional and program levels. This communication may lead to some refinements in learning outcomes, the way that courses are designed to help students achieve the learning outcomes, and the way students' levels of learning outcome attainment are assessed. Human skills should also be developed and assessed outside of the classroom when students participate in internships and other activities. This will provide students with experience employing human skills in non-academic environments that often are more like the work-related and personal contexts in which they will employ their human skills after they complete their degrees. Finally, an HEI should have common definitions of human skills so that its faculty, staff, and those who sponsor students in internships and other activities are all seeking to develop and assess students in similar ways. These common definitions should also be made available to students so they can share with employers how they have developed by completing their programs.

HEIs also need to promote familiarization with AI and other technologies to prepare graduates for work and life. How this is done is important as Leo Lo explains why we must be careful that teaching students to use AI does not undermine the development of human skills: "Future employers will expect graduates to utilize AI tools intelligently and responsibly, making AI literacy an essential skill for the workforce. Unchecked use of generative AI tools may produce a generation of graduates lacking vital critical thinking and writing skills, leaving them ill-equipped for professional environments that demand adaptability and innovation" (Lo, 2023). To



 

review and revise a document produced by generative AI, students must understand how to write and think critically and creatively. If not, they will rely solely on generative AI to produce a product, which may be deficient, and they will not develop the human skills needed to excel in the workforce. Maintaining this balance while prioritizing and promoting the development of human skills and AI-related skills will be both a challenge and opportunity for HEIs over the next decade. How this is done will vary by institution and education level, but it is important that HEIs make it a priority.



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# Absent Presence: The Human Influence in AI-Generated Content in the Age of Technoculture

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## Abstract

In recent years, the field of artificial intelligence (AI), particularly under the banner of generative AI (GAI), has made unprecedented advancements, pushing the boundaries of what was traditionally considered within the realm of human capability. AI systems have not only matched but also surpassed human proficiency in various tasks, sparking widespread discussions about their significant impact across multiple fields, including the arts and humanities. This paper considers the profound implications of AI's rapid progress and explores the concept of "Absent Presence" within the context of Derrida and Technoculture, particularly as illustrated in the arts and humanities. Drawing parallels with renowned literary and artistic works, such as Shakespeare's *Winter's Tale*, Sidney's *Astrophil and Stella*, and Lady Mary Wroth's *Urania*, the theme of absence and presence is examined in how the human actor is present even while absent, thus providing a metaphor to understand the role of human creativity in AI-generated content. Additionally, we consider the iconic empty chair paintings by Van Gogh as visual manifestation of human presence communicated without representing them. Furthermore, recent studies have unveiled the phenomenon known as Model Autophagy Disorder (MAD), highlighting the pivotal role of high-quality human-created content in AI training, as opposed to derivative AI-generated material. This discovery underscores the necessity of human input even in an era of AI-generated content, where an "Absent Presence" threads through the digital content. In this investigation, the discussion centers on the significant impact of human involvement within the realms of AI applications, even when such presence appears ostensibly absent. By examining this phenomenon through the arts and humanities perspective, the analysis brings to light the capacity for altering the terrain of innovation, understanding, and cooperation between humans and machines in these fields. The exploration emphasizes the intrinsic human element that pervades AI-driven environments, suggesting a reconfiguration of the creative, interpretive, and collaborative processes in these domains.

**Keywords:** *AI, Absent Presence, Technoculture, Generative AI, Human Creativity*

## 1. Introduction

In recent years, the field of artificial intelligence (AI) has experienced a remarkable transformation, showcasing exponential growth in capabilities that have significantly impacted global perceptions and applications. While AI has been evolving since 2015, the stable launch of ChatGPT in November 2022 heralded a new era in generative tools (Fui-Hoon Nah et al., 2023). Day by day, these GAI algorithms and models are advancing in areas once thought to be the exclusive domain of human expertise (Inkpen et al., 2023). Tasks such as reading comprehension, speech recognition, and image identification are now performed by AI with a proficiency that often surpasses that of humans (Rajest et al., 2023). The rapid advancement in generative technology has sparked many discussions about its potential impact on various aspects of human life, including education, industry, and social interactions (Babaniyazovich, 2023; Obaigbena et al., 2024; Rathore, 2023).

The astonishing progress of AI begs the question: What does the future hold when machines can outperform humans in increasingly complex tasks? As we stand on the precipice of an era where AI systems can not only mimic but excel in human-like tasks, concerns and uncertainties about the role of AI in our lives are becoming ever more pronounced (Berretta et al., 2023; Khogali & Mekid, 2023). What implications will this have for the job market, education, and the very fabric of our society? How will AI reshape the way we interact, learn, and create? Recent developments in AI have overturned previous predictive models of its evolution, casting new doubts and concerns on what was once considered understood. This shift has injected a renewed sense of anxiety and uncertainty into discussions previously outlined in studies like the AI100 2021 report (Mellamphy, 2021).

While these questions are warranted and have even led to rebuttals that verge on human exceptionalism, the role of humans in the Fifth Industrial Revolution is ensured (Pedersen, 2024). In fact, when exploring this brave new world of AI, it is imperative to consider the concept of "Absent Presence" within the context of Derrida and Technoculture (Sahay, 1997). Just as the *Winter's Tale* of Shakespeare evokes the notion of an absent figure with a lingering agency, and the empty chairs of Van Gogh speak volumes about the presence of absence, AI, too, possesses an intriguing duality. Despite its remarkable ability to generate content autonomously, such as the text produced by ChatGPT, there exists a subtle but profound thread of human influence that weaves through AI-created content—a presence that is seemingly absent but undeniably impactful.

As such, this paper will consider the rapid strides made by AI, the concerns surrounding its omnipresence, and the philosophical underpinnings of Absent Presence in the age of AI. Drawing parallels with literary and artistic expressions of absence, we will navigate the intricate interplay between human creativity and the ever-advancing capabilities of AI, exploring the delicate balance between the two in our evolving technocultural landscape. Recent studies have shed light on a phenomenon known as Model Autophagy Disorder (MAD), which underscores the critical importance of training AI on high-quality human-created content rather than derivative AI-generated material. Through this exploration, we aim to shed light on the profound



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implications of AI's Absent Presence and its role in shaping the future of human interaction, creativity, and existence.

## 2. Absent Presence: Literary and Artistic Devices

"Absent Presence" is a nuanced concept that refers to the idea that even when a person or entity is physically absent from a particular space or situation, their influence, impact, or essence continues to be perceptible or felt (Greer, 2014). It suggests that the absence of a physical presence does not equate to a complete lack of influence or significance (Walsh, 1998). In the realms of literature and art, the theme has been deftly explored through a myriad of devices and conceits (Spikes, 1992). Such examples can be gleaned from various works, including Shakespeare's *Winter's Tale*, Sidney's *Astrophil and Stella*, and Lady Mary Wroth's *Urania*, where the human actor is present even in their absence. (Note that portions of the Shakespeare and Sidney content were first printed in *The Rhetoric of Shakespeare's Women: Figures, Sense, and Structure*, diss. by Kathi Ann Vosevich, 1988.) Additionally, we shall consider Vincent van Gogh's iconic empty chair paintings, which serve as visual manifestations of human presence communicated without the direct representation of the human form.

In Shakespeare's *Winter's Tale*, the theme of absence and presence is poignantly explored through the character of Hermione. Despite her apparent absence due to a false death, her influence is acutely felt throughout the play. Instead of relying on what may be termed "vocal" or verbal rhetoric, Shakespeare relies on "nonvocal" or nonverbal rhetoric. By this, I mean that Hermione's "dialogue" with both her husband Leontes and the audience continues after her apparent death: her silence speaks, as it were. She is an absent presence. In other words, her absence creates a palpable tension as the audience and characters are not aware of her continued existence until the last act. Through this rhetorical device of *negatio* (a refusal to speak) Shakespeare masterfully highlights the impact of her agency, even in her physical absence.

This idea of absent presence was not unknown in the Renaissance. *Astrophil and Stella* (probably composed in the 1580s), Sir Philip Sidney's sonnet sequence delves into the complexities of love and desire. Within this context, the theme of "Absent Presence" is masterfully and literally depicted through Astrophil's unrequited love for Stella in *Sonnet 106*: "Oh absent presence, Stella is not here." Despite her physical absence, her presence lingers in Astrophil's woeful feeling. Thoughts of Stella stay with him when she is gone, and nothing can erase her picture in his mind. This theme in Sidney's sonnets accentuates the paradoxical coexistence of absence and presence, revealing how Stella's influence remains in Astrophil's heart.

Sidney's niece and first female writer of prose fiction in English, Lady Mary Wroth, wrote an enormous romance entitled *Urania* (published in 1621), as well as a sonnet sequence as an appendix to her novel from the perspective of the woman, entitled *Pamphilia to Amphilanthus*. Amphilanthus is absent from the sequence (aside from being mentioned in the title and in his



 

presence in that the poems are written *to* him). This interplay between the absent figure and consequent melancholy of Pamphilia who longs for him underscores the enduring impact of his human agency, even in a world devoid of his physical presence. To quote Walter Ong, S.J., in *The Barbarian Within* (1962), absence thus both builds up barriers to communication and tears down the same barriers through communications, since these barriers "tease us to more vigorous attempts, sharper alertness, greater efforts at compassion or sympathy." In sum, the literary tradition where absence evokes presence has been well-demonstrated.

Similarly, the visual arts also demonstrate the potent nature of absence and the agency of individuals regardless of their physical presence. For instance, Vincent van Gogh's iconic series of empty chair paintings (as evinced in Figure 1) provide a visual manifestation of the concept, and have been extensively studied (Blum, 1956; Jardine & Batycky, 2015; Springer, 2001; Székely, 1982). Through these works, van Gogh conveys the profound impact of human presence even when the figure itself is absent. The empty chairs serve as placeholders for human interaction, bearing the imprints of the absent sitter. The use of color, texture, and composition in these paintings evokes a sense of longing and nostalgia, emphasizing the enduring significance of human agency in the spaces they occupy.



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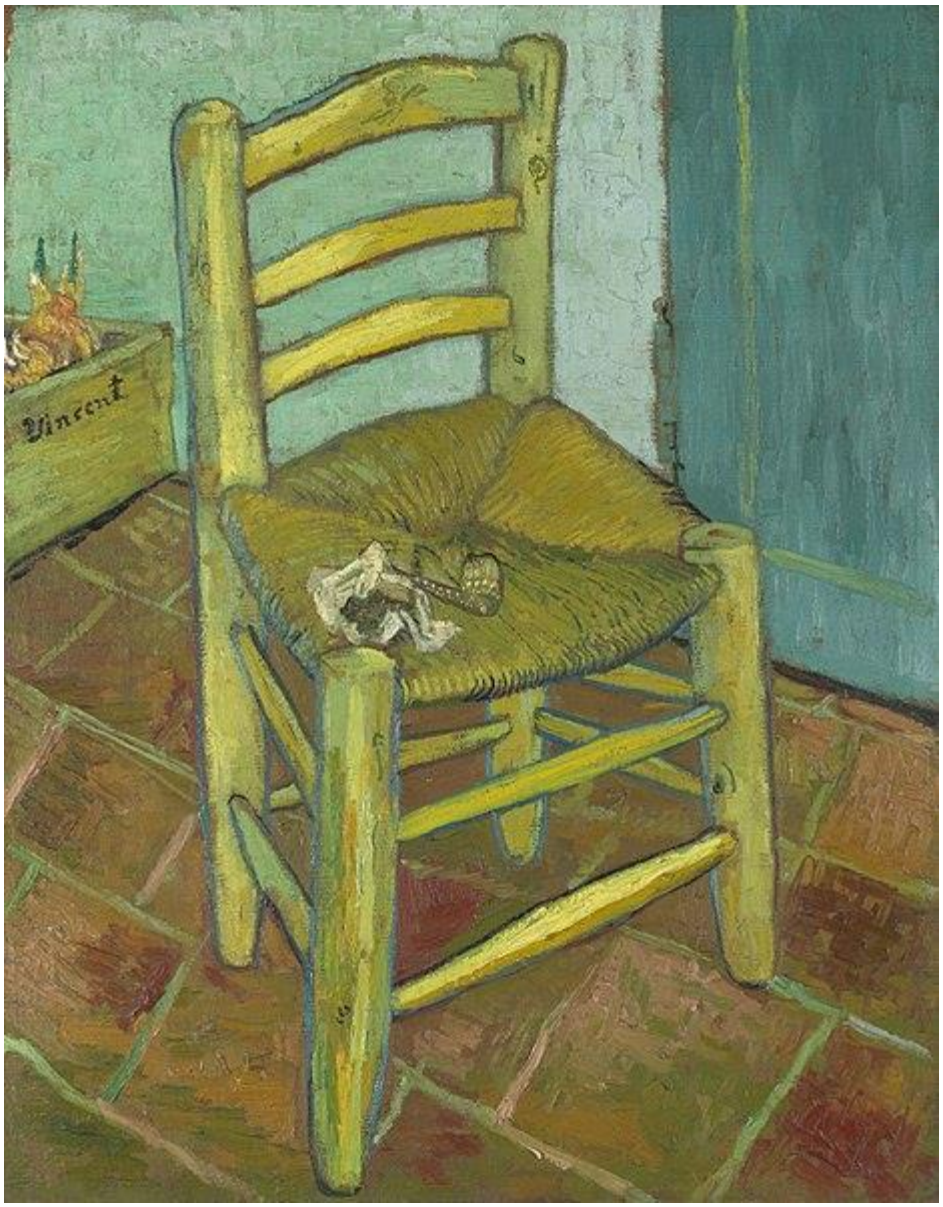


**Figure 1- Vincent van Gogh, *Chair*, 1888. Public Domain.**

In these literary and artistic works, the theme of Absent Presence is eloquently communicated through a rich diversity of devices and conceits. Whether through dramatic irony, rhetorical language, melancholy longing, or visual symbolism, these artists illuminate the enduring influence of humanity, of human agency, even in the absence of the physical self. These examples serve as poignant reminders that the human presence, though seemingly absent, leaves an indelible mark on the canvas of existence—just as with AI.

### 3. Human-Created Content in Training Models

In the realm of artificial intelligence (AI), particularly in the development of Large Language Models (LLM) and art generators, the concept of "Absent Presence" takes on a distinctive



 

dimension. It becomes evident that AI, despite its remarkable capabilities, relies heavily on the foundation laid by human-created content for the generation of high-quality output (Mondal et al., 2024). LLMs, such as ChatGPT by OpenAI, are trained on vast datasets that encompass a wide spectrum of human knowledge, language, and culture (Pawade et al., 2024). These datasets comprise texts, documents, literature, and conversations created by humans over centuries. In essence, these models inherit and build upon the collective wisdom and creativity of humanity. The very existence of these models is a testament to the enduring presence of human contributions in the world of AI (Chakrabarty et al., 2024). Thus, while AI, including LLM and art generators, can generate new content, remix existing material, and offer fresh interpretations, it is essential to recognize that this creativity is rooted in the input, source material, and data it has been trained on. AI acts as a tool that extends the reach of human creativity but does not replace it. In this context, the notion of Absent Presence becomes apparent. AI becomes a conduit through which the human creative spirit continues to shape and evolve.

Recent research, as highlighted by Yang (2024), has shed light on a phenomenon termed Model Autophagy Disorder (MAD). This disorder occurs when AI-generated content is continuously fed back into AI models for training, resulting in a decline in output quality and diversity. It suggests that without a steady supply of fresh, real data sourced from original human work, rather than AI-generated content, generative models may suffer from degradation in precision and recall. This underscores the critical role of human input and creativity in ensuring the continued excellence of AI-generated content. As well, the interconnectedness of AI-synthesized content within the AI ecosystem is evident in datasets like LAION-5B, used in training text-to-image models. This dataset contains synthetic images sampled from earlier generations of generative models, emphasizing how AI-generated content builds upon itself. However, the quality and diversity of this content are directly influenced by the quality and diversity of the original human-created data (Schumann et al., 2024).

As AI-generated content becomes more prevalent in various domains, including education, industry, and social life, the question arises: What happens when AI models start training on AI-generated data rather than primarily human-generated content? Shumailov and his team (2023) have looked into this issue and found that training models using AI-generated content can lead to irreversible defects, known as "model collapse." This phenomenon occurs as models forget the true underlying data distribution over time, ultimately generating content with increased errors and reduced variety. It highlights the irreplaceable role of original human-generated data in maintaining the quality and diversity of AI-generated content. Therefore, the presence of humans, even when seemingly absent from agency in the creative process in the context of AI-generated content underscores the enduring influence of human creativity and input. AI, while a powerful tool, relies on the rich diversity of human-created content for its foundation. As AI continues to advance and shape various aspects of our lives, the presence of humanity remains palpable, even in seemingly automated content output.



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## 4. Conclusion

In the ever-evolving landscape of technology and generative artificial intelligence, the concept of "Absent Presence" serves as a profound reminder that the human essence and influence will always be an integral part of content consumed by humans. While AI continues to advance and amaze with its capabilities, it is essential to acknowledge that its prowess is built upon the foundation of human creativity, knowledge, and ingenuity. As noted in the context of AI-generated content, from Large Language Models (LLMs) to art generators, the presence of humanity even while seemingly absent is strikingly evident. AI depends on the vast reservoir of human-created content for its training and inspiration. It serves as a tool that extends and amplifies human creativity rather than replacing it. The enduring impact of human agency can be perceived in the very essence of AI-generated output.

However, the concept of "Absent Presence" also carries a note of caution. Recent research has highlighted the importance of maintaining a steady supply of high-quality human-created data to prevent "Model Autophagy Disorder" and "model collapse" in AI. These findings emphasize that while AI can create and innovate, it thrives when nourished by the richness of human input and originality. The concept under investigation is a testament to the enduring legacy of humanity in the world of AI and technology. It assures us that even as AI continues to advance, the human touch, creativity, and intellect will remain an intrinsic part of the content that enriches our lives. It underscores the symbiotic relationship between human ingenuity and technological progress, ensuring that the human spirit will always be present in the content that resonates with us.



 

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# Leveraging Human-in-the-Loop Engagement Through AI in Web Design Education: A Case Study on Adapting to Dynamic Client Requirements

Jason Lively, Independent Scholar

## ABSTRACT

The integration of Artificial Intelligence (AI) within educational frameworks, particularly in disciplines such as web design and development, represents a significant evolution in pedagogical strategies. This article examines a unique educational setup where students, while engaging in a web design class, utilize AI tools for text, image, and code creation within a simulated real-world scenario involving a client—dubbed "Chef Cookie Cutter". This simulated client interaction introduces unpredictability through mid-assignment requirement changes, thereby mimicking the dynamic nature of real-world web development projects. The focus of this case study is the critical role of human-in-the-loop (HITL) engagement in AI-assisted assignments, where students' adaptability, creativity, and problem-solving skills are put to the test. Such engagement not only prepares students for the intricacies and challenges of their future professions but also emphasizes the importance of human oversight in AI-driven processes. By incorporating generative AI, video avatars, and personalized learning mechanisms, this educational approach fosters a rich, interactive learning environment that enhances digital pedagogy. The findings suggest that integrating HITL in AI assignments significantly improves learning outcomes by fostering an adaptive learning environment that closely mirrors the complexities and demands of the industry, thereby preparing students more effectively for their future careers.

**Keywords**: *Human-in-the-loop, AI-assisted web design, Dynamic client requirements, Educational pedagogy, Adaptive learning environment*

## 1. Introduction

The ascent of generative artificial intelligence (AI) tools, including but not limited to Stable Diffusion and Lensa.ai, has not only captivated social media users but also propelled these technologies into the mainstream, marking a significant milestone in their adoption (DelSignore, 2022). Despite this widespread popularity, a segment of traditional artists and designers has articulated a staunch opposition towards the integration of AI in the realm of art creation. Their concerns primarily revolve around issues of copyright infringement and the perceived erosion of artistic merit, a stance supported by various scholarly contributions (Ansari, 2022; Murphy, 2022; Hazucha, 2022). Furthermore, the legal landscape concerning AI-generated artworks has been fraught with complexities, as evidenced by recent judicial precedents. Notably, a decisive ruling by the U.S. Copyright Office on February 21, 2023, underscored these challenges. In this case, copyright protection was granted solely to the textual content and its organization within Kris Kashtanova's comic book, Zarya of the Dawn, which was illustrated via the text-to-image



 

AI program Midjourney. The AI-generated imagery, however, was deliberately excluded from copyright protection. This decision catalyzes a broader discourse on the implications of AI in artistic and creative processes, questioning the delineation between AI contributions and human creativity (Ford, 2023).

As the development and accessibility of artificial intelligence (AI) technologies advance, the academic realm has encountered escalating concerns regarding the potential for widespread plagiarism, igniting debates over the appropriateness of AI's incorporation into higher education settings (Francke & Alexander, 2019; Sherry, 2022). Despite these apprehensions, the impending arrival of Web 3.0 and 6G technologies heralds a new era for the internet, promising enhancements in processing capabilities and the introduction of sophisticated 3D generative technologies. Such advancements underscore the necessity of integrating AI into educational curricula, particularly to equip students with the requisite skills for navigating the future landscapes of web design, development, and user interface/user experience (UI/UX) design. Nonetheless, there persists a notable reluctance within the academic community to delve into the practical applications and delineate best practices for the incorporation of AI into coursework. The discourse has predominantly concentrated on the theoretical and aesthetic ramifications of AI's disruptive potential, with insufficient attention to its pragmatic benefits (Ajani, 2022). Ajani's exploration into the nuances of human authorship within AI-generated content brings to the fore a debate on the essence of "art," oscillating between the dichotomy of technique expression and sentiment display (p.253). Consequently, dialogues have predominantly focused on the intrinsic value of "art" in encapsulating the human experience as opposed to showcasing technical virtuosity (Rosenberg, 1983; Mulholland, 2022).

The assessment of artificial intelligence (AI) and non-fungible tokens (NFTs) within the art domain continues to provoke diverse opinions, underscoring the ongoing discourse regarding their value and impact (Zhang & Yang, 2021; Wellner, 2022). Despite these debates, the undeniable influence of AI on the creative endeavors of contemporary artists stands as a testament to the technology's disruptive potential (Slotte Dufva, 2023). AI-driven art generators are empowering artists by offering novel solutions and enhancements to their creative processes. These innovations range from the provision of new color schemes and compositions to the instigation of unique forms of inspiration and the facilitation of iterative creative methodologies (Compton, 2022). Nonetheless, the full spectrum of these applications remains underexplored, with scholarly and methodological frameworks for the analysis of AI-generated art still in their infancy. Furthermore, the implications of generative AI technologies for the fields of web design and development warrant more comprehensive scrutiny. There exists speculation that traditional coding practices may become obsolete, replaced by more intuitive interfaces such as drag-and-drop functionalities for website construction. Despite these advancements, the requisite for human expertise remains paramount, particularly in refining AI-generated content and ensuring the operational integrity of websites (Anonymous, 2023). Consequently, the ongoing evolution of AI poses critical questions regarding the necessity of traditional websites in the future,



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highlighting AI's pivotal role in redefining the parameters of the fine arts and creative processes at large.

In the context of the evolving landscape of web design and development education, new educational approaches are needed. As such, the Restaurant Project assignment under discussion here serves as an exemplary model for integrating AI into academic curricula. This model not only facilitates direct engagement with cutting-edge AI tools but also emphasizes the indispensable role of human creativity and oversight in the development process. The crux of this assignment—a project that tasks students with creating a website using AI for text, image, and code generation—underscores the practical applications and potential of AI in real-world scenarios. By introducing a simulated client, "Chef Cookie Cutter," who mid-way alters the project requirements, the assignment simulates the dynamic and often unpredictable nature of real-world web design projects, thus preparing students for the complexities and challenges inherent in their future professions.

This pedagogical approach, grounded in the principles of human-in-the-loop (HITL) engagement, accentuates the synergistic relationship between human ingenuity and AI capabilities. It highlights that while AI can offer innovative solutions, human expertise is paramount for navigating the nuances of client interaction, interpreting evolving project requirements, and making critical design decisions. This synergy between human creativity and AI-driven efficiency enables the creation of web designs that are not only technically sound but also aesthetically pleasing and user-friendly.

Moreover, by exposing students to the iterative process of design and development, influenced by both technological advancements and client feedback, the assignment fosters a holistic understanding of the web design profession. It encourages students to view AI tools not as replacements but as collaborators that augment their creative process. This paradigm shift towards a collaborative model of human-AI interaction prepares students for a future where technological literacy and creative problem-solving skills are equally valued.

The assignment exemplifies a forward-thinking educational strategy that prepares students for the complexities of the web design and development industry. By balancing the innovative potential of AI with the critical need for human creativity and interaction, it offers a comprehensive framework for understanding and leveraging AI in web design and development coursework. This balance ensures that students are not only proficient in utilizing AI tools but are also adept at integrating these tools within the creative process, thus fostering a new generation of web designers and developers who are equipped to navigate the challenges and opportunities presented by the integration of AI in their field.

## 2. Literature Review



 

The integration of generative artificial intelligence (AI) tools within the realm of contemporary art has ignited a fervent discourse concerning the legitimacy of AI-generated artworks and their ramifications on conventional artistic practices (Bonadio & Lucchi, 2019; Zhang & Lui, 2021). Such a paradigmatic shift towards the embrace of generative AI outputs has concurrently fostered poststructuralist inquiries into the essence of artistic identity and the materiality of art objects (Anderson, 2017). This literature review endeavors to delineate the contours of current academic dialogue and to chart prospective avenues of inquiry into the nexus of AI and artistry. It specifically addresses the influence of social media, the fine arts, and algorithmic computation on artistic creation and perception, while also considering the metaverse as a revolutionary context that transcends traditional modalities of art engagement, thereby crafting novel paradigms for artist-audience interaction. Furthermore, the review examines how the process of creative prompting might recalibrate the relationship between the creator and the created, invoking poststructuralist perspectives on the generation and interpretation of meaning, as well as reception theory.

Despite the burgeoning interest in AI's application to art creation, discourse has predominantly lingered on philosophical or theoretical considerations, with scant attention to the practical methodologies, strategies, or workflows that artists and designers might employ. Existing literature often gravitates towards abstract discussions. Coeckelbergh (2017), for example, articulates a conceptual framework poised at the intersection of philosophy and technology, questioning the very nature of "creation," "art," and the capacity of machines in "creating art." This inquiry challenges conventional dichotomies between human and machine-made art, advocating instead for a nuanced, collaborative interpretation of creativity where technological tools augment the artistic process. Similarly, Mazzone and Elgammal (2019) delve into AI's role in discerning stylistic nuances and identifying overarching patterns in art history, suggesting a reevaluation of the symbiotic relationship between machine-driven and human-driven creativity. This relationship, framed as an "actor network" by Tao (2022), envisions humans and machines as co-contributors to the artistic endeavor, each amplifying the other's strengths.

Further discourse probes into the essence of creativity within the nexus of AI and art, scrutinizing the capacity of machines to partake in the creative process and the characterization of the process itself as inherently creative. Ahmed (2020) posits a design-oriented perspective on AI, advocating for its interpretation not merely as an artifact for exhibition within media museums but as an instrument facilitating design. Through the analysis of interactive and immersive media installations, Ahmed contends that AI's capacity to render "immaterial humanistic characteristics"—such as emotions, experiences, senses, and memories—tangible, advocates for a reconceptualization of AI beyond its conventional perception as a product or traditional design element. This perspective suggests that the interactions and emotional engagements elicited by AI-generated art should themselves be considered integral components of the design process. Nevertheless, these discussions often circumvent the contentious debate surrounding the notion of creativity in art.



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The discourse surrounding AI-generated art frequently gravitates towards the concept of creativity and its applicability to works produced by AI. Csikszentmihályi's (1988) conceptual framework for creativity, encompassing a knowledge domain, a volitional agent, and field experts, provides a foundational basis for this analysis. Jennings (2010) extends Csikszentmihályi's model, stipulating three criteria that define a volitional agent with creative autonomy. In the context of AI-generated art, "creativity" implies the system's ability to independently navigate creative avenues, unconstrained by the directives of programmers or operators. However, Ajani (2022) emphasizes that creativity necessitates an individual's capacity for innovation, the assimilation of knowledge, and validation by domain experts. Given that creativity demands external affirmation, AI's creative outputs, in both art and design, must undergo evaluation by field experts to attain recognition as genuinely creative endeavors.

The prevailing scholarly discourse underscores an imperative for further investigation into the practical applications of generative AI tools in the artistic and design spheres. With the ascendance of generative AI technologies, there emerges a clarion call for the establishment of novel methodologies for generating and interpreting AI-facilitated content. A pivotal area of emphasis is the cultivation of collaborative and co-creative processes that empower artists to synergize with AI, thereby extending its functional purview. Artists and designers are encouraged to proactively explore the potentialities and constraints of AI in art creation, striving to integrate these technologies into their work in ways that transcend novelty. Concurrently, there is a necessity for the formulation of new evaluative frameworks capable of appraising the creative and artistic merits of AI-generated content, recognizing the intricacies of human-AI collaboration. This endeavor may necessitate the introduction of novel criteria for assessing creativity and artistic value, alongside innovative strategies for audience engagement. Through interdisciplinary collaboration between the arts and technology sectors, artists hold the potential to significantly influence the trajectory of AI-generated art, unlocking unprecedented avenues for creative expression and the construction of meaning.

## 3. Methods

The methodology section outlines the pedagogical approach and structure of a web design class focused on integrating artificial intelligence (AI) tools into the curriculum. The class, hosted by a private college in the Saint Louis region, included a diverse cohort of 26 undergraduate and graduate students. These students hailed from various disciplines, including Computer Science, Computer Information Systems, Digital Marketing, Finance, Game Design, Marketing, and Art and Design. They were enrolled in Web Design I - User Experience, a project-based course that is the second in a series dedicated to web design. This course advanced student knowledge in HTML and CSS, while also incorporating JavaScript, various frameworks, and libraries to deepen their understanding of web design, with a particular emphasis on user experience through simulated client interactions.



 

A key component of the course involved familiarizing students with content management systems (CMS) and equipping them with the skills to configure, modify, and populate a CMS-driven site. Moreover, the curriculum covered search engine optimization techniques and digital marketing strategies, essential for promoting and marketing websites effectively **(Table 1).** The overarching goal of integrating AI tools—specifically focusing on text- and image-based generative AI—was to evaluate pedagogical best practices in web design and development. This evaluation aimed to ascertain student perceptions, performance, and feedback, augmented by instructor observations and insights.

| Week | Focus | Activities | Objective |
|---|---|---|---|
| 1 | Introduction to Course and Web Design | Course objectives briefing, Introduction to the pivotal role of web design | Familiarize students with the course structure and the significance of web design |
| 2 | Overview of AI Applications in Web Design | Video presentation on eleven AI applications for web design, Guided exploration of AI tools | Introduce AI tools and applications relevant to web design, Encourage exploration of AI capabilities |
| 3-4 | CMS Configuration and Population | Learning CMS skills: configuration, modification, and site population | Equip students with practical skills in CMS management |
| 5-6 | Search Engine Optimization and Digital Marketing Strategies | Covering techniques for effective website promotion and marketing | Teach effective strategies for SEO and digital marketing |
| 7-8 | AI Integration in Design Process and Final Project Completion | Using AI for content generation and visual design, Iterative design process, Final project submission with AI elements annotated | Apply AI tools in the creative process, Emphasize the integration of coding, functionality, and aesthetics in web design |

**Table 1- Overview of Activities and Objectives for the Course**

The course was structured as an eight-week module, with each week dedicated to a specific aspect of web design and AI integration. Initially, students were introduced to the course's objectives and the pivotal role of web design. Subsequently, a video presentation outlined eleven different AI applications pertinent to web design, guiding students on how to leverage AI for various design decisions. Special emphasis was placed on the use of AI in enhancing the aesthetic dimensions of web projects, encouraging an iterative design process. In this context, AI was positioned as a supplemental tool for content generation and visual design, aiming to bridge the gap, particularly for students with a stronger background in computer science, who might find the design aspects more challenging.



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Notably, the assignment framework encouraged students to articulate how AI was utilized within their creative process **(Figure 1)**. This included the annotation of their projects with HTML comments to denote AI-generated elements, fostering transparency and reflective engagement with the AI tools used. While the direct application of AI for coding tasks was constrained by certain framework limitations, its utility in content and visual design remained a focal point of the course. The curriculum aimed to foster a nuanced understanding of AI as an augmentative resource in web design, emphasizing its potential to enhance traditional educational paradigms through the strategic integration of coding, functionality, and aesthetics.

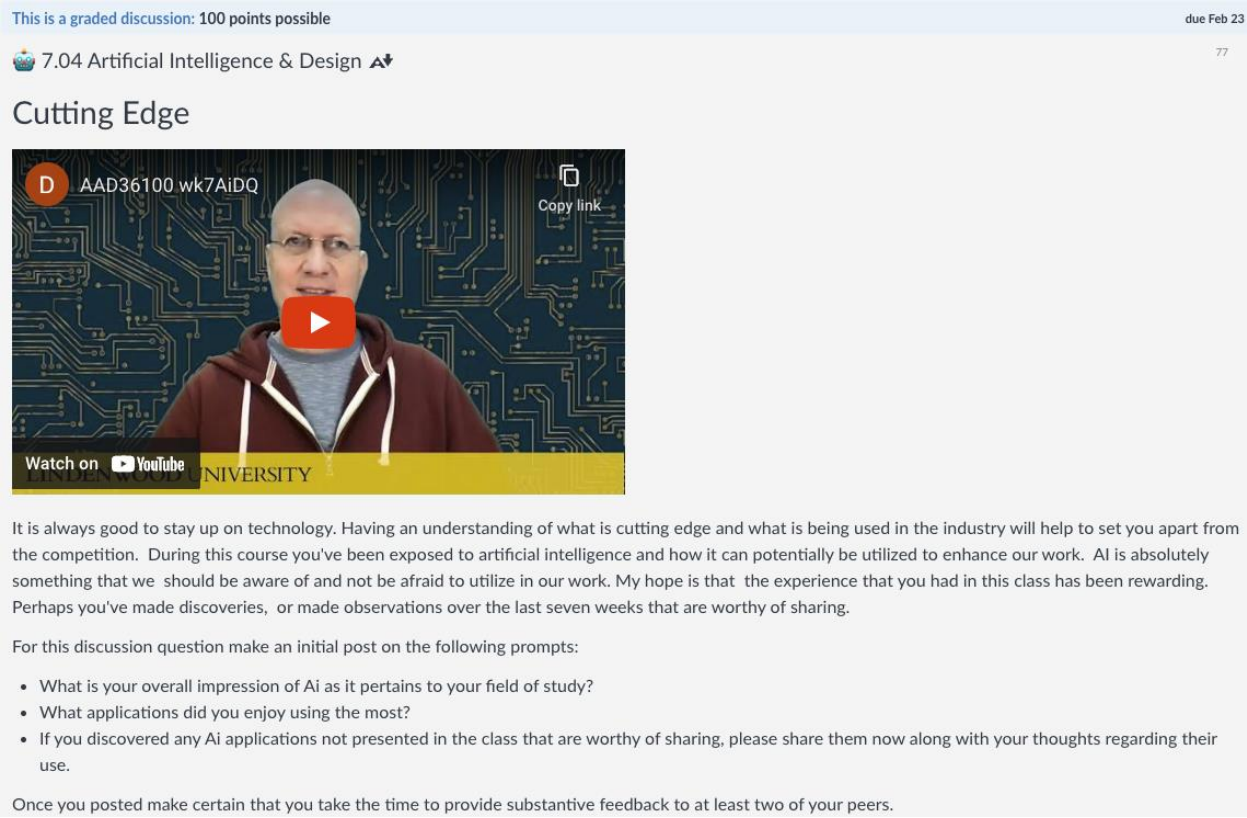


**Figure 1- Introduction of AI Overview**

The Restaurant Project was part of the larger website project **(Figure 2)**. The assignment in question unfolds within the structure of an eight-week course, aimed at melding the traditional tenets of web design with the avant-garde capabilities afforded by AI. The initial phase of the course serves to acclimate students to the overarching objectives and the pivotal role of web design in the contemporary digital landscape. A critical component of this phase involves an extensive exploration of AI applications pertinent to web design, facilitated by a comprehensive video presentation. This introduction to AI is not merely theoretical; it is a call to action for students to engage with AI tools, thereby bridging the gap between coding proficiency and aesthetic sensibility, especially for those with a robust background in computer science.

As the course progresses into the mid-section, students delve into the intricacies of content management systems (CMS), acquiring the skills necessary to configure, modify, and populate CMS-driven sites. This hands-on experience is complemented by lessons in search engine optimization (SEO) and digital marketing strategies, equipping students with the tools to effectively promote and market their websites. The culmination of the course is marked by an emphasis on the integration of AI in the design process. Students are tasked with employing AI tools for content generation and visual design, fostering an iterative process that champions creativity and innovation. The assignment necessitates a reflective engagement with the AI tools utilized, requiring students to annotate their projects with HTML comments to denote AI-generated elements. This exercise not only fosters transparency but also encourages a critical evaluation of the role of AI in the creative process.

Throughout this journey, the direct application of AI for coding tasks is acknowledged to be constrained by certain framework limitations. However, the assignment underscores the utility of AI in content and visual design, positioning AI as a supplemental tool rather than a replacement for traditional education. The goal is to foster a nuanced understanding of AI as an augmentative resource, emphasizing its potential to enhance the educational paradigm through the strategic integration of coding, functionality, and aesthetics.

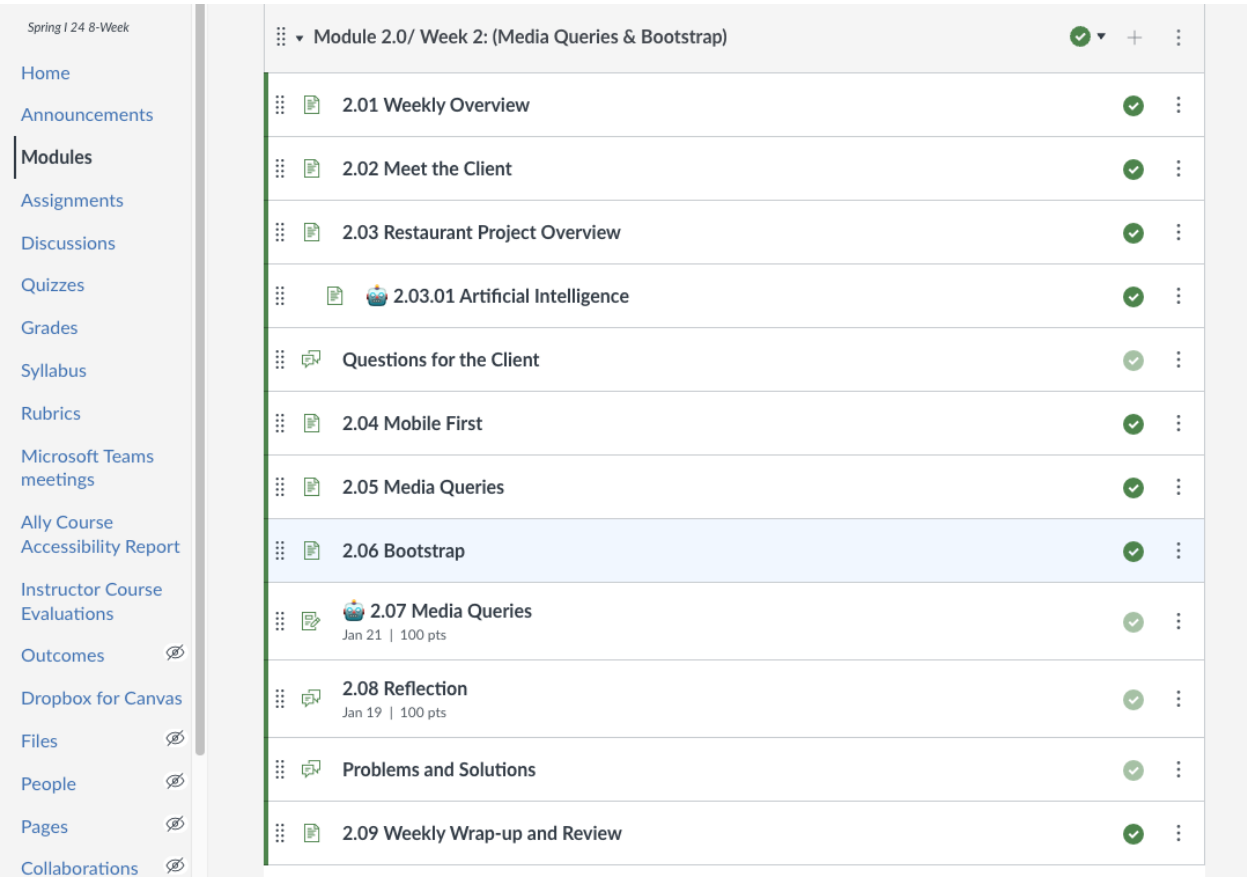


**Figure 2- Module Overview for Assignments**



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In the fourth week of the course, the students were introduced to a pivotal assignment involving a simulated client, Chef Cookiecutter **(Figure 3)**. This task required the students to apply the knowledge and skills they had acquired thus far to develop a website that met the specific needs of the client. A unique aspect of this project was the mandate to incorporate artificial intelligence (AI) tools into the development process, a challenge that necessitated both technical proficiency and creative acumen. Students were tasked with not only constructing the site but also producing a video report detailing their progress. This report was expected to highlight the utilization of AI tools in their project, providing insights into how these technologies were leveraged to fulfill client requirements.

Given the exposure to 11 AI applications earlier in the course, students were now challenged to judiciously select and apply at least four of these tools throughout the duration of the project. This selection process was critical, as students needed to demonstrate an understanding of the functionalities and potential applications of these tools in the context of web design and development. The video report served as a platform for students to articulate the rationale behind their choice of AI tools, describe the integration of these tools into their project, and reflect on the impact of AI on the design and development process.

The subsequent week, week five, introduced an additional layer of complexity to the project through the client's request for an animated logo. This requirement not only tested the students' design skills but also their ability to employ AI in creative ways. The animation of the logo, inspired by or directly generated through AI, necessitated a deep dive into the capabilities of AI tools for graphic design and animation. Students were required to navigate the intersection of AI technology and creative design to produce an animated logo that aligned with the client’s vision. This component of the assignment emphasized the role of AI as a collaborator in the creative process, pushing students to explore innovative approaches to animation and design.

Throughout these phases of the project, students engaged in a continuous iterative process, applying feedback from the client (simulated as part of the educational experience) and adapting their designs accordingly. This process mirrored the dynamic nature of real-world web design projects, where client feedback and iterative refinement are integral to achieving the desired outcomes. The Chef Cookiecutter assignment, with its emphasis on the practical application of AI tools in web design and development, served as a microcosm of the broader industry trends, preparing students for the complexities and opportunities that lie ahead in their professional careers. By navigating the challenges presented by this assignment, students gained invaluable experience in integrating AI into the creative process, a skill set that is increasingly relevant in the rapidly evolving field of web design.



 

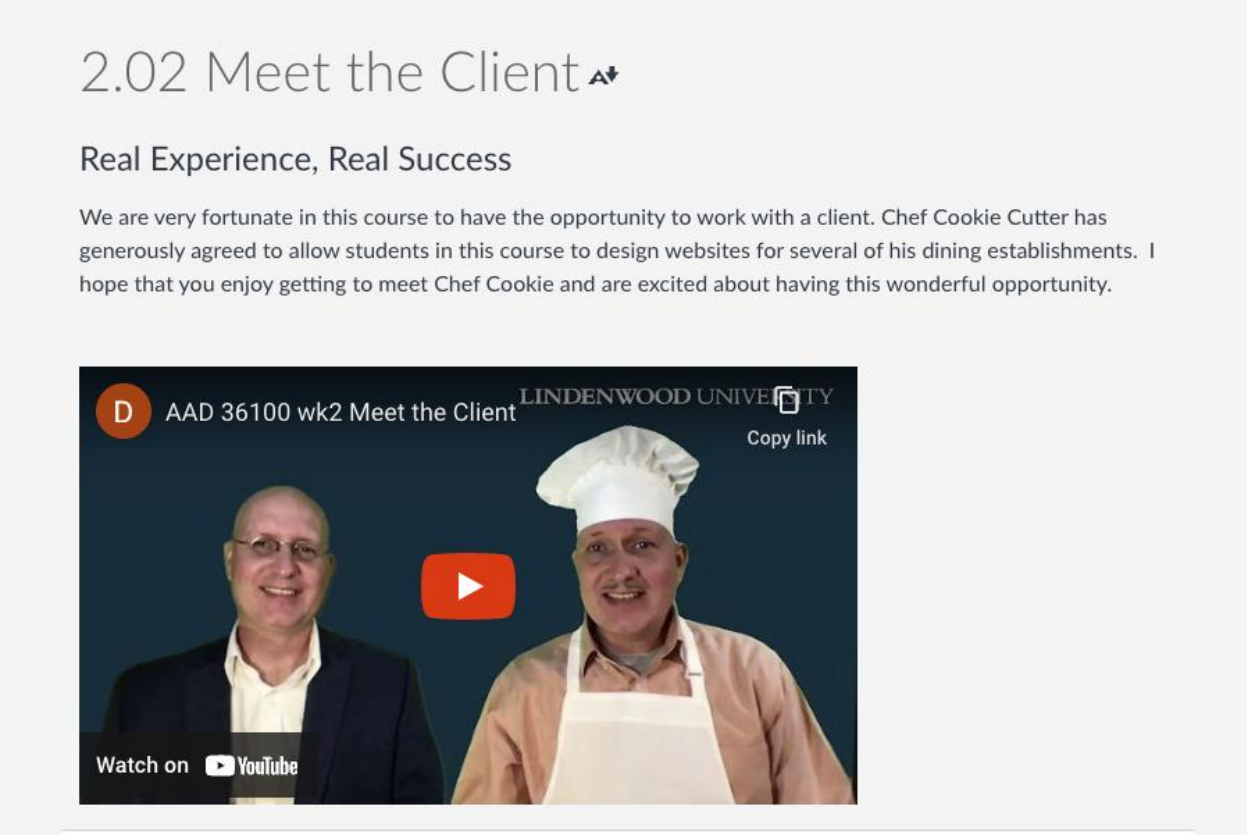


**Figure 3- Meet the Client Video Assignment**

## 4. Instructor Observations

In the context of the web design course, instructor feedback on the integration of AI tools was unequivocally positive, centering on the potential and benefits these technologies afford in an educational setting. A salient strategy employed by the instructor was the preliminary demonstration of generative AI capabilities, effectively showcasing to students the broad array of possibilities these tools present. Although the inclusion of AI in the final projects was not a stipulation, a significant majority of students independently chose to incorporate AI tools into their work. According to the instructor, this voluntary integration substantially augmented the quality of the final projects, mirroring the students' perception of AI's potential to elevate their design projects in forthcoming endeavors.

A pivotal component of the course, the Chef Cookie Cutter assignment, underscored the application of AI within a practical, real-world scenario. This project required students to navigate the complexities of integrating AI tools into their design process, reflecting a real-world workflow modification that prepares them for contemporary challenges in web design and development. The assignment facilitated discussions on the ethical use of AI, underscoring the importance of imbuing students with not only the technical acumen for AI application but also an ethical framework for its use. The course culminated in a reflective dialogue on the ethical implications of AI in design, advocating for an educational approach that dispels initial negative



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biases and focuses on the positive potential of AI. This necessitates a paradigm shift in institutional culture towards AI, promoting an environment that encourages the exploration and application of AI tools.

Instructional methods included extensive demonstrations on utilizing AI for diverse design needs, such as image generation, color palette creation, and logo ideation. By concentrating on the positive applications of AI and steering clear of its potential drawbacks, students were motivated to explore the extensive capabilities of AI. Additionally, the adaptation of course rubrics to include AI fostered an atmosphere of experimentation among students. As well, the strategy led to a positive reception among students, who initially harbored reservations about AI. Through the Chef Cookie Cutter assignment, students experienced firsthand the modifications required in their workflow to incorporate AI effectively, mirroring real-world scenarios. The course structure, built on showcasing the utility and ethical considerations of AI, coupled with encouragement for AI experimentation in design projects, cultivated a learning environment that not only alleviated initial apprehensions but also underscored the practical and creative advantages of AI in web design and user experience.

## 5. Conclusion

The integration of AI-generative tools within the realms of art and design education heralds a transformative era, imbuing the creative process with unprecedented potential. This study has illuminated the significant utility of AI in web design and user experience courses, showcasing its applicability across a spectrum of student backgrounds. While the path forward necessitates further research and refinement in the deployment of these technologies, the evidence underscores their profound influence on creative methodologies. It is imperative to acknowledge that AI is not a replacement for human creativity but a powerful adjunct that augments and expands the artistic repertoire. Ethical concerns and copyright considerations related to AI-generated content demand meticulous attention within art and design pedagogy. As the discipline continues to evolve, it becomes essential for educators to recalibrate the curriculum, emphasizing the conceptual underpinnings of creativity alongside technical skill.

The future trajectory of research should delve into both the aesthetic potential and coding capabilities of AI-generative tools, with a particular focus on the strategic use of text prompts for generating art. The capacity for artists to engage directly with algorithms opens new horizons for creative exploration. It is incumbent upon governing bodies, such as NASAD, to articulate guidelines for the seamless integration of these tools into educational frameworks. Moreover, this study underscores the efficacy of AI in enriching web design competencies, advocating for a deeper integration of such technologies into academic curricula as they continue to advance.

The advent of AI avatars introduces a novel dimension to these discussions, offering the potential for diverse character interactions beyond the singular role of the instructor. This innovation presents an opportunity to enrich the learning experience with a variety of personas, each bringing unique perspectives and challenges to the educational tableau. With the emergence



 

of platforms like ChatGPT-4 and its enhanced functionalities, the horizon of possibilities for integrating AI in art and design education broadens further. The continuous exploration and adoption of AI technologies promise to redefine the landscape of art and design education, equipping artists with a new arsenal of tools and opportunities for creative expression and innovation.



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# Embracing the Irreplaceable: The Role of Neurodiversity in Cultivating Human-AI Symbiosis in Education

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## Abstract

This study investigates the indispensable role of human skills—such as empathy, ethical judgment, and nuanced understanding—in the development and application of artificial intelligence (AI) within higher education, highlighting the unique contributions of neurodivergent perspectives in creating a symbiotic human-AI relationship. Drawing upon research that evidences the superior performance of diverse teams in creativity and innovation, the paper argues for the integration of neurodiversity into AI development as a means to address the philosophy of 'fearing the Other,' thereby mitigating biases and fostering ethical AI interactions. The technology sector's adoption of Diversity, Equity, and Inclusion (DEI) programs, including biopsychosocial interventions and environmental adaptations to support the neurodivergent workforce, serves as a model for higher education. By leveraging the estimated 15-20% of the global population which is neurodivergent, this approach not only aims to alleviate the employment disparities faced by neurodivergent individuals, but also enriches the ethical and innovative capacities of educational AI systems. This concise analysis advocates for an educational technology landscape that not only replicates human intelligence but also embodies human values, thanks to the invaluable contributions of the neurodivergent community.

**Keywords:** *Neurodiversity, Artificial Intelligence, Ethical judgment, Human-AI symbiosis, Higher Education*

## 1. Introduction

Research into neurological or developmental conditions such as autism spectrum condition (ASC) has garnered considerable focus in the last decade, reflecting a broader societal recognition of their importance (Schall, 2010; Scott et al., 2018; Bury et al., 2020; Scott et al., 2022). Parallel to the concept of biodiversity, neurodiversity champions the notion that deviations in neurological development from what is traditionally considered 'normal' represent a natural and valuable form of biological diversity, meriting both acceptance and support. The term "neurodiversity" was coined in 1998 by Judy Singer, an Australian social scientist (Deakin, 2022), to advocate for a more inclusive understanding of neurological differences.

Baron-Cohen (2019) elaborates on this framework, suggesting that while certain differences may present as disabilities in highly social and unpredictable environments, creating autism-friendly



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spaces can minimize these challenges, allowing individuals' unique talents to flourish. This implies that environmental adjustments are crucial, as typical workplace designs with open-concept floorplans and insufficient sensory accommodations can pose significant barriers for those with neurodivergent conditions (Gaudion, 2016; Harnett, 2019). Consequently, many individuals identifying as neurodivergent do not view their cognitive processing as inherently disabling, instead they argue it is the disabling factors which arise from unsupportive learning and performance environments. Although the most recognized characteristics of neurodiversity are often associated with ASC—including challenges in communication, social interaction, and repetitive behaviors—the spectrum encompasses a wide range of experiences and sensory needs, necessitating tailored approaches in both educational and workplace settings.

Neurodiversity encompasses a broad array of cognitive functions and behavioral characteristics, such as social communication capabilities, emotional recognition and expression, attention levels, and various other mental processes (Dawson, Franz, & Brandsen, 2022). Early investigations into neurodiversity primarily followed a medical model, emphasizing the need for prevention and cure of the impairments frequently associated with these conditions. This approach often led to discussions within psychological and medical literature that focused on defining neurodivergent individuals by their deficits, a perspective rooted in a normative history of educational and social exclusion (Rogers & Vismara, 2008; Doyle, 2020).

For instance, the recognition of dyslexia became prevalent with the increasing emphasis on literacy (Politi-Georgousi & Drigas, 2020); ADHD diagnoses surged with the demands of sedentary lifestyles post-industrial revolution (Olsson & Hibbs Jr, 2005); and autism became more pronounced with the necessity for frequent social interaction and the presence in sensory-regulated environments like modern workplaces (Lawson, Mathys, & Rees, 2017). The term "disorder" itself, often used when the root causes of symptoms are unknown, and "disability", implying a deviation below expected neurological or physical functioning, reflect these deficit-based perspectives. Moreover, comorbidities are prevalent within the neurodivergent community, with studies indicating that 50% of individuals diagnosed with autism spectrum condition (ASC) experience at least four concurrent conditions, including learning and language difficulties. Furthermore, about 75% of autistic individuals may also exhibit traits associated with ADHD, which affects working memory, impulse control, focus, stress management, and organizational skills among other areas (Baron-Cohen, 2019), underscoring the complex interplay of challenges and capabilities within the neurodivergent population.

As the discourse on neurodiversity unveils the unique contributions neurodivergent thinkers bring to education and the workforce—highlighting their potential to innovate and solve problems through distinct cognitive processes—the parallel extends into the realm of AI. This progression underscores the critical importance of integrating diverse perspectives into AI development. By valuing what neurodivergent individuals offer, AI technologies can be enriched with broader, more inclusive insights, enhancing their ability to address complex challenges with innovative solutions. For instance, large language models (LLMs) like ChatGPT are trained on



 

vast and diverse datasets, encompassing a wide range of internet text, to ensure a comprehensive understanding of human language nuances. This training process includes texts from books, websites, and other digital media, aiming to capture the plurality of human thought and expression. However, given the potential for these datasets to include biased or offensive content, developers implement robust guardrails to mitigate such risks. These guardrails involve filtering mechanisms to exclude explicit, harmful content from the training data, and fine-tuning processes that guide the model towards generating responses that align with ethical guidelines and societal norms. Furthermore, continual updates and monitoring are conducted to refine these models, ensuring they evolve in response to emerging ethical considerations and societal changes. The application of these methodologies demonstrates a commitment to reducing prejudice and offensive output in AI interactions, fostering a more respectful and inclusive digital communication environment (Bender et al., 2021; OpenAI, 2022).

As AI increasingly influences human experiences, the necessity of integrating neurodivergent perspectives into AI development becomes paramount to ensure a diversity of thought and innovation. The current landscape, primarily influenced by neurotypical knowledge and interactions, overlooks the rich, varied insights that neurodivergent individuals offer—insights that are crucial for pioneering novel approaches and perspectives in AI technologies. Despite some progress, such as inclusion of broader datasets in training processes, there remains a substantial gap in deliberate, systematic efforts to involve neurodivergent viewpoints directly within the development and assessment of language models. This study aims to bridge this gap by advocating for the engagement of neurodivergent individuals in the creation and fine-tuning of AI, alongside employing advanced training methodologies focused on enhancing diversity and inclusivity.

The benefits of such an integrated approach are multifaceted. Neurodivergent persons possess unique cognitive processing abilities—such as heightened attention to detail, superior pattern recognition, and innovative problem-solving—that are invaluable for identifying biases and enhancing the performance of AI systems. This research intends to leverage these abilities to improve AI's accuracy, inclusiveness, and creativity. By doing so, it seeks to challenge and expand the AI field's existing frameworks, advocating for a model of development that truly encompasses the full spectrum of human cognitive diversity. The anticipated results of this study will contribute significantly to the discourse on the essential role of neurodiversity in AI, underscoring the need for a more inclusive and innovative future in technological advancement.

## 2. Literature Review

With an estimated 1.2 billion neurodivergent individuals globally, there is a pressing need for organizations to comprehend their distinctive needs, talents, obstacles, and goals (CDC, 2022). The past two decades have witnessed a paradigm shift in the perception of neurodiversity, moving from a focus on treatment to support, and from a diagnostic to an identity-first



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vernacular (ASAN, 2022). This evolution in language reflects a broader societal shift towards recognizing neurodiversity not as a series of "Specific Learning Difficulties" but as a spectrum of cognitive differences with unique strengths and challenges (Dwyer & Sadhbh, 2022). Historically, research into autism spectrum condition (ASC) aimed to alleviate the perceived "burden" on caregivers and society, with interventions like Applied Behavioral Analysis (ABA) focusing on normalizing behaviors (Senokossoff, 2016). Contemporary discussions, however, emphasize "difference" rather than deficit, acknowledging the inherent diversity in human brain function (Griffin & Pollak, 2009; Murray et al., 2022). Scientifically, a portion of autism is linked to rare genetic variances, suggesting a broader spectrum of neurodiversity beyond ASC (Wosniak et al., 2017).

Attention deficit/hyperactivity disorder (ADHD) represents one of the most recognized forms of neurodiversity. Despite its commonality, discussions often exclude ADHD from broader neurodivergent classifications (Sonuga-Barke & Thapar, 2021). Research indicates that neurodivergent brains, including those with ADHD, exhibit differences in brain structure and neurotransmitter activity, such as increased amygdala size and altered dopamine levels, challenging the pathologization of ADHD characteristics (van Harmelen, 2013; Xing et al., 2022). The term "variable attention stimulus trait" (VAST) has been proposed to more accurately describe the ADHD experience, highlighting the condition's complexities beyond attention deficits (Hallowell & Ratey, 2022). Individuals with ADHD often demonstrate exceptional creativity, energy, and hyper-focus, qualities increasingly valued in the professional world (Fabritius, 2022).

ASC visibility has surged, influenced by popular culture that often skews perceptions towards a stereotype of white, male geniuses. This representation neglects the diversity and complexity within the autism spectrum, oversimplifying the condition to a set of desirable traits while ignoring the challenges individuals face (Pomerance & Palmer, eds. 2022). Neurodivergent coaching strategies that focus solely on enhancing strengths risk neglecting the broader spectrum of needs and challenges individuals with ASC encounter. Research emphasizes the importance of supporting all aspects of neurodivergent individuals, including communication and social interaction difficulties, to foster an inclusive environment where diverse cognitive abilities are recognized and valued (Araujo, Mophosho, & Moonsamy, 2022).

Individuals across the neurodiversity spectrum, much like their neurotypical counterparts, experience sensory stimuli in distinct ways based on their unique histories and sensory sensitivities. These sensory experiences can vary greatly among individuals, leading to preferences for certain stimuli or aversions to others. For some, external sounds and lights may trigger a survival response, a mechanism that operates beyond conscious control, indicating a heightened state of vigilance that is common among neurodivergent people (Bellato et al., 2022). This heightened vigilance can stem from challenges in regulating the nervous system, often observed in those with sensory sensitivities or PTSD-like cognitive patterns (Elton et al., 2022). Research has linked an enlarged amygdala in individuals with ASC to nervous system



 

overstimulation, which can precipitate intense stress responses, sometimes manifesting as "meltdowns" (Andrews et al., 2022; Karim, Akter, & Patwary, 2022). During such episodes, the amygdala overpowers the prefrontal cortex, leading to a cognitive shutdown that can have profound emotional and physical repercussions, emphasizing the importance of sensory-aware environments, particularly in the workplace.

The contributions of neurodivergent individuals in professional settings are invaluable, yet misconceptions persist. Contrary to the stereotype of emotional detachment, many in the neurodivergent community possess deep empathy but may become easily disheartened (Shalev et al., 2022). Additionally, a susceptibility to negative thought patterns, such as catastrophizing, can lead to heightened anxiety and depression, a scenario often exacerbated in undiagnosed women who may struggle with workplace challenges in silence (Ginapp et al., 2022; Kasahara, 2022). Employees with ADHD, in particular, may feel undervalued, affecting their self-esteem (Harris, 2020). Moreover, neurodivergent individuals often experience criticism more intensely, with rejection sensitive dysphoria (RSD) representing an extreme reaction to negative feedback or perceived rejection (Dwyer, 2022). Feedback methods in professional environments, therefore, should be carefully structured to be constructive and based on clear, measurable criteria.

Despite these challenges, the neurodivergent workforce brings a plethora of strengths to the table. Known for their meticulous attention to detail, process-oriented approach, reliability, and dedication, neurodivergent individuals excel in various tasks (Saleh et al., 2022). Those with ASC can display remarkable perceptual abilities, intense concentration, and innovative problem-solving skills. ADHD individuals often exhibit hyper-focus, creativity, and dynamic energy, while persons with dyslexia may show strong spatial skills and entrepreneurial spirit (Fabritius, 2022; Smith-Spark & Gordon, 2022). The lesser-discussed talents, such as those found in visual thinkers, include innovation and advanced geospatial capabilities (Oliviero, 2008). Collectively, the neurodivergent population contributes uniquely to the workplace, bringing skills like creative problem-solving, coding expertise, and empathetic understanding to their roles.

## 3. Recommendations

The integration of diverse cognitive processes, particularly those present within the neurodivergent community, into problem-solving, thinking, and decision-making frameworks stands as a pivotal countermeasure against the pitfalls of groupthink, homogenization, and autophagy that can afflict large language models and collective intelligence systems. These pitfalls manifest as a lack of creativity, innovation, and critical thought, leading to stagnant or regressive intellectual environments. Groupthink, a phenomenon where the desire for harmony or conformity in a group results in an irrational or dysfunctional decision-making outcome, poses a significant risk to the development and application of large language models (Callaway & Esser, 1984; Gomes et al., 2019). Such models, when trained on homogenized data sources that lack diversity, may inadvertently propagate narrow viewpoints, perpetuating biases and



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reinforcing stereotypes (Buchanan, 2023). The homogenization of thought not only limits model ability to generate diverse and innovative outputs but also risks echoing and amplifying existing societal biases, thus hindering progress towards equitable and inclusive AI systems (Anderson et al., 2024).

The homogenization of data inputs and the consequent outputs in AI and LLMs result in a loss of nuanced understanding and creativity (Liang et al., 2024). This process, akin to intellectual autophagy, where the system cyclically consumes and regenerates based on a uniform set of data, stifles the emergence of novel ideas and solutions. Without the infusion of diverse perspectives, particularly those from neurodivergent individuals who possess unique problem-solving abilities and cognitive processes, AI systems risk becoming echo chambers that lack the capability to address complex, real-world problems in innovative ways. To counter this, neurodivergent individuals offer a broad spectrum of cognitive styles and approaches to problem-solving, thinking, and decision-making that can significantly enrich AI development and application (Ashbell-Clarke, 2023). For instance, the heightened pattern recognition capabilities of individuals with ASC can enhance the ability of these tools to identify trends and anomalies within large datasets, while the creative problem-solving traits seen in those with ADHD could inspire more inventive AI solutions. Similarly, the detailed-oriented nature and spatial intelligence of individuals with dyslexia can contribute to more thorough and considerate AI algorithms.

Therefore, incorporating neurodiversity into AI development and training of LLMs disrupts the cycle of intellectual autophagy by introducing fresh, unconventional insights that can challenge prevailing norms and inspire novel approaches**.** By valuing and integrating the distinct problem-solving methods and cognitive styles of the neurodivergent population, AI systems can transcend the limitations of groupthink and homogenization, fostering a more innovative, adaptable, and inclusive technological landscape (Ulnicane & Aden, 2023). Thus, the acknowledgment and inclusion of neurodivergent perspectives not only address ethical imperatives for diversity and inclusion but also serve as a strategic advantage in enhancing the problem-solving and decision-making capacities of these systems. In addressing the imperative to weave neurodivergent perspectives into the fabric of these developments, a comprehensive strategy emerges, encapsulating several pivotal recommendations **(Table 1)**.

First and foremost, the active involvement of neurodivergent individuals throughout the development, training, and evaluation stages of AI systems is paramount. This direct engagement ensures that the diverse spectrum of human cognition informs the evolution of AI, enabling these systems to reflect a broader range of human experiences and insights. Such a participatory approach not only democratizes the development process but also enriches the AI with nuanced understandings that might otherwise be overlooked. The diversification of training datasets stands as a critical step towards mitigating the biases inherent in AI models trained predominantly on neurotypical data (Naseer et al., 2023). Through the incorporation of a wide array of data sources, including inputs reflective of the neurodivergent experience, AI systems



 

can move towards outputs that are more equitable and representative of societal diversity. This effort to broaden the datasets aims to challenge and ultimately diminish the prevalence of homogenized thought patterns within AI outputs, fostering a technology landscape that is both inclusive and innovative (Jiao et al., 2023). Counterfactual data augmentation represents another innovative technique aimed at enhancing comprehension of diverse human behaviors and conditions. The simulation of alternative viewpoints and scenarios within the training data, AI can develop a more comprehensive grasp of the complexities and variances in human cognition, further distancing itself from the pitfalls of oversimplification and bias (Singla et al., 2023).

Recognizing and leveraging the unique strengths of neurodivergent individuals—such as exceptional pattern recognition, attention to detail, and creative problem-solving abilities—can significantly contribute to the enhancement of analytical and creative capacities of AI (Pacilio, 2024). These distinct cognitive processes offer invaluable insights that can help identify and correct biases within AI models, leading to outcomes that are not only more accurate but also more inclusive. Fostering a culture of inclusivity and collaboration within the AI development ecosystem is essential. Promoting diversity of thought and encouraging cooperation between neurotypical and neurodivergent team members can create a rich environment for innovation, where diverse perspectives are valued and explored. Such a culture not only supports the well-being of all contributors but also catalyzes the emergence of groundbreaking solutions that might not arise in a more homogenized setting (LeFebre-Levy et al., 2023).

Lastly, a commitment to continuous learning and adaptation is crucial. Establishing ongoing feedback loops with neurodivergent users and stakeholders regarding AI systems can be iteratively refined to better meet the needs of a diverse user base. This process ensures that AI technologies remain responsive and relevant, evolving in tandem with our growing understanding of the full spectrum of human cognitive diversity. In sum, by embracing these recommendations, the development of AI can transcend the limitations of current paradigms, embracing the vast potential of neurodiversity to inspire innovation and inclusivity in technology. This approach not only aligns with ethical imperatives for diversity and equity but also enhances the capability of AI systems to serve a broader segment of society, reflecting the rich tapestry of human cognition and experience.

**Table 1. Strategies for Integrating Neurodivergent Perspectives into AI Development**

| Recommendation | Action Steps | Expected Outcome |
|---|---|---|
| Active Involvement in Development Processes | - Prioritize the inclusion of neurodivergent individuals in AI development stages.<br>- Ensure their perspectives are considered in training and evaluation. | AI systems that better understand and represent the diversity of human experiences. |



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| | | |
|---|---|---|
| Diversification of Training Datasets | - Incorporate diverse data sources, including inputs from neurodivergent individuals.<br>- Utilize data representing a broad spectrum of human experiences. | Reduced biases in AI outputs, leading to more equitable and representative technological solutions. |
| Counterfactual Data Augmentation | - Implement techniques to simulate alternative viewpoints and conditions in training data. | Enhanced AI understanding of diverse perspectives and complexities in human behavior and cognition. |
| Recognition and Utilization of Neurodivergent Strengths | - Leverage the unique abilities of neurodivergent individuals, such as pattern recognition and creative problem-solving.<br>- Apply these strengths to enhance AI's analytical and innovative capacities. | Improved accuracy and innovation in AI models, addressing biases and enhancing analytical capabilities. |
| Fostering a Culture of Inclusivity and Collaboration | - Promote diversity of thought and encourage collaboration between neurotypical and neurodivergent team members.<br>- Cultivate an environment that values all contributions and supports the well-being of all employees. | A collaborative and innovative work environment that benefits from the full range of human cognitive diversity. |
| Continuous Learning and Adaptation | - Establish feedback loops involving neurodivergent users and stakeholders.<br>- Use feedback for the iterative improvement of AI systems to ensure they remain responsive to a diversity of needs and experiences. | AI systems that evolve in response to new insights and remain relevant and responsive to the needs of a diverse user base. |

## 4. Conclusion

The integration of neurodivergent perspectives into AI development emerges as a critical imperative in the contemporary technological landscape. This review underscores the increasing concern over the potential to replicate and perpetuate neurotypical biases, thereby overshadowing the rich tapestry of human cognition that neurodivergent individuals offer. The discussion illuminated the necessity for AI systems not only to mimic human thought processes but to encapsulate the full spectrum of human experience, including those outside the neurotypical norm. Recognizing the unique strengths and perspectives of neurodivergent

individuals—ranging from exceptional attention to detail to innovative problem-solving capabilities—provides a compelling case for their inclusion in the AI development process.

The review proposed a series of recommendations aimed at fostering a more inclusive, innovative, and representative AI landscape. These included the active involvement of neurodivergent individuals in these development stages, the diversification of training datasets to include a broader range of human experiences, and the adoption of counterfactual data augmentation techniques. Additionally, it highlighted the importance of leveraging neurodivergent strengths, fostering a culture of inclusivity and collaboration, and committing to continuous learning and adaptation based on feedback from neurodivergent users and stakeholders.

Moving forward, further research is essential to explore the practical applications of these recommendations within the AI development process. Studies should focus on identifying effective strategies for involving neurodivergent individuals in AI projects, assessing the impact of diversified datasets on AI performance, and evaluating the outcomes of AI systems that incorporate neurodivergent perspectives. Furthermore, research should aim to quantify the benefits of neurodivergent inclusion in terms of innovation, accuracy, and user satisfaction, providing empirical evidence to support the adoption of these practices industry-wide. Ultimately, embracing neurodiversity in AI development is not just an ethical imperative—it is a strategic advantage. By broadening the cognitive horizons of AI systems, we can ensure that technology advances in a way that is truly reflective of, and beneficial to, the full diversity of human society. The recommendations outlined in this review provide a roadmap for achieving a more inclusive and innovative future for AI, paving the way for research and development efforts that celebrate and harness the unique contributions of the neurodivergent community.



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# AI Integration in Cultural Heritage Conservation: Ethical Considerations and the Human Imperative

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## Abstract

The integration of artificial intelligence (AI) into the conservation of cultural heritage marks a significant transformation in preservation methodologies, heralding both innovative solutions and complex ethical dilemmas. This article undertakes a comprehensive examination of the multifaceted role AI plays in the conservation and restoration of cultural artifacts, buildings, and sites, underscoring the irreplaceable value of human skills and ethical judgment in this domain. Through an analysis of current research, case studies, and insights from professionals in the field, the paper elucidates how AI technologies—encompassing machine learning algorithms, digital twinning, and predictive maintenance—can enhance the accuracy and efficiency of conservation efforts. However, it simultaneously addresses the ethical quandaries these technologies engender, including the risks of inauthentic restoration, the perpetuation of biases, and the erosion of cultural sensitivity. By advocating for a balanced approach that leverages AI's capabilities while safeguarding against its potential pitfalls, the study calls for the establishment of interdisciplinary governance frameworks and ethical guidelines to navigate the intricate interplay between technological advancement and cultural heritage preservation. Ultimately, the paper posits that the integration of AI into cultural heritage conservation necessitates a symbiotic relationship between technological innovation and the nuanced, irreplaceable human element, ensuring that efforts in preservation are as ethically informed as they are technologically advanced.

**Keywords:** *Cultural heritage preservation, Ethical frameworks, Human-centric AI, Technological stewardship, Interdisciplinary governance*

## 1. Introduction

The integration of artificial intelligence (AI)- including machine learning (ML), computer vision, and natural language processing (NLP)- into the realm of cultural heritage conservation represents a pivotal moment in the preservation of global heritage, embodying both a promising horizon of technological innovation and a complex web of ethical considerations (Bordoni et al., 2013; Pisoni et al., 2021). Given the abilities of AI technologies for digital replication, predictive maintenance, and other useful output, they find themselves at the forefront of transforming heritage conservation practices (Falcone et al., 2021). These technologies offer novel approaches to identifying patterns of decay and damage, thereby enabling more effective protection



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strategies for heritage sites and objects (Soleymani et al., 2023). As noted by Buratti (2021), the adoption of AI in heritage conservation ushers in a new era characterized by enhanced capabilities to combat deterioration and loss, signaling a significant departure from traditional conservation methods. At the same time, Garozzo (2020) contributes to the discourse by presenting a balanced examination of the tools employed by conservators in the digital age, highlighting the evolution of conservation technologies. This evolution underscores a critical need for a sophisticated understanding of how these tools can be applied responsibly and effectively within the heritage sector. Concurrently, Prunkl (2021) delves into the ethical and practical frameworks essential for navigating the increased utilization of AI in heritage contexts, emphasizing the imperative of ethical diligence in the face of technological advancement.

This review seeks to elucidate the specific AI technologies revolutionizing the field of heritage conservation. Through a detailed investigation of the applications and mechanisms that support professionals in conservation, the treatment aims to demystify the technologies currently shaping conservation practices. For instance, Xie (2022) offers insights into the transformative impact of these technologies, from the *in situ* monitoring of heritage structures to the digital re-creation of historical buildings via 3D modeling, highlighting their potential to significantly advance the preservation of cultural heritage. However, the employment of AI within the cultural heritage sector is not without its challenges. Issues surrounding authenticity, representativeness, data biases, and cultural sensitivities emerge as central ethical concerns, necessitating careful consideration and moral oversight. Hong (2022) identifies and discusses these ethical dilemmas, presenting real-world examples that illustrate the complexities involved in applying AI to heritage conservation. The analysis addresses crucial questions regarding authenticity, aesthetics, and biases, exploring how AI systems can be deployed in culturally sensitive and ethically sound manners.

The practical application of AI in heritage conservation is further illuminated through a series of global case studies, which demonstrate the diverse and impactful ways in which AI technologies can be leveraged across different cultures and heritage forms. These case studies showcase the role these new technologies can play in a variety of conservation projects, from the analysis of fire-damaged remains at Notre Dame Cathedral in Paris, France to the strategic utilization of big data for the preservation of China's Terracotta Army (Kincaid, 2020; Luo et al., 2015). Additionally, the development of ML models for deciphering ancient scripts at the Mayan ruins, the assessment of climate impacts on the Venetian Lagoon, the identification of artifacts in the Valley of the Kings in Egypt, and proactive conservation efforts in Brazil's São Luís exemplify the breadth and depth application possible in heritage conservation (Krelling et al., 2023; Liu et al., 2023; Wang et al., 2024; Zennaro et al., 2023). Through these examples, the review builds a comprehensive understanding of the capabilities, limitations, and the lessons learned from its application in real-world conservation projects, thereby contributing to a nuanced discourse on the symbiotic relationship between AI and cultural heritage preservation.



 

In light of the growing role of AI technologies in the preservation of cultural heritage, this review critically engages with the technological advancements, ethical considerations, and practical applications of AI in the conservation domain. The escalating complexity and vulnerability of heritage sites worldwide underscore the urgent need for innovative conservation strategies. AI, with its potent capabilities for pattern recognition, structural analysis, and predictive maintenance, emerges as a transformative force in this context. Yet, the deployment of AI technologies is fraught with ethical dilemmas, necessitating a nuanced understanding of their implications on cultural authenticity, representativeness, and sensitivity. This review adopts a comprehensive approach, synthesizing insights from academic literature, case studies, and expert interviews to map the current landscape of AI applications in cultural heritage conservation. The goal is to elucidate the mechanisms through which AI technologies are being integrated into conservation efforts, identify the challenges and ethical concerns associated with their use, and propose a framework for their responsible deployment. By doing so, this study aims to contribute to the development of informed, ethically grounded, and effective AI-enabled conservation practices that honor and preserve the intrinsic value of cultural heritage for future generations. The anticipated outcome is a deeper understanding of AI's potential and limitations in heritage conservation, alongside actionable insights for its ethical application, thereby fostering a balanced discourse on the role of technology in safeguarding cultural legacies.

## 2. Literature Review

The intersection of Artificial Intelligence (AI) with the field of cultural heritage conservation represents a transformative phase in the methodologies employed for the preservation and interpretation of cultural assets. This literature review delves into the multifaceted application of AI technologies in the domain of cultural heritage, examining both the technological advancements that facilitate these applications and the ethical considerations that they entail. Drawing upon the seminal works of scholars such as Buratti (2021) and Li (2021), the review begins by exploring AI's role as a novel medium for cultural expression and preservation, emphasizing its capacity to reconstruct lost knowledge and evoke emotionally resonant experiences of artistic heritage through immersive technologies.

The review further highlights practical applications of AI in the conservation of cultural heritage, as demonstrated by Garozzo (2020) in the restoration of historical artworks and Lee (2019) in the integration of image categorization with natural-language documentation processes. These applications underscore AI's potential to overcome traditional barriers in conservation through innovative computational techniques and data modeling approaches, including the use of recurrent neural networks and probabilistic modeling for predictive analysis.

The importance of a human-centric approach in the application of AI to cultural heritage is underscored by the contributions of Pisoni (2021) and Xie (2022), who advocate for the adaptation of AI technologies to enhance museum accessibility and preserve intangible cultural heritage, respectively. This perspective is further enriched by Fontanella (2020), who provides a



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comprehensive overview of the field's multidisciplinary nature and its potential future directions, emphasizing the ongoing opportunities for AI to contribute positively to cultural heritage conservation.

Crucially, the ethical dimensions of employing AI within the realm of cultural heritage conservation emerge as a pivotal area of concern. Scholars such as Prunkl (2021), Baihakki (2023), Benford (2015), Hong (2022), Kooli (2022), and Luxton (2014) offer critical insights into the moral dilemmas and ethical frameworks that must be navigated to responsibly implement AI technologies. These discussions highlight the complexity of ethical considerations, ranging from minimizing harm and bias to operationalizing ethical guidelines across diverse case studies and addressing the autonomy and control issues associated with the deployment of AI in public domains.

Collectively, the studies reviewed underscore the growing influence of AI technologies in enhancing the documentation, interpretation, and accessibility of cultural heritage. They illuminate both the promising opportunities presented by AI for extending the reach and efficacy of conservation efforts and the imperative to address the ethical challenges posed by these technological advancements. As AI continues to evolve and find application in cultural heritage conservation, the dual focus on leveraging its benefits while meticulously considering its moral implications invites further exploration and innovation in the field. This evolving landscape calls for sustained research into the potential advantages and ethical dimensions of AI in cultural heritage conservation, heralding a future rich with possibilities for both technological advancement and ethical integrity.

## 3. Recommendations

In light of the comprehensive analysis undertaken in the preceding sections, which explored the multifaceted applications of AI in cultural heritage conservation alongside the pertinent ethical considerations, it becomes imperative to chart a forward path that balances the innovative potential of AI technologies with the profound moral responsibilities they entail. The recommendations herein are formulated to guide practitioners, policymakers, and researchers in the responsible integration of AI into the preservation and interpretation of cultural heritage. Central to these recommendations is the advocacy for the development and implementation of robust ethical frameworks that ensure AI applications in cultural heritage conservation are governed by principles of integrity, respect for cultural diversity, and a commitment to minimizing harm. Additionally, fostering interdisciplinary collaborations emerges as crucial, bridging the gap between technological experts, conservation professionals, ethicists, and communities to co-create AI solutions that are not only technologically advanced but also culturally informed and ethically sound. Moreover, the necessity for ongoing research is underscored, specifically aimed at evaluating the impact of AI technologies in conservation practices, identifying potential risks and benefits, and exploring innovative methodologies for integrating AI in a manner that enhances the accessibility, understanding, and appreciation of cultural heritage across global contexts. These recommendations aspire to support the sustainable



 

and ethical use of AI in cultural heritage conservation, ensuring that technological progress contributes positively to the preservation of our global cultural legacy for future generations **(Table 1)**.

**Table 1: Strategic Recommendations for Integrating AI in Cultural Heritage Conservation: Objectives and Implementation Strategies**

| Recommendation | Objective | Implementation Strategy |
|---|---|---|
| Develop stable dialogue | Facilitate interdisciplinary collaboration | Establish forums for interaction among technologists, conservators, historians, and ethicists to share knowledge and co-create solutions. |
| Create ethical framework | Address AI-specific ethical concerns in conservation | Draft and formalize guidelines that tackle bias, authenticity, and data privacy within AI applications in cultural heritage. |
| Enhance AI literacy | Empower cultural heritage professionals | Introduce training programs and resources to improve understanding and decision-making around AI technologies. |
| Educate AI systems | Augment memorization of intangible cultural heritage | Utilize AI to preserve oral histories, languages, monuments, and artifacts through advanced learning algorithms. |
| Expand case study research | Understand AI's adaptability across cultures | Conduct comprehensive studies on AI's application in diverse cultural heritage scenarios to identify best practices. |
| Create avatar-driven experiences | Engage the public with cultural heritage | Develop AI-powered avatars for immersive visitor experiences while ensuring the preservation of artifact integrity. |
| Develop tailored AI tools | Meet specific conservation needs | Invest in AI solutions designed for the unique challenges of each cultural heritage site. |
| Establish regulatory regimes | Mitigate misuse of AI in conservation | Collaborate with policymakers to set up regulations governing the ethical use of AI in heritage conservation. |



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| | | |
|---|---|---|
| Increase transparency | Foster public trust and engagement | Promote open discussions about AI initiatives in heritage conservation to involve the community in the debate. |
| Embrace green conservation | Ensure sustainability of AI systems | Demand AI applications that support environmental sustainability and contribute to a lasting cultural future. |
| Conduct regular AI reviews | Assess and improve AI systems | Implement periodic evaluations of AI technologies to gauge their impact, effectiveness, and areas for enhancement. |
| Provide professional development | Adapt workforce to AI-enabled conservation | Offer on-the-job training and development opportunities for personnel to acquire skills in AI applications. |
| Tackle ethical AI questions | Address ownership, representation, and cultural narratives | Engage in research that explores the ethical dimensions of AI in heritage conservation, focusing on complex issues like ownership and representation. |

Firstly, it is essential to develop stable lines of dialogue among technologists, conservators, historians, and ethicists. Such interdisciplinary engagement will facilitate the sharing of insights and co-creation of solutions that are both technologically sophisticated and culturally sensitive. This collaboration is foundational in addressing complex issues such as bias, authenticity, and data privacy, which are pivotal in the context of AI applications in cultural heritage. Furthermore, the establishment of a specialized ethical framework for AI in cultural heritage conservation is critical. This framework should directly address the unique challenges posed by the integration of AI technologies, guiding their development and application in a manner that respects the integrity of cultural artifacts and the communities they represent.

The enhancement of AI literacy among cultural heritage professionals is also recommended. Such empowerment will enable informed decision-making and foster a culture of innovation within the field. Similarly, educating AI systems on the preservation of oral histories, languages, monuments, and artifacts can augment the memorization of the intangible aspects of cultural heritage, ensuring their transmission to future generations. The recommendations also emphasize the importance of expanding case study research across diverse cultural heritage scenarios. This will provide valuable insights into how AI can be adapted to meet the conservation needs of varied geographies and cultures, further enriching the field with innovative practices.

Innovative uses of AI, such as the creation of avatar-driven visitor experiences, can significantly enhance public engagement with cultural heritage. However, such applications must be designed

to maintain the integrity of the artifacts and the authenticity of the experiences they seek to recreate. The development and investment in AI tools tailored to the unique conservation needs of each cultural heritage site are crucial. Working closely with policymakers to establish regulatory regimes for the use of AI in conservation will mitigate potential misuse and ensure the ethical deployment of these technologies. Transparency and public engagement in discussions surrounding AI's role in heritage conservation are vital for fostering a broad understanding and acceptance of these technologies. Similarly, AI systems should embrace principles of green conservation, ensuring their sustainability and minimizing their environmental impact.

Regular reviews of AI systems post-implementation will help assess their effectiveness and identify areas for improvement. Such evaluations are essential for adapting and refining AI applications in cultural heritage conservation over time. Finally, providing on-the-job training and professional development opportunities for existing personnel will facilitate the seamless integration of AI-enabled conservation methods. This approach ensures that the workforce remains equipped and adaptable to the evolving technological landscape, but the human element will remain indispensible.

Amidst this technological evolution in cultural heritage, the indispensability of the human element remains a cornerstone in ensuring these efforts are not only effective but also meaningful and ethically sound. Humans offer an irreplaceable depth of understanding and empathy that AI cannot replicate, essential for interpreting cultural significance and nuances. The emotional and cultural intelligence of humans enables the identification and appreciation of the intangible aspects of cultural heritage, such as the emotional, spiritual, and societal values associated with historical artifacts and sites. This nuanced understanding ensures that conservation efforts, even when facilitated by AI, are aligned with the cultural context and significance of the heritage being preserved.

Moreover, ethical considerations in the use of AI for cultural preservation necessitate human oversight. Decisions regarding what constitutes ethical use of technology in conservation, how to address issues of digital replication authenticity, and the potential biases inherent in AI algorithms require human judgment. The human capacity for ethical reasoning ensures that cultural heritage preservation practices mediated by AI adhere to moral and ethical standards, respecting the integrity of cultural artifacts and the communities to which they belong. Additionally, human expertise is crucial in the design, implementation, and interpretation of AI technologies in cultural heritage conservation. The development of AI algorithms and systems tailored to the unique challenges of conserving diverse forms of cultural heritage relies on the domain-specific knowledge of historians, conservators, and cultural experts. These professionals provide the essential contextual information and expertise needed to guide AI technologies in a direction that is both technically innovative and culturally sensitive.

The synergy between human expertise and AI capabilities offers a promising path forward for cultural heritage conservation. By combining the computational efficiency and pattern-



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recognition capabilities of AI with the interpretative depth, ethical judgment, and cultural sensitivity of human experts, the field can achieve a balanced approach to preservation. This collaboration ensures that conservation efforts are not only technologically advanced but also deeply rooted in an understanding and respect for cultural heritage. The role of humans in the AI-driven process of cultural heritage preservation is indispensable. The integration of AI technologies in conservation efforts must be complemented by the insights, ethical considerations, and contextual understanding that only human actors can provide. This balanced approach promises to enhance the efficacy and sensitivity of conservation efforts, ensuring that cultural heritage is preserved in a manner that honors its complexity and significance.

While the integration of AI in cultural heritage conservation offers innovative solutions to complex challenges, it is the human element that ensures these technological advances are applied with the necessary depth of understanding, ethical consideration, and cultural sensitivity. The essential nature of human involvement in this process underscores the need for a collaborative approach, where technology serves as a tool guided by human expertise and values, ensuring that cultural preservation efforts are both effective and respectful of the heritage they seek to protect.

## 4. Conclusion

The integration of AI technologies into cultural heritage conservation represents a groundbreaking shift in the methodologies employed to safeguard our cultural legacies. This review began with an exploration of the transformative potential of AI in enhancing the preservation and interpretation of cultural heritage, highlighting both the innovative opportunities it presents and the complex ethical considerations it entails. The indispensable role of human expertise, judgment, and ethical oversight in complementing the capabilities of the emergent technologies was emphasized, underscoring the nuanced and symbiotic relationship between technology and human insight in this domain.

The findings of this study underscore the significant benefits that AI technologies offer to cultural heritage conservation, including advanced pattern recognition, predictive maintenance, and the digital reconstruction of historical artifacts and sites. These technologies, when ethically and thoughtfully applied, have the potential to revolutionize conservation practices, making them more efficient, accurate, and accessible. However, the research also elucidates the paramount importance of maintaining a human-centric approach to AI integration, ensuring that ethical considerations, cultural sensitivity, and the interpretive depth that human experts bring to the table are not overshadowed by technological advancements.

The discussion on the essential nature of human involvement in AI-driven conservation efforts highlights the irreplaceable value of human empathy, ethical reasoning, and cultural understanding in ensuring that technological applications respect the integrity and significance of cultural heritage. This balanced approach not only enhances the technical efficacy of conservation efforts but also ensures they are conducted with the requisite ethical and cultural conscientiousness. ooking ahead, the next steps for research in this field involve a deeper



 

investigation into the collaborative dynamics between AI technologies and human expertise in cultural heritage conservation. Further studies could explore innovative models of interdisciplinary collaboration that optimize the strengths of both AI and human insights. Additionally, there is a need for comprehensive frameworks that address the ethical challenges associated with AI applications in conservation, ensuring that these technologies are developed and utilized in a manner that respects cultural diversity and heritage values.

Moreover, expanding the scope of case studies to include a broader range of cultural heritage scenarios across different geographies and cultures would provide valuable insights into how AI can be adapted to meet diverse conservation needs. This would also contribute to the development of AI tools and solutions that are not only technologically advanced but also culturally informed and ethically grounded. The integration of AI in cultural heritage conservation opens up exciting possibilities for safeguarding our cultural heritage with unprecedented precision and sensitivity. However, the successful realization of these possibilities hinges on our ability to foster a harmonious balance between technological innovation and the deep-seated human values that underpin cultural heritage conservation. As this field continues to evolve, it will be the synergy between computational prowess and human wisdom that will ensure our cultural legacies are preserved for future generations to explore, understand, and appreciate.



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# MedMicroMaps: A Novel Decision-Tree Guide for Infectious Diseases Differential Diagnoses, and Evaluation of Pre- and Post-Pandemic User Engagement by Preclinical Medical Students

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## Abstract

In the rapidly evolving landscape of medical education, particularly in response to the COVID-19 pandemic, innovative digital resources have become essential for training in infectious diseases. This study explored the effectiveness of MedMicroMaps, a suite of multimedia e-learning tools, among second-year medical students at a Caribbean medical school. Students were provided with animations, illustrations, diagnostic algorithms, and case-based tutorials to enhance their learning experience. Engagement was tracked through viewer analytics and feedback surveys across different instructional formats: in-person, virtual, and hybrid. The findings revealed the highest user engagement in in-person settings (67.5%), significantly reduced engagement in virtual-only formats (2%), and moderate engagement in hybrid settings. The results highlight the pivotal role of multimedia e-learning resources in medical education, suggesting that while these tools are beneficial, their impact varies significantly with the mode of delivery. The study points to the necessity of integrating such tools into the curriculum while adapting delivery methods to maximize student engagement and educational outcomes. Future directions include expanding these resources to more immersive technological platforms using



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artificial intelligence, indicating a trend towards more interactive and engaging learning environments in medical education.

**Key Words**: *Infectious diseases, Microbiology, Method of Loci, Spatial Memory, Mind Map, e-Learning, Virtual Reality, Augmented Reality, Extended Reality, Artificial Intelligence, Machine Learning, Metaverse*

## Introduction

The transformation in preclinical medical education from pure didactic in-person lectures to reliance on strict *e*-learning modalities became apparent in 2020 in context of the COVID-19 pandemic (Wilcha 2020). As students and faculty returned to on-campus learning, the question emerged of how best to leverage an effective balance of digital content with traditional oral content delivery to meet the changing learning preferences of a younger generation of students (Moran 2018). Studies across diverse disciplines have established the benefits of *e*-learning modules, especially for non-traditional learners (Kim 2006, Lochner (2016). A pre-pandemic study that examined of medical student preferences for *e*-learning study tools found that >90% of participants utilized online study resources, including question banks and videos (Wynter 2019). Two digital-based resources, Sketchy Medical and Osmosis are widely used for study guides in preclinical education, utilizing 2-dimensional cartoon animations on a range of biomedical subdisciplines (Sayıner 2021). The popularity of the entertaining media is supported with the observation that YouTube channel for Osmosis had 3.11 million subscribers at time of writing and published editorials authored by medical students (Monzon 2021). Sketchy Medical reported subscriptions capturing approximately 1/3 of American medical students (Techcrunch 2020) and an informal polling at USA-accredited medical school on Caribbean island revealed that >70% of students had used the resource as supplement to course material (unpublished data). The fundamental basis of the Sketchy platform design is use of mnemonics and the Method of Loci *aka* Memory Palace to create color-coding and cartoon symbols with spatial repetition to facilitate memorization and recall, with reported variations in efficacy (Moll 2023, Twomey 2021, Kluger 2022). As an example of symbolism for the biological characteristics of hydrogen sulfide $H_2S$ production by the agent *Salmonella*, the Sketchy Microbe cartoon shows a burnt salmon fish to represent the distinct black bacterial colony growth on supplemented media (Sketchy.com). Although these tools may yield short-term benefits of rote memorization for optimal performance on text-based standardized tests including the USMLE-Step 1, passive learning models reinforce a fixed mindset versus growth mindset; however, a range of *e*-learning resources for infectious diseases exist with higher order content (Sayıner 2022). Students encounter challenges with the ability to apply critical thinking for higher order questions that



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yield diverse variations to patient presentations, comorbidities, exposure risks, and evolving drug resistance.

Medical educators are observing the dawn of the age of artificial intelligence and immersive technologies, prompting the query of how to adapt established teaching modalities to suit the contemporary and future classrooms, including how to apply decision-tree logic (Podgorelec 2002), the foundation of machine learning in artificial intelligence. Furthermore, the institutions of higher education are assessing currently available immersive technologies of XR-AR-VR (extended/augmented/virtual reality) modalities to fortify the broader goal of training future physicians with adaptive, lifelong learning skills, which are necessary for cognitive assimilation of novel, emergent pathogens including SARS-CoV2. In addition to the pioneering work of Walt Disney in coining the term edutainment in 1954, recent advancements in technology have led to the integration of XR (Extended Reality) with asynchronous learning methodologies, enhancing the educational landscape (Disney, 1954). This combination has proven to be pivotal in addressing the diverse learning styles prevalent among students today, offering interactive and engaging experiences that cater to individual preferences (Johnson & Smith, 2023). By incorporating elements of gamification and immersive storytelling, edutainment through XR creates a compelling educational hook that not only captures students' attention but also facilitates long-term content retention (Huang, 2020).

Understanding generational differences in education is crucial for optimizing the effectiveness of educational content delivery. Millennials and Generation Z, often referred to as digital natives, have grown up in an era immersed with technology, making them particularly receptive to XR-based learning experiences (Garcia, 2020). Research indicates that these cohorts exhibit higher levels of engagement and motivation when learning through XR platforms compared to traditional methods (Jones & Williams, 2019). This heightened engagement can be attributed to the interactive nature of XR environments, which provide hands-on learning opportunities and encourage active participation (Thomas & Clark, 2022). The incorporation of XR technology in education has led to the emergence of new pedagogical approaches and teaching strategies. Educators are using XR tools to create simulations and virtual laboratories that simulate real-world scenarios, allowing students to apply theoretical knowledge in practical settings (Parker &



 

Anderson, 2021). This experiential learning paradigm not only enhances comprehension but also fosters critical thinking, problem-solving, and decision-making skills (Smith & Johnson, 2023).

In conclusion, the integration of edutainment with XR asynchronous learning represents a transformative shift in education, offering immersive and engaging experiences that resonate with diverse learning styles. As new generations of learners embrace XR technology, educators and institutions must continue to explore innovative ways to harness its potential for enriching educational experiences and fostering lifelong learning. During the COVID-19 pandemic, considering the widespread shift to virtual learning worldwide, a comprehensive interactive mind map tailored for infectious diseases aka *MedMicroMaps* was created to provide a pattern map of lecture content (Palaniappan 2023). Furthermore, multimedia microbiology study resources were developed to guide preclinical medical students in navigating various diagnostics possibilities through clinical, epidemiological pathways using case-based scenarios with supportive animations and illustrations to highlight complex host: pathogen interactions.

## 1. Methods

### 2.1 Project Aims

Aim 1: To evaluate user engagement of microbiology digital media resources (*MedMicroMaps*, pathogenesis animations, illustrations, and Case-Based Guides).

Aim 2: To collect qualitative and quantitative feedback from study participants on individual utilization of digital media resources and self-reported impact on mastery of the course material.

### 2.2 Participant Population

Students enrolled in USA-Accredited off-shore medical school in year 2 preclinical courses were provided supplemental *e*-learning materials hosted on either Sakai LMS, Panopto or Digication server to correspond to essential course content delivery via In-person: Cohort 1 (*n*=526); Strict Virtual: Cohort 2 (*n*=833); and Hybrid: Cohort 3 (*n*=928, estimate 100 in person), Cohort 4 (*n*=865, estimate 500 in person).. Course material and announcement of supplemental material were announced via didactic synchronous lecture modality or assigned student Directed Learning Activities (DLA) with PowerPoint (PPT) text-based material converted to PDF. Students were



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provided with an email and in class summary that described the goals of the project, participant involvement and informed consent as approved by the Institutional Review Board.

## 2. Microbiology Digital Media Resources

**Animations and Illustrations**: Pathogenesis animations and illustrations were created in collaboration the Center for BioMedical Visualization (CBV) to represent bacterial classification, virulence factors and host-pathogen interactions with *Staphylococcus aureus* skin infections (Part 1), post-viral *Streptococcus pneumoniae* sinus infections (Part 2) and gastrointestinal infections using Blender, Adobe Illustrator and Adobe Animate (See Figures 2,3). The exported files in PPT and .mp4 format were provided to students via Panopto (pre-pandemic) with links embedded in lecture PDFs or Digication (pandemic) server. MedMicroMaps microbe world animation was generated with artificial intelligence using Pixverse.AI.

**MedMicroMaps**: Comprehensive diagnostic decision-tree algorithms organized by system-based modules to encompass clinical presentations, epidemiological populations with subset risk factors and microbial biological classification were developed using PPT format with interactive hyperlinks in collaboration with a graphic designer at CBV. The resource was provided initially to students on Sakai LMS corresponding to the sub-topic module folders and was subsequently provided on Digication server.

**Digication e-Portfolio**: Cohort 5 students (*n*=865) in hybrid delivery format were provided link to Microbiology Digital Media Resources website hosted on Digication webserver, via QR code announcement during first live lecture of infectious disease system module. QR responses were tracked via QR Tiger Subscription. The website server has been updated to Google Domains www.medmicromaps.com to increase user accessibility without restriction of login with institutional credentials.

**Case-Based Guide to MedMicroMaps**: Themed Office Hours using case-based learning to guide through decision tree diagnostic logic of *MedMicroMaps* were hosted as live Zoom session and recorded on Panopto and subsequently uploaded to the Panopto or Digication servers. Case materials were organized with presentation and onset, patient history, physical examinations, imaging and laboratory findings with embedded differential questions, polled with PointSolutions, and summary material from MedMicroMaps, originally authored or modified

from Nath Problem-Based Learning, Sherris Medical Microbiology, AccessMedicine, Infectious Disease Society of America.

**Quantitative and Qualitative User Engagement**: Student participation and utilization of the various resources were assessed with extracted statistics to Excel data sheet from Panopto, Sakai, Digication and QR Tiger. Student feedback with informed consent, including Likert 5-point scale ratings and open-ended comments, were collected on Qualtrics with a link provided via email announcement on LMS Sakai server.

## 4. Results

The pilot study was launched for Cohort 1 January 2020 prior to onset of COVID-19 pandemic (see Figure 1: Study Design) with the addition of the Part 1 animation on *Staphylococcus aureus* Bacterial Pathogenesis (format .mp4 hosted on Panopto) associated with required DLA (Direct Learning Activity) in Term 3 for 2nd year medical school course (Figure 2.A, Animations). All students had downloaded the PDF for the DLA (*n*=526) and 67.5% (*n*=355) of students had viewed the 2-D Panopto video by the study deadline of 1 week. Of the students who watched utilized the Panopto link, 88% (*n*=312) completed both the 2-D video (required) and the 3-D animation (optional). During Fall 2020 with virtual-only instruction for Cohort 2 post-onset of COVID-19 pandemic, the link to the Panopto 3-D animation was eliminated from the required DLA PDF and provided in virtual-only supplemental office hour (live-stream Zoom with recording hosted on Panopto), and only 2% of Term 4 medical students viewed the animation (n=18, total population = 833). Data analytics were not assessed for students enrolled in Term 4 Spring 2021 as the MedMicroMaps system was being further developed.

Instruction shifted to hybrid format in Fall 2021 with simultaneous in person and live Zoom streaming virtual delivery for Cohort 3. A link to follow-up Part 2 animation on *Streptococcus pneumoniae* Bacterial Pathogenesis (see Figure 2.B: Animations) as format .mp4 hosted on Panopto server was provided to virtual students (approximately 2/3 of population) via Zoom chat function and in person students via PDF file posted on Sakai. Within 72 hours of the link posting, 33% of Term 4 medical students viewed the animation (n=307, total population = 928). During the duration of the MedMicroMaps development, the author of the study would receive inquiries about resource posting in Sakai from students after they had completed Term 5 and were actively studying for USMLE-Step 1 Board Examination. To overcome the challenge of



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sorting through past semester file placement, the comprehensive e-portfolio "Microbiology Digital Media Resources" was created as a centralized location for all the supplemental material on the Digication server, including all organs system MedMicroMaps. Additional resources included Zoom and Panopto recordings of Case-Based Guides, tutorials to the MedMicroMaps systems, and infographics representing course of disease for gastrointestinal infections (See Figure 4 & 5, Supplemental Material) Upon announcement of the website with a QR code provided to Cohort 4 students (*n*=865), scan tracking by QR Tiger showed viewing by 57.6% of the population in a single day (*n*=498), spanning 16 countries across 4 continents. Engagement on the Digication website indicated 1000+ views per module per month for subsequent Terms 4 and Terms 5 (current total views 16K at time of writing), with increased viewing the weekend prior to the module. After the final infectious disease module, 79 students (9.1% response rate) from Cohort 4 completed the Qualtrics survey. The majority of the responses indicated Extremely Satisfied (68.4%, *n*=54) or Somewhat Satisfied (12.6%, *n*=10) to "Rate your overall satisfaction with the Pathogenesis Animations" (see Figure 5). When prompted for specific utilization of the *MedMicroMap*, students ranked Exam Preparation highest (71.4%, *n*=50), followed by used with Practice Questions (57.4%, *n*=43) (see Figure 6). Qualitative open responses indicated popularity for the animations and the decision-tree algorithms (see Table 1), represented by statement: *I really enjoyed the animation. It helped me visualize the process and understand everything better. I even showed my wife because I thought it was so interesting*. Responses included construction criticism to include antimicrobial treatments and virulence factors in the MedMicroMaps resource, which will be incorporated in future renditions of the *e*-learning resource.

## 5. Conclusions and Future Directions

The findings from this pilot study demonstrate the impact of instructional delivery methods on students' engagement with educational materials, particularly in the context of the COVID-19 pandemic. While the incorporation of 3-D animations alongside traditional learning material led to high levels of utilization and completion rates in a pre-pandemic setting, the transition to virtual-only instruction resulted in significantly lower engagement levels (67.5% compared to 2%). The variations of user engagement per semester were influenced by student-teacher interactions and modes of providing links to the supplemental resources with the greatest single-

day engagement (57.6%, *n*=498) with the QR code linking to the Digication website provided during a synchronous, hybrid lecture. These results underscore the importance of adapting teaching strategies to meet the evolving needs and challenges faced by medical students in today's educational landscape. The educational research study is ongoing with integration of the MedMicroMaps system with accompanied e-learning tools into the 2-year infectious disease curriculum at Rocky Vista University. MedMicroMaps with the accompanying multimedia resources has been incorporated in the curriculum design of Microbiology, Immunology and Infectious Disease course. An introductory map slides for pre-recorded PPT session was created with instructor reinforcement of spatial positioning (see Figure 8: Viral Map) organized with biological classification and was provided for all viruses, half of bacteria and none of eukaryotic agents. A Qualtrics feedback survey with informed consent will be administered following the completion of the course with 6-month and 12-month assessment for biological classification recall accuracy. Lastly, the MedMicroMaps system with the comprehensive decision-tree logic was originally designed for immersive technologies including Virtual, Augmented, and Reality developing in the Metaverse (collectively referred as XR Extended Reality). Visually engaging study materials are readily adaptable to XR platform, leveraging the computational advantages conferred by generative artificial intelligence, with the ability for the learner to scale down to the invisible microscopic world with a 1 nanometer viral particle fitting in the palm of the hand (Figure 9, Supplemental Material). The future of MedMicroMaps in cross-platform interfaces envisions storylines covering all infectious diseases, with adaptable design for diverse audiences within allied health fields, including those in allopathic and osteopathic medicine, nursing, pharmacy, graduate biomedical and veterinary sciences, with skill levels ranging from advanced placement high school biology to practicing physicians.



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**Figure 1 Pilot Study Design**

Medical students in 2nd year basic sciences courses at a USA-accredited Caribbean medical school were provided supplemental digital media resources corresponding to microbiology lecture modules with delivery formats changing from in-person, Zoom-based virtual, and hybrid formats in response to pandemic restrictions. Resources included animations, novel mind map MedMicroMaps, case-based office hours, and infographic illustrations for gastrointestinal infections, provided on course LMS, Panopto or Digication servers.

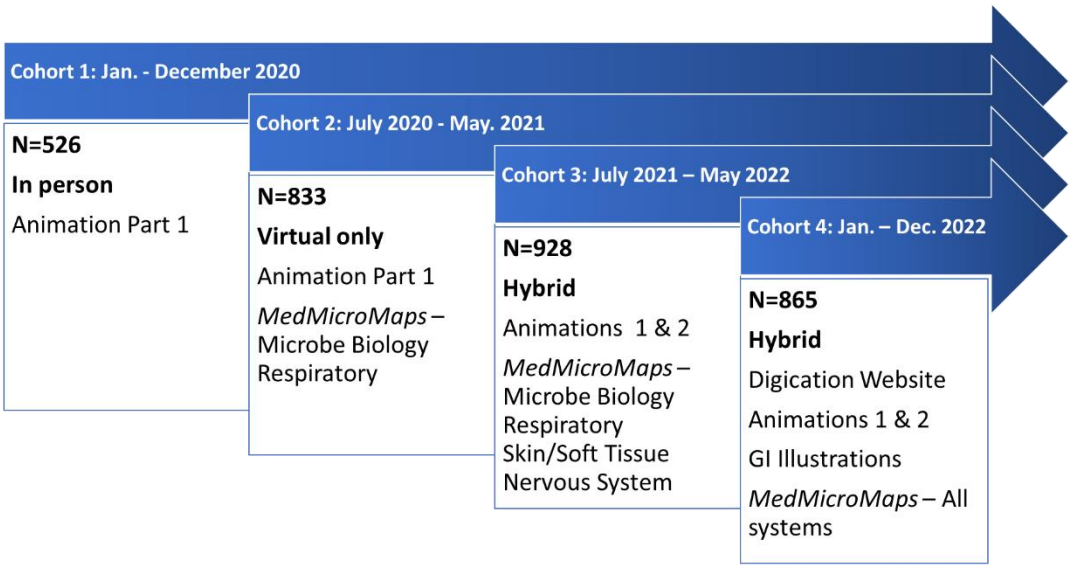

**Figure 2 Pathogenesis Animations**

In collaboration with SGU Center for BioMedical Visualization, 3-D pathogenesis animations (A. Part 1: *Staphylococcus aureus*, B. Part 2: *Streptococcus pneumoniae*) were created to illustrate complex host-pathogen interactions. Animations were provided as supplemental material hosted on Panopto or Digication website server. User engagement and student feedback were assessed with the respective server statistics and a Qualtrics survey.

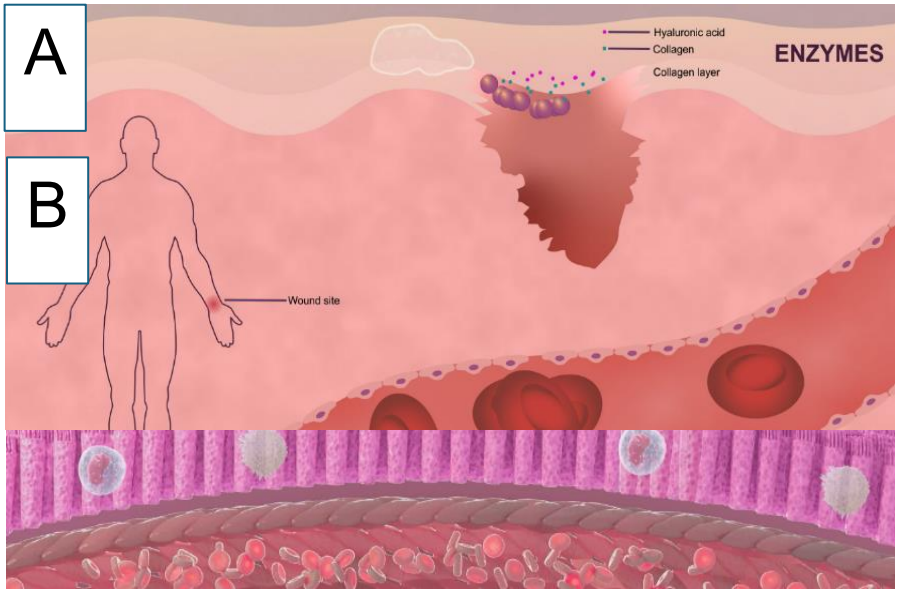




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**Figure 3: Infographics Illustrating Course of Disease for Gastrointestinal Infections.**

Medical illustrations were created to demonstrate the course of disease for gastrointestinal infections, specifically showing the host and bacterial interactions of Entero Pathogenic *E coli (*file with animations available in supplemental material). Illustrations provided diversity of patient representation to correspond to epidemiological incidence.

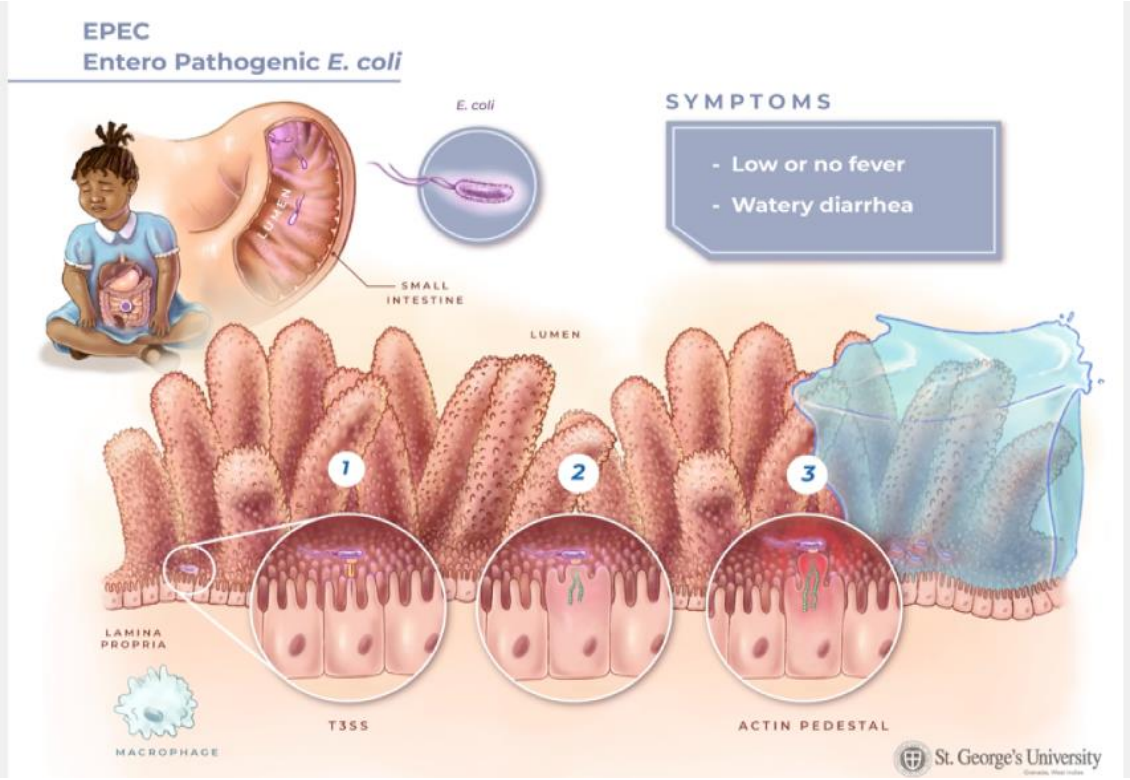

**Figure 4 Representation of Respiratory *MedMicroMaps* Diagnostic Algorithm**

An interactive guide of infectious diseases on PowerPoint platform was developed for preclinical medical students, using the principles of mind maps and Method of Loci to create a consistent color-coding and spatial patterns arranged on a compass with cardinal directions to emphasize decision-tree logic. Embedded hyperlinks routes the user through differential diagnoses, following the content order of board-style vignettes.

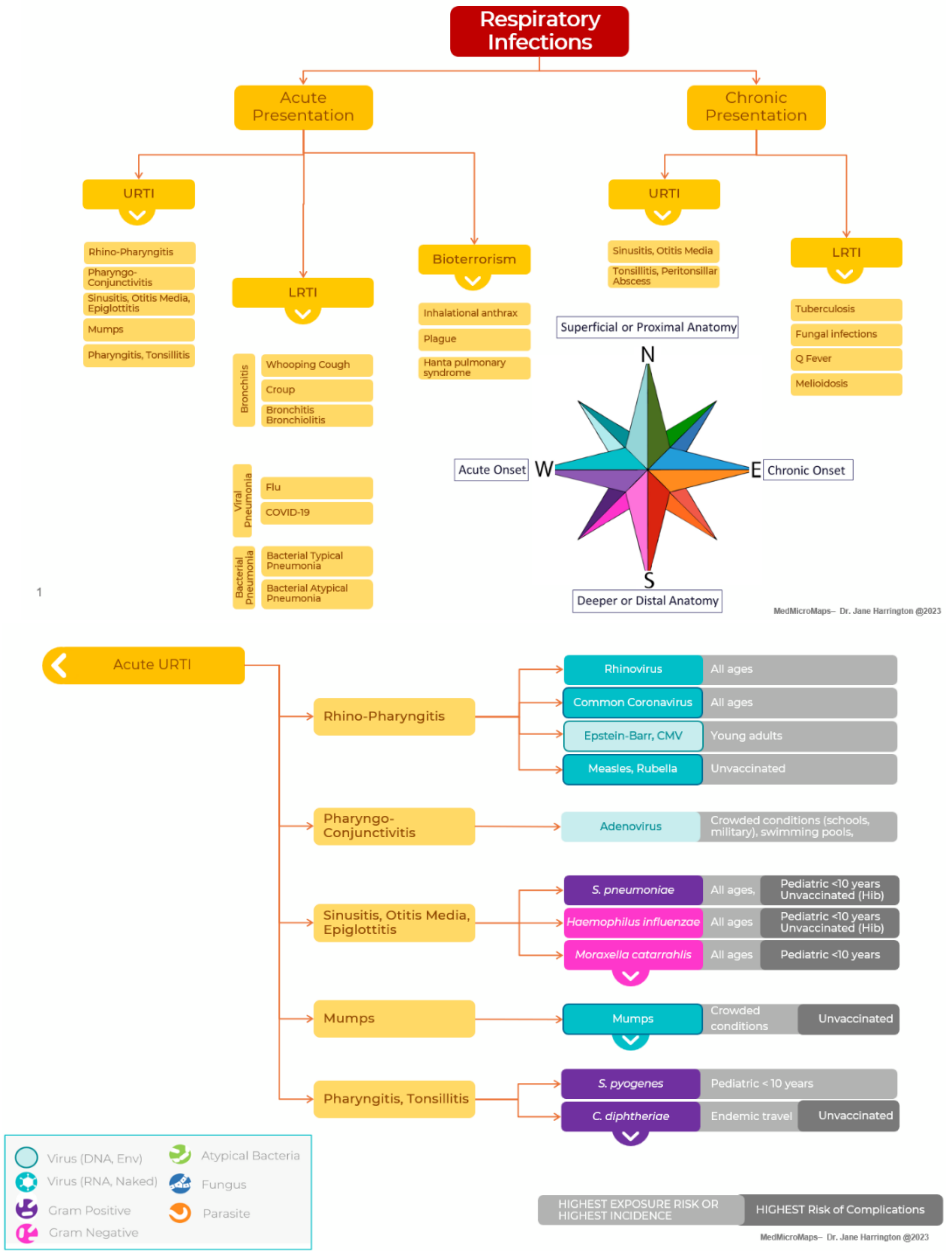




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**Figure 5: Student Engagement with Multimedia Resources**

Bar graph illustrating the levels of user engagement for Cohort 1 (pre-pandemic) using Panopto, measured by the percentage of PDF downloads and viewership categories. The red bar indicates the proportion of students who downloaded PDFs, while the green, blue, and orange bars represent the students who viewed the PDFs at rates of >65%, 65%-15%, and <15%, respectively. The Y-axis indicates the percentage of students participating in each category.

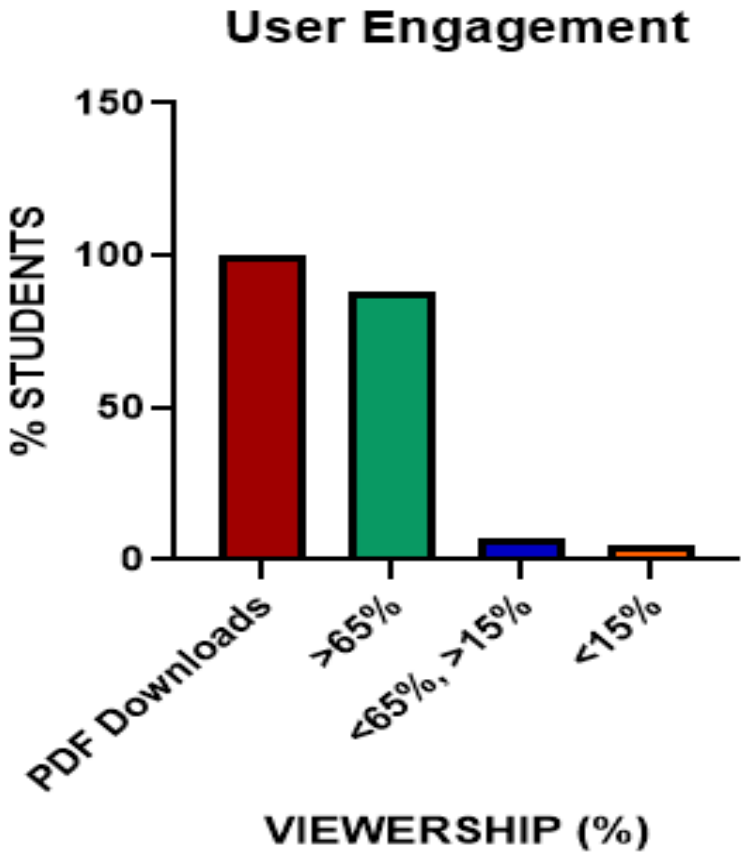
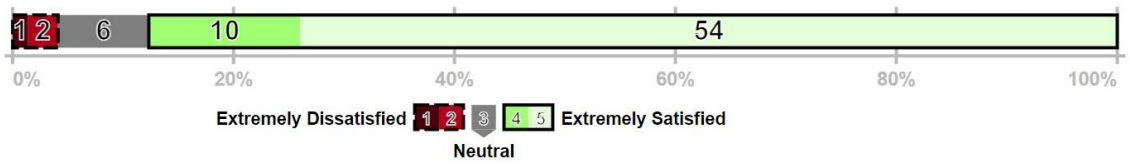


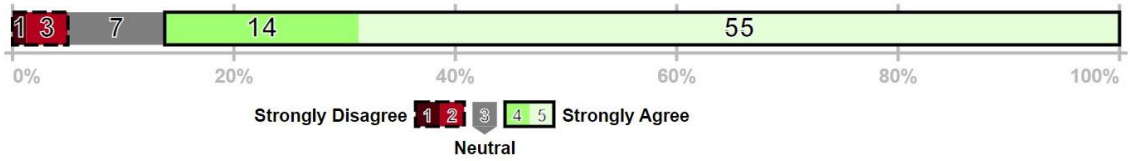
**Figure 6: Qualitative Student Feedback.**

A 5-point Likert scale representing Cohort 5 student responses were asked how satisfied they were using supplemental digital media resources.

*A. Rate your overall level of satisfaction with Pathogenesis Animations.*




*B. To what extent do you agree that the Respiratory Infections MedMicroMaps enhanced your*




*learning experience with the material covered in this module?*



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**Figure 7: Distribution of User Preferences for the MedMicroMaps**: Stacked bar graph representing the usage of MedMicroMaps by students within two different systems: the Central Nervous System (CNS) and the Respiratory Infections modules. The segments within each bar indicate the number of students engaging with the resource in different ways, categorized by activities such as preparing for module exams (red), doing practice questions (dark orange), following module lectures (light orange), referencing during themed office hours (yellow), and not using MedMicroMaps (beige). The horizontal bars indicate the total number of students for each category and system.

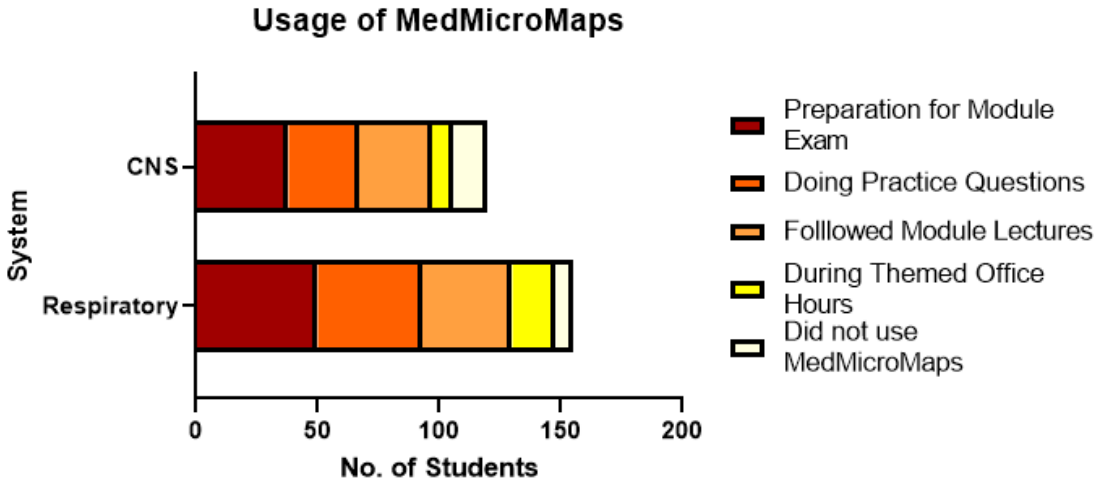

**Figure 8: Green Screen Video Recording of MedMicroMaps.** A representative GIF of instructor presenting a section of MedMicroMaps, specifically the Skin and Soft Tissue Infections portion including Viruses. Spatial repetition is incorporated into required student directed learning materials delivered as pre-recorded videos on Panopto server.

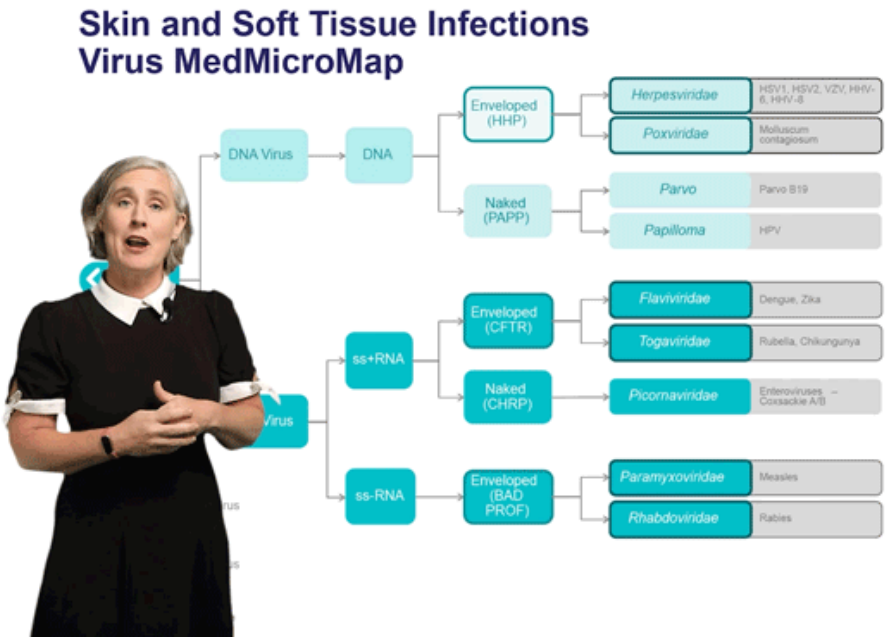




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**Figure 9: MedMicroMaps Trailer Created with Generative Artificial Intelligence**

The computational processing powers of large language models, including generative AI program Pixverse are a new avenue to exploring the microscopic world of MedMicroMaps by creating images and videos of infectious agents that fit in the palm of a human hand.

**Table 1 Qualitative Feedback from Cohort 4 Medical Students**. Table 1 represents feedback received on MedMicroMaps, where positive feedback is depicted on the left, and negative feedback is shown on the right.

*Please provide any feedback on Microbiology digital resources (open response).*

| Positive Feedback | Negative Feedback |
|---|---|
| The MedMicroMaps were a great resource to help organize and consolidate the information needed on the microbes. They were an important resource for me that I referenced during class, doing practice questions, and studying for the exams. The format for the office hours was helpful in practicing cases and understanding what was important in each topic. | Not a fan of flow charts to begin with but the flow charts can be improved in the design aspect, visually. |
| Digital visual resources make studying much interesting and easy to retain. These charts also help to connect all the dots as you progress in learning new infections | None were useful. All was thought for detail learning instead of pattern learning ways. |
| The digital resources including the Med Micro Map were my primary source of information and study reference for all of the microbiology content from Terms 4 to 5 and I continue to use the PDF to review the material. | Match treatments earlier, helps compartmentalization. (Regardless if tested on the upcoming exam) |
| I really enjoyed the animation. It helped me visualize the process and understand everything better. I even showed my wife because I thought it was so interesting. | it was not useful in ruling out choices, just showing what groups orgs fall in. i tried to use it answering questions, but not helpful and was cumbersome. |



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| | |
|---|---|
| LOVED the med micro maps, but some of the links don't work to go forward to a microorganism or back to the overview slide. | I would have loved the micro map to have a roadmap slide that also included the virulence factors and all the other necessary information all on 1 page |
| Loved the roadmaps and animations created!! super helpful and helps link the dots between microbe & diseases | CNS micro map doesn't appear to be on Course-LMS yet |

## 5. Statement of Ethics

*Ethical Review*

The investigations of this study were compliant with ethical practices established by Nuremburg Code. The educational research project was submitted to the Internal Review Board at St. George's University and was determined to fit the criteria for exemption for full review prior to initiation of study investigations. An electronic informed consent was provided to participants and confirmation of consent was obtained for feedback survey responses.

*Statement of Competing Interests*

The author of the article had no conflicting established partnerships of financial or non-financial support during the pilot study and held an academic position at St. George's University. No funding agencies contributed to the pilot study. The corresponding author of the article currently holds an academic role at Rocky Vista University and has recently established a start-up company MedMicroMaps, LLC. to apply for grant funding with the National Science Foundation, Small Business Innovation Research program. MedMicroMaps, LLC. has no established financial relationships with external funding partners.



 

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# Do You Know Where Your Games Come From? Artificial Intelligence and Game Development

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## Abstract

This paper was written to explore the possible effects of artificial intelligence being implemented in the design pipeline of video game development. In it, we will explore a history of artificial intelligence, from its early imaginings in books and philosophy, to its current iterations, such as ChatGPT and other popular engines like Midjourney and Stable Diffusion. We will also discuss steps in game development so as to understand where the potential implementations of artificial intelligence can, will, or does occur. Following those explanations, we will explore the three methodologies of Marxism, Psychoanalysis, and Cultural Studies as ways of examining the idea of artificial intelligence implementation in the development pipeline of video games, and from these different methodologies, the resulting insights of their given theory/method. After full use of these methodologies, we will conclude with that examination of the question: "Which of the following methodologies: Marxism, Psychoanalysis, and Cultural Studies, best enable us to understand the effect of Artificial Intelligence in the Game Development pipeline?" based on what we previous discussed.

**Key words:** *Artificial Intelligence, video games, Marxism, Psychoanalysis, Cultural Studies, game development*

## 1. Introduction

Video games have been used in multitudes of ways, from relaxation tools, competitive outlets, education and simulators of varying kinds. Over the last 40 to 50 years, they have become a cultural force that has helped influence popular culture through the advancements (Metuarau, 2017). From the earliest ideas stemming from military simulations (Metuarau, 2017) and Atari's *Pong*, great changes occurred as developments came and technology improved, eventually giving us the grand systems and styles of video games that we have today.

Artificial intelligence that comes to mind with the advancements of technology. Many believe that artificial intelligence has been a product of newer technologies, when actually, it has been around much earlier than that. Philosophers have used the possibilities of intelligent machines as a literary device to help us define what it means to be human, while science fiction writers used the possibility to advance the intelligence of nonhumans and to make us think about the characteristics that make us human (Buchanan, 2017). Authors, such as Jules Verne, Issac Asimov, and L. Frank Baum, were very influential to researchers of artificial intelligence (Buchanan, 2017). Baum, the author of *The Wizard of Oz,* gave us TikTok in 1907, an "Extra-Responsive, Thought-Creating, Perfect-Talking Mechanical Man…Thinks, Speaks, Acts, and Does Everything but Live" (Buchanan, 2017). Robots and other artificially created beings, such as golems from the Jewish tradition or Frankenstein from Mary Shelly's book of the same name, have always captured the imagination of the masses, in part by the fear of them they had (Buchanan, 2017). In the 1700s, clockwork animals and human-like "dolls" showed that they weren't to be feared because of the limitations (Buchanan, 2017). In the 18$^{th}$ and 19$^{th}$ century, when chess was known as the game of intelligence, chess playing machines were popular testing



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artificial intelligence, with the most famous of them being "The Turk" (Buchanan, 2017). Great advancements in electronics, and the 20th century, post WW2, rise of the modern computer brought many of them into universities and laboratories all over America and Europe and were dubbed "Giant Brains" due to their calculating power (Buchanan, 2017). Artificial Intelligence wasn't all about robots, though. It was also "about understanding the nature of intelligent thought and action using computers as experimental devices" (Buchanan, 2017). This can be seen more recently in the developments of ChatGPT, an artificial intelligence program that analyzes data and produces responses to questions asked of it, and text-to-image ai generators like Midjourney and Stable Diffusion.

In the development of video games, there are many things that work in tandem to each other to achieve the best product that can be enjoyed by others. These can be broken down into five stages: pre-production, production, quality assurance, launch, and post-production (Game Ace, 2023). Pre-production is the idea phase and where a lot of data is collected. Project managers and owners take the reins and line out the game's objects and make clear the fundamental concept the game is to have. (Game Ace, 2023). Major aspects for this phase include market and competitor analysis, who the target audience is, choosing which platform to use, allocation of resources, the concept art, how things will be monetized, risk analysis, and marketing strategies (Game Ace, 2023). Production is the heart and backbone of game development, as it is the most labor-intensive part of the the development cycle. Major aspects of this phase include prototyping, visual content creation, level designing, detailing the game's logic or how things run in the game, adding immersive elements such as sounds and music, and coding (Game Ace, 2023). Quality assurance is the final look over before launch to ensure that the gamer's journey is seamless, attempting to catch as many issues/bugs as possible and refining things that may not work as planned (Game Ace, 2023). Launch is the grand release of the the game into the hands of the public, who take the game and explore what was made and help to round out some rough edges that may have been missed, giving feedback, and thus, we reach the last stage of post-production. The development team takes the feedback from the gamers and use that information to refine and enhance the gameplay experience (Game Ace, 2023).

Now, what if artificial intelligence was incorporated into the development of a video game? Where would it best be used? What would the effects of its use be on the teams developing the games? To explore the possibilities of these questions, we can turn to Marxism, Psychoanalysis, and Cultural Studies to see which may better explain what the combination of artificial intelligence and video game development could look like.

## 2. Methodologies

Marxism can be defined as a political philosophy and method of socioeconomic analysis. Created by Karl Marx, this method maintains the author of a worker's class and prevailing ideology which determined what is produced by them (Barry, 2009). In his book, *The Communist Manifesto*, Marx advocated for the working class, who had been exploited during the Industrial Revolution, to rise up and seize power and distribute the wealth of the workers amongst everyone, creating a classless society with common ownership of production (Barry, 2009). Applying this to game development and artificial intelligence can be done in a few ways. The applying of artificial intelligence can occur during pre-production, production, and post-production. In pre-production, it could be used as a way gathering data that is specified and neatly put it together and done so more quickly than a team of people could do just by the

aspects of what artificial intelligence can currently do. This can also be said for the concept art creation. Now that text-to-image generators are here, they can be used to quickly put down the ideas for a concept and produce numerous options in a shorter amount of time than an individual artist can. Thus, these can indicate a potential shift when it comes to the time that could be saved by implementing artificial intelligence into these areas. "What are the symptoms of this social transformation? They can be seen whenever a company like Microsoft outsources a call center from Redmond to Bangalore, or in the new medical surveillance networks scanning global health databases for the next outbreak of SARS" (Galloway, 2006) is a quote that I feel best represents the ideas behind this. Saving time is important, but the idea of being able to use people that don't have as much specialized training/knowledge in certain areas, allowing "normal people" to be able to have access to the creation process is, in a way, very similar to the sharing of the means of production and losing the "classes" that are there of "artist" and "non-artist." Yet, work still can flow well within the production pipeline. Leon Trotsky, in his book *Literature and Revolution*, would say that with the more people able to work in the pre-production aspects of development, which would achieve faster results, that "Art needs comfort, even abundance. Furnaces have to be hotter, wheels have to move faster, looms have to turn more quickly, schools have to work better" (Trotsky, 1924). The more we can produce, the more we can achieve.

Psychoanalysis is defined as a form of therapy and theory that was developed to help cure mental illnesses by exploring the interaction between the subconscious and conscious mind (Barry, 2009). Sigmund Freud is the German theorist that developed the first therapeutic methods of psychoanalysis. One main aspect of this was the idea of "the fear of castration," the loss of male genitalia that was seen as a symbol of power (Freud, 1900). This is also seen in his idea of Oedipal complex, the attachment of a male child to their mother which included envious and aggressive feelings toward the father; these feelings are hidden away in the subconscious for fear of displeasure or punishment (Freud, 1900, Barry, 2009). This is something that can be explored in the integration of artificial intelligence in video game development, for the role of the artificial intelligence would be to replace some work that people currently do. While this could be used to speed up production times and cut costs, this could invoke the sense of loss or castration that Freud talks about amongst the artists/workers that are replaced by artificial intelligence. In 2023, a strike was held by the Screen Actors Guild-American Federation of Television and Radio Artist, or SAG-AFTRA, that was about achieving better pay and work conditions but also to include provisions on artificial intelligence and its uses in recreation of aspects of actors/workers without permission or compensation (CBS News, 2023). There were also lawsuits that were held regarding artists suing artificial intelligence generators that were potentially trained to create artwork based off of some of their works without the explicit permission of these artists (U.S. Copyright, 2023). These two occurrences depict the aggression and negative feelings that have occurred from the uses of artificial intelligence outside of game development and proves that there is a high probability of its occurrence there too.

Cultural Studies is a study that revolves around the idea that there is always a more dominant group in any society or circle that you may look at throughout history, and that no matter what we do, we cannot escape the fact that if we aren't a part of that culture, we can't truly know it or that we can separate culture from the politics of the times of that culture (Barry, 2009). This could include the strikes and artists suing artificial intelligence generators since these don't have many laws or regulations as of yet. Their uses can, at times, be seen negatively and unjust, thus the politics of the time, massive use of artificial intelligence and lack of guidelines for their



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conduct, led to the cultural feelings of negativity toward artificial intelligence (CBS News, 2023, U.S. Copyright, 2023). Some would argue that these AI generators aren't causing much harm but are bringing the access of creativity that was previously out of reach, sometimes, without training or schooling. A quote from Paul Valéry in Walter Benjamin's *The Work of Art in the Age of Mechanical Reproduction,* can help back that idea: "Just as water, gas, and electricity are brough into our houses from far off to satisfy our needs in response to a minimal effort, so we shall be supplied with visual or auditory images, which will appear and disappear at a simple movement of the hand, hardly more than a sign" (Benjamin, 1969). But it could also be argued on the other side that these generators are just replicating things over and over again and "even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be" (Benjamin, 1969). Are the ideas that are produced by the generators just replicas of previous works that the generators have been fed or studied? Would they constitute as their own works by these methods because they would be created in their own time and place in the sense of the generators' production of them? Cultural studies can also examine the natural ecosystem of the development pipeline by the people working in the company and then on that specific project. This line of thinking can be shown in the article, "Little Big Scene: Making and Playing Culture in Media Molecule's LittleBigPlanet" by Sara Grimes. In the article, Grimes explores the social system that was created by players of the game LittleBigPlanet where they were able to use aspects of the game to create their own iterations of the game that they could share with others and interact with what others had produced on an online forum made by the company Media Molecule (Grimes, 2015). Now, I think that, in a similar way, one could apply this and explore the circles of each stage of production and then break it down into smaller circles, i.e. data collection, concept art, narrative direction, and then, once those are defined, implementing artificial intelligence into a section and seeing how that influences the social system, including the positives or negatives of the culture in those circles after artificial intelligence has done it's designated job. I believe Trotsky said it best, "The social whirlpool will no calm down soon. There are decades of struggle ahead of us…" (Trotsky, 1924).

## 3. Conclusion

We have explored the history of artificial intelligence, from the literary and metaphor to the evolution of ChatGPT and Midjourney and Stable Diffusion. We briefly laid out the steps and intricacies of a game development pipeline. With those under our belt, we explored the three methodologies, Marxism, Psychoanalysis, and Cultural Studies, and applied them to the combination of artificial intelligence and game development. Marxism brought out the ideas of sharing the spotlight of creating art or delegating tasks that normally would have taken others longer to do and takes away the lofty idea of "the artist," allowing for the work to be more accessible to the common person. Psychoanalysis pointed out that there could be some issues from people feeling negatively about artificial intelligence integrating into the development of video games, as it could take away their "power" and bring back out repressed feelings of aggression and jealousy indicative of the Oedipal complex. Cultural Studies explored the ideas of the political and social aspects that artificial intelligence could play in the development of video games and the others included in it. This includes exploring the social circles in the development process and the political situations of the time, such as artificial intelligence lacking in guidelines and repercussions, as well as the vast majority now using these generators and downplaying the

works of others by the recreations or renditions of works through these generators. All of these methodologies have substantial merit that can be used in relation to artificial intelligence and video game design. More research and examination are required and highly recommended in these methodologies regarding artificial intelligence and video game development.



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