Generative AI and the Future of Work and Education

Rutgers Consulting Group

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2. Executive Summary

The rapid advancement of generative AI (GenAI) stands to fundamentally impact nearly all aspects of society. Therefore, leaders in both the private sector and academia must understand its effects in order to incorporate it into their operations and minimize the accompanying risks.

INTRODUCTION TO GENERATIVE AI

When ChatGPT first launched in November 2022, it became the fastest-growing internet app of all time, exceeding platforms such as Facebook and YouTube. The platform garnered **100 million monthly users in just two months,** supported by the massive levels of excitement generated around it. **The market is expected to grow at an annual rate of 27%.**

GENERATIVE AI AND THE FUTURE OF WORK

Due to its various use cases, Generative AI is expected to change the dynamics of the work environment. There will be an estimated **12 million occupational transitions by 2030**. There will be growth in various industries, one of which is **healthcare**. Overall, GenAI brings about a need to reskill since a lot of its use is centered around **automation** and **efficiency**.

GENERATIVE AI AND THE FUTURE OF EDUCATION

8 out of 8 experts agreed that the integration of generative AI into the education space is inevitable. The technology has the capacity to promote equity in education, as students are able to utilize AI for more personalized learning. However, educators need to consider a change in teaching methods, as the introduction of AI makes way for numerous unethical practices. With the proper guidelines and regulations in place, educational institutions can properly prepare students for the future.

3. Methodology

To measure student perceptions of generative AI and its usage in education and the future of work, the RCG team surveyed 82 Rutgers student participants. The survey primarily focused on usage habits of generative AI, types used and familiar with, concerns with misinformation and bias, and future implications for the labor market. The team analyzed trends regarding views on generative AI and the necessary preparation desired to enter the evolving workforce.

To contextualize the current state, impact, and outlook of generative AI in education and the workforce, the team interviewed eight industry experts from various organizations, including startups focused on AI equity, the Rutgers School of Arts and Sciences, the Rutgers Business School, the Rutgers Bloustein School of Public Policy, and globally renowned strategy consulting firms.

This integration of primary research, expert interviews, and secondary research rooted in academia and public literature allowed the team to assess the ways generative AI is used currently in the classroom and the workplace and how generative AI will continue to impact learning and working through future advancements.
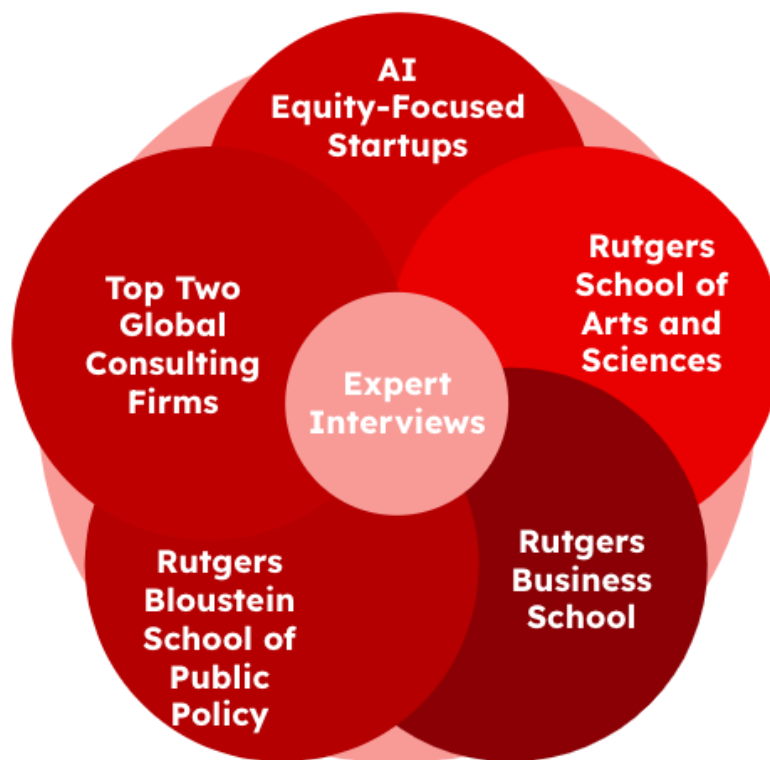
4. Introduction to Generative AI

4.1 What is Generative AI?

Generative AI, or Generative Artificial Intelligence (GenAI), is **an advanced branch of artificial intelligence focused on the development of systems capable of autonomously producing new and innovative content to support various tasks**. In essence, it is supposed to mirror the human brain in its patterns of learning and responding to information.[1] Unlike conventional software, which follows pre-defined instructions, Generative AI learns patterns and structures from vast datasets, enabling it to generate novel outputs across various domains.

At its core, Generative AI leverages machine learning techniques, particularly generative models, to understand and mimic the underlying patterns within the data it is trained on. This enables the system to create content that exhibits a remarkable degree of realism and creativity. Common manifestations of Generative AI include the generation of lifelike images, music composition, natural language text, and even the design of visual elements such as logos or characters.

The capacity of Generative AI **to produce original content without explicit programming** makes it a valuable tool in diverse fields. It has found applications in art, design, entertainment, and beyond. The technology's ability to autonomously create content has the potential to streamline creative processes and open new possibilities in various industries, marking a paradigm shift in how we approach tasks traditionally associated with human creativity.

4.2 Subfields within Generative AI

Building generative AI models requires specific techniques, which vary depending on the specific use cases. The most popular techniques are **diffusion models, variational autoencoders (VAEs), generative adversarial networks (GANs), and transformer networks.**

Diffusion model training is a long process of adding random noise and then reconstructing data samples, allowing large-scale generation of high-quality output. Adding random noise is the process of gradually including irrelevant components of the data sample, forcing the computer to learn how to recreate the original in its reverse process. Image and video generators are thus common targets for diffusion models.[2] However, these models are relevant for many other uses, such as anomaly detection for reading X-ray scans[3] or even object detection for autonomous vehicles.[4]

A faster technique is a variational autoencoder (VAE). Training is completed through the encoding process, where a latent space is created by condensing the inputs. Taking samples of this latent data and decoding them allows the model to generate novel data such as text, images, and audio.[5] VAEs are popular in a variety of use cases, such as generating fake human faces or composing synthetic music.[6]

Now generally overtaken by diffusion models, generative adversarial networks (GANs) were once the most popular technique. In this process, two neural networks, the generator and the discriminator, work in tandem to create data that is indistinguishable from the original model input. The generator is the component that creates fake data, and the discriminator must determine whether it is real or fake. This

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[1] IJIMAI Journal Publication
[2] Nvidia
[3] University of Basel
[4] Huazhong University of Science and Technology
[5] Ibid.
[6] Towards Data Science

model improves slowly as the generator creates data that is unable to be distinguished by the discriminator from the input. Though GANs can generate everything other models can and are efficient and high quality, they are limited in their scope of output due to an inability to focus on the entire data distribution.[7] Exhibit 1 shows a simplified version of how these models are trained to respond to inputs through data. Once it has received sufficient training, the model itself is able to distinguish and understand how to respond to certain prompts.
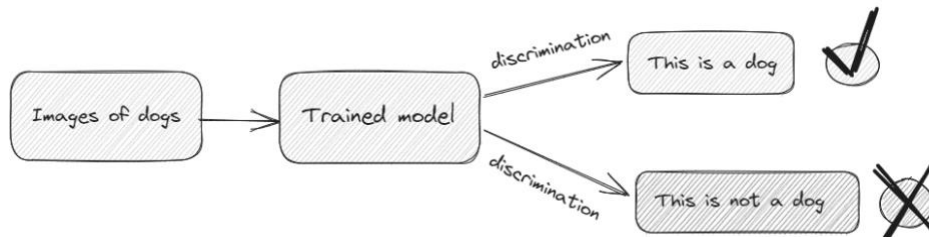

Exhibit 1: Training behind GenAI
Source: Medium

Transformer networks are most likely to mimic how the human brain works. It requires the computer, in its own way, to have a "memory" and "attention" to certain information. The model is made aware of possible relevant information surrounding an input through these concepts. OpenAI's ChatGPT stands for Chat Generative Pre-trained Transformer, which uses these techniques for text, image, and audio generation, as well as text-to-speech. **Transformer networks are what allow ChatGPT to generate meaningful output based on the previous context that may have been previously provided within inputs.** A large language model (LLM) often goes hand-in-hand with the transformer networks to develop a complex neural network architecture.[8] At its core, LLMs process and understand long sequences of text and subsequently learn the relationships between words and phrases, often predicting the most probable grouping of text.[9]

Another related area of generative AI is autonomous agents. Essentially, this AI-powered model can take a given objective and go through an entire process to complete the task. From creating tasks for itself to prioritizing tasks to complete, autonomous agents loop through this process until the objective is reached.[10] Autonomous agents represent the next step for large language models and can be considered the beginning of true Artificial General Intelligence (AGI), or when AI becomes "alive" and able to think for itself. The overarching goal of autonomous agents is to create and promote efficient interactions between humans and machines to offer higher degrees of customization. An application of autonomous agents lies in Conversational AI, a system that integrates AI, natural language processing, and machine learning to create more seamless usage of the technology.[11] Exhibit 2 compares a conversational AI to a chatbot and highlights the advanced techniques used by conversational AI.

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[7] Ibid.
[8] Wisecube.ai
[9] Medium
[10] Microsoft Research Blog
[11] Medium

Exhibit 2: Chatbots vs Conversational AI

Microsoft has recently introduced a new framework called Autogen, which allows for communication between different LLMs to solve tasks. With this newest addition, developers are able to interact with the interface without having to write code since the models can perform a variety of tasks ranging from information retrieval to configuring unique settings.[12] The exhibit below is an example from Microsoft on how a developer could interact with the autonomous agent to navigate the system and create the desired output.
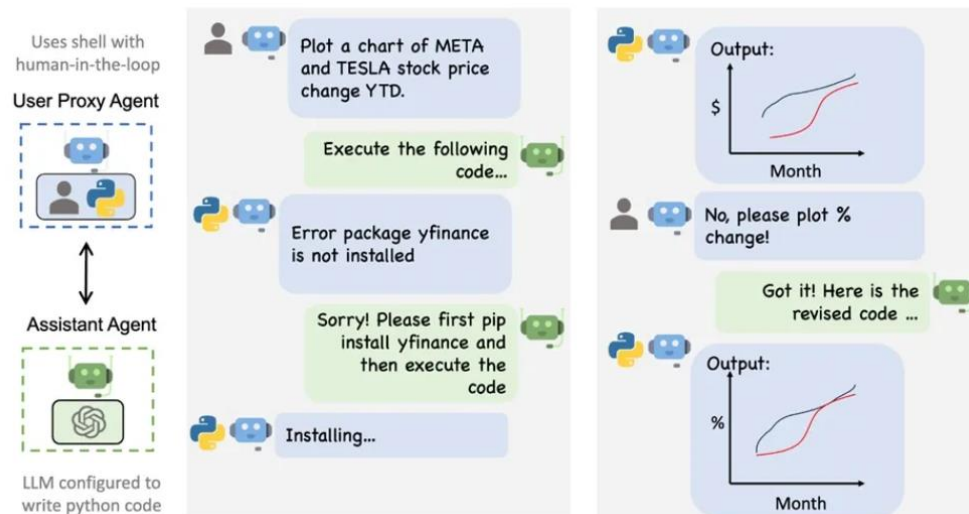

Exhibit 3: Microsoft Study: Example of a conversation with an autonomous agent

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[12] Microsoft Research Blog

5. Generative AI and the Future of Work

5.1 Current Applications

Generative AI has clearly pervaded mainstream society and the workplace is no exception. Nearly all white-collar industries are expected to experience increased efficiency and productivity because of its implementation. As a result of language, audio, visual, and synthetic data generation applications, industries ranging from biotech to entertainment will be affected. **Through language generators such as ChatGPT, the gold-standard large language model chatbot, writing emails, translating, coding, and even interpreting genetic sequences can be swiftly accomplished**.[13] Generated audio and visuals can be used to drive or inspire creative processes. Contrastingly, AI-generated graphs and diagrams can be used for scientific purposes. The last product, synthetic data, is primarily relevant for developers training AI models; clean and filtered data sets are crucial to training accurate AI models and these data sets can be near impossible to obtain on a chaotic Internet.[14]

One area in which generative AI can prove to be useful is in marketing and advertising. Overall, **the marketing and advertising industry has seen the highest adoption rate of generative AI as of 2023**.[15] In prior years, PepsiCo has leveraged AI-powered market research to introduce cost savings and automation. In this specific case, PepsiCo used early AI provider Zappi to assist in the product development phase. **Integrating Zappi into the market research and product development stages reduced the costs of standard research projects by up to 90%.** PepsiCo was looking for more ways to expand its different brands and came up with 35 potential ideas. From there, the generative AI technology was used to assess each idea and categorize them based on what it would accomplish for the business, from "sale and sustain" to "short-term trial." [16] Overall, the technology that Zappi provided offered PepsiCo a quicker and more efficient way to categorize results, in addition to providing a streamlined way of assessing how each idea would fit within the company's goals. This PepsiCo case study offers a brief glimpse into the various ways in which GenAI can be used to help companies plan and reach their goals.

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[13] Nvidia
[14] Nvidia
[15] Statista
[16] The Transformation of Business

Midpoint automation adoption[1] by 2030 as a share of time spent on work activities, US, %

● Automation adoption without generative AI acceleration   ● Automation adoption with generative AI acceleration   XX — Percentage-point acceleration in automation adoption from generative AI

	0	10	20	30	40
STEM professionals			●—16—►	●	
Education and workforce training		●—16—► ●			
Creatives and arts management		●—15—► ●			
Business and legal professionals		●—14—► ●			
Managers		●—9—► ●			
Community services		●—9—► ●			
Office support				●—7—► ●	
Health professionals		●—6—► ●			
Builders			●—6—► ●		
Property maintenance		●—6—► ●			
Customer service and sales		●—6—► ●			
Food services				●—5—► ●	
Transportation services		●—5—► ●			
Mechanical installation and repair			●—5—► ●		
Production work				●—4—► ●	
Health aides, technicians, and wellness		●—4—► ●			
Agriculture			●—3—► ●		
All sectors[2]		●—8—► ●			

[1]Midpoint automation adoption is the average of early and late automation adoption scenarios as referenced in *The economic potential of generative AI: The next productivity frontier,* McKinsey & Company, June 2023.
[2]Totals are weighted by 2022 employment in each occupation.
Source: O*NET; US Bureau of Labor Statistics; McKinsey Global Institute analysis

Exhibit 4: Automation of tasks
Source: McKinsey

The above chart from McKinsey depicts two different scenarios – the first one being automation adoption at its current pace without the assistance of generative AI (left point of each plot), and the second one including the advancements of generative AI (right point of each plot). The numbers marked for each sector category indicate percentage-based **increases in automation adoption due to generative AI**, demonstrating a substantial impact on automation processes across a multitude of industries. Sectors such as **STEM professionals, education and workforce training, and creatives and arts management are three of the top sectors where generative AI is expected to make the greatest impact on automation adoption** as shown in Exhibit 3. **Across all sectors, generative AI is expected to increase the adoption of automation by 8% of time spent working by 2030**, further reaffirming generative AI's positive impact on workplace efficiency.

With the integration of GenAI systems, a multitude of jobs will benefit from increased efficiency and speed. One industry that is likely to undergo widespread change is the software development and programming industry. In an experiment conducted by The Brookings Institute, the **use of GenAI**

enhanced the speed of code development by 27%.[17] With this technology, programmers are granted a variety of uses, including using GenAI to assist in brainstorming or to scan code for any errors before deploying an application. As many uses as GenAI has within programming, however, software development and programmers will still be a key aspect of organizations. Dr. Joann Ordille, an Associate Professor of Practice in Management Science and Information Systems at Rutgers Business School, believes that **GenAI has not yet reached a point in which the tasks of programmers can be completely outsourced**.[18] At the end of the day, the programming role must evolve to align with the utility that GenAI provides. This view is supported by a McKinsey study, which identifies how AI can greatly assist in simple programming tasks, but when the tasks become more complex, its use diminishes greatly.[19] In Exhibit 5 below, tasks such as code documentation and code generation, the more repetitive and administrative aspects of coding see significant time reduction (up to 50%). On the other hand, however, it becomes a lot more difficult to introduce GenAI into tasks that are more complex in nature (less than 10%).
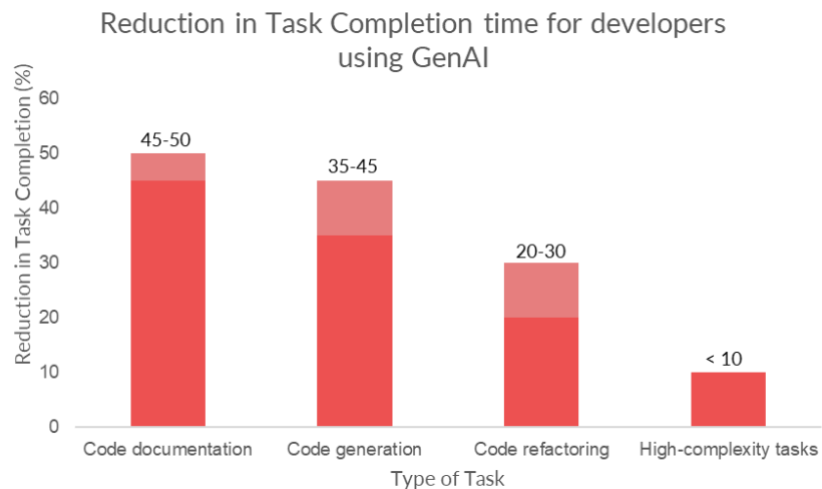

Exhibit 5: % of Time Saved using GenAI Across Software Development Tasks
Source: McKinsey

5.2 Industry Impact

While GenAI is bound to introduce widespread changes, it will affect certain industries more than others. Most notably, **the healthcare sector is expected to experience the most job growth** compared to other categories, while STEM, transportation/warehousing, and business/paralegal follow behind.[20] AI has emerged as a transformative force in healthcare, particularly **revolutionizing medical oncology**. Machine learning algorithms can analyze genetic information, patient records, and medical literature, to identify patterns indicative of cancer. Furthermore, AI can generate synthetic data sets that reflect actual patient statistics in order to preserve patient confidentiality. In personalized treatment and medicine, AI analyzes genetic and molecular data to create tailored treatment plans based on the individual characteristics of each patient's cancer, optimizing therapeutic outcomes. It can aid in the prediction of treatment responses and potential side effects, helping clinicians make more informed decisions. This amalgamation of AI technologies not only **improves the efficiency of oncological processes** but also contributes to **better patient outcomes** and **advances the paradigm of precision medicine** in cancer care.[21]

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[17] The Brookings Institute
[18] Interview with Joann Ordille
[19] McKinsey & Company: What's the future of generative AI? An early view in 15 charts
[20] McKinsey & Company: Generative AI and the Future of Work in America
[21] American Cancer Society

However, the emerging trend of increasing FDA-approved AI medical technologies is being met with resistance by doctors. **The FDA has approved around 700 AI-powered medical products as of July 2023 through the 510(k) program, established in 1976 for devices like pacemakers and X-ray machines.**[22] Physicians and health professionals are expressing concerns over the approval process of AI-powered medical devices in the United States, stating that regulators may not be providing adequate oversight or disclosure. Critics argue that this program, not updated for modern machine learning, lacks the necessary clinical trials and transparency for AI devices. The FDA does not require makers of AI-powered medical products to disclose crucial information, such as the development process and the number of people tested.[23] **Critics emphasize the need for updated regulations to ensure the safety and efficacy of AI in medicine, highlighting that the current framework is nearly 50 years old.** The lack of transparency and rigorous evaluation is seen as a hindrance to the adoption of potentially life-saving AI tools in healthcare.

Scenarios such as the ones outlined prior indicate that AI is a powerful tool for society, but also a potential liability if people become overly dependent. Particularly in risky situations, such as AI systems for autonomous vehicles and healthcare, the utmost care should be taken regardless of its presence.[24] In essence, there is always a possibility for incorrect output. Thus, it is still necessary for rigorous testing and safety measures to ensure complete confidence in AI capabilities.

On the other hand, one industry that is expected to experience a large shrinkage is **marketing, media, and content creation**. In December 2022, Buzzfeed, the online media company cut 12% of its staff and stated that it would extensively use AI technologies in those areas. Meta made a similar move by replacing most of its Facebook news curators with various AI algorithms.[25] In terms of marketing, Gartner predicts that **by 2025, 30% of outbound marketing messages from large companies will be generated by AI** and will utilize personalized advertising.[26] Ultimately, this trend is representative of a change in the nature of work itself. Companies are exploring various methods to reduce costs while maintaining productivity, such as automation, outsourcing, and operational restructuring. As a result, the labor market may experience changes in the types of jobs available, the skills required for those jobs, and the compensation offered to employees. An IBM study highlights that, **in the next three years, 40% of workers will have to reskill due to the changes brought by generative AI**.[27] In the case that workers are not able to reskill and shift focus, there is potential for high levels of job loss. Fortunately, most Americans in this situation are opting for the former, and American society is expected to reap the benefits of this decision. **As a result, by the year 2030, generative AI is expected to increase the number of jobs, with a skew towards the healthcare and STEM industries.**[28]

5.3 Generative AI and Labor Market Implications

Today, generative AI is also used to **manage and organize information**. People have endless amounts of information at their fingertips, and that flood of information can be hard to sort through. Especially in workplaces, employees must manage information from multiple sources and applications, and it becomes easy to miss important opportunities. With the development of generative AI, employees can utilize it for summarization and for "cutting through the noise." With the information that employees need to sift through, the technology can identify areas of highest priority, which ultimately helps employees come up with a plan of action.

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[22] U.S. Food and Drug Administration
[23] DeepLearning.ai
[24] Nvidia
[25] Economics and Business Review Journal
[26] Gartner
[27] IBM
[28] McKinsey & Company: Generative AI and the Future of Work in America

Generative AI's impact on the labor market is multifaceted, with potential consequences for workers across different income levels, thus leading to gender and racial disparities. **Individuals in the lowest wage categories, earning less than $30,800 and earning between $30,800 to $38,200 annually, face a heightened likelihood of needing to change occupations by the end of the decade.** Notably, jobs in the lowest wage quintiles are currently held disproportionately by individuals with lower educational attainment, women, and people of color. As certain occupations, such as office support and customer service, are projected to shrink, these demographic groups may face significant job displacement, emphasizing the need for strategic interventions to facilitate skill acquisition, job matching, and mobility. [29] Conversely, the highest wage quintile anticipates significant job growth, indicating a **growing divide in employment opportunities across wage levels**.

On the other hand, blue-collar work such as physical labor is expected to be among the industries least affected by the generative AI boom. The change is already beginning to occur - **about 8.6 million occupational shifts took place between 2019 and 2022**, signifying that Americans are beginning to take the next steps, **moving away from industries like fast food, manufacturing, and customer service in favor of higher-paying careers**.[30] Before the widespread implementation of generative AI, research from McKinsey estimated **automation "[taking] over tasks accounting for 21.5 percent of hours worked in the US economy by 2030"**, but the figure now rises to **29.5 percent with generative AI**.[31] Therefore, AI is not necessarily eliminating jobs - rather, it is forcing a trend in employment shifts. The individuals holding jobs in shrinking industries must either adapt or face the consequences.
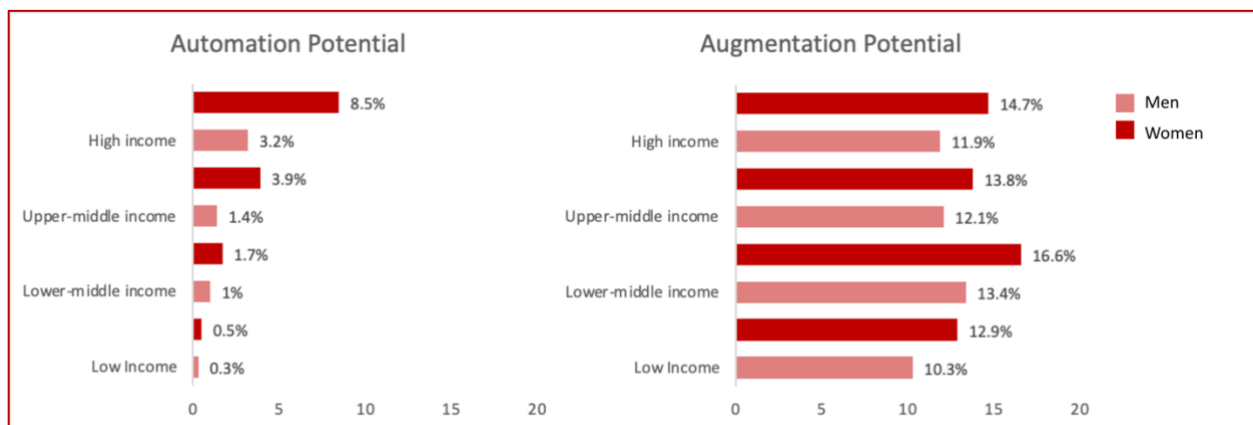
Exhibit 6: Comparison of Automation and Augmentation Potential of GenAI
Data Sourced From: International Labor Organization

In Exhibit 6, **8.5% of jobs held by women in high income countries have the potential to be automated compared to the 3.2% of jobs held by men**. On the other hand, there is potential for women's jobs to be augmented rather than replaced by automation.[32] Maintaining or increasing women's participation in the workforce can be realized through a careful transition aimed at inclusivity of workers across industries. To address these disparities and assist workers in transitioning to better-paying jobs, widespread access to **training programs, innovative job matching approaches, and changes in employer practices** are essential. Moreover, the evolving labor market demands an increased focus on social-emotional and digital skills,

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[29] McKinsey & Company: Generative AI and the Future of Work in America
[30] Financial Times
[31] McKinsey & Company: Generative AI and the Future of Work in America
[32] International Labor Organization

emphasizing the importance of preparing the workforce for changing skill requirements and maintaining resilience in the face of technological advancements.

5.4 Business Risk

However, as more businesses work to integrate this technology, it is necessary to acknowledge the imperfections and risks associated with it. A global Salesforce study of the general population highlighted that **73% of the study respondents believe that generative AI introduces new security risks** and **59% worry that the outputs are biased**.[33] One of the biggest concerns surrounding this new technology is the lack of knowledge of how exactly the AI models work and how they process information. According to a CNBC article, technology like ChatGPT is banned within Samsung, as an employee was caught inputting sensitive company information.[34] Using ChatGPT or Google Bard could be immensely useful in helping executives develop corporate strategy or determine the best possible use of resources, however, for generative AI to assist, it needs access to proprietary data. As much as it can be used to make processes more efficient, these GenAI models come with various privacy concerns because there is no set regulation on the data used to train these models. ChatGPT was trained on over 45 terabytes of data, but there are concerns that this model relies heavily on "privacy-invasive methods for mass data collection." [35]

Another risk that becomes prevalent is the **diminishing of original thought.** A Boston Consulting Group study found that **the proliferation of generative AI's relatively uniform output could potentially reduce a group's diversity of thought by 41%.** If there becomes **too heavy of a reliance on generative AI and the outputs that it produces,** the **amount of innovation could be stifled, as supported by 70%** of BCG employees who were surveyed.[36]

Dr. Jim Samuel, a professor at the Rutgers Bloustein School of Public Policy, explains that there needs to be more done to understand the nature of AI technology so that both businesses and students can understand its limitations. At the student level, Dr. Samuel notes that **over-reliance on AI leads to a lack of true learning and that a proper attitude from students is necessary**. He believes that education is not about getting a grade, but about training your mind and that AI should be used to supplement learning, with students asking themselves what they can do that AI cannot do. From a business perspective, one of the main challenges is the uncertainty surrounding the use of AI, particularly the "black box" nature of some AI systems. To increase transparency, Dr. Samuel suggests that companies should declare the raw data and technology that they use and make everything open source. Through efforts to understand GenAI, people can learn where it could potentially be susceptible to bias or even misinformation.[37]

To combat all these risks, there are multiple steps that businesses can take. It is important to note that generative AI is only as good as the data used to train it. There are **areas that it excels in, such as natural language processing and image recognition**, and **others that it is severely lacking in, notably common-sense reasoning and creativity**.[38] Sometimes, however, it can be difficult to determine whether the technology would be a good fit for certain tasks. Now, as generative AI becomes more integrated, business leaders need to take on a new responsibility. Leaders need to understand which areas generative AI excels in, and subsequently assess how that can benefit the business. Beyond benefits, it is also necessary for leaders to identify and avoid areas in which it can potentially bring harm.

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[33] Salesforce
[34] CNBC
[35] Congressional Research Service
[36] Boston Consulting Group
[37] Interview with Jim Samuel
[38] McKinsey & Company: The economic potential of generative AI: The next productivity frontier

In general, there is an overarching concern that generative AI has the potential to eliminate a variety of white-collar jobs. However, a common theme remains: **having a multi-faceted skillset, ensuring outputs are of utmost accuracy, and maintaining regulatory policies in the AI industry will be crucial to maintaining the prevalence of non-AI-dominated roles in the future**. However, the stigma remains that AI could disrupt hundreds of millions of jobs with **the nearly 1 billion knowledge workers worldwide being affected**. [39]

As the concern remains on white-collar jobs, blue-collar jobs are here to stay. Trades, labor-related jobs, and those that blend aspects of white and blue-collar jobs have long-lasting potential. Data from McKinsey further indicates that **while generative AI may wipe out some jobs entirely, demand from other industries will experience increases, forcing those workers to adapt to an ever-evolving job market by acquiring new skills**.[40] As AI continues to evolve, **skills[38] such as leadership, communication, management, data analysis, and programming/mathematical skills alongside creativity** will be of utmost importance.

Many of the risks that concern businesses and individuals' intent on implementing generative AI lie in its **potential to develop implicit biases**. Generative AI applications such as ChatGPT, DALL-E, or Bing Chat are trained much differently than traditional artificial intelligence models in the sense that they feed upon vast amounts of data as opposed to building off humans. The downside to this is that the information given to generative AI applications may not always reflect the most accurate, ethical, or truthful information. The internet has been plagued with webs of lies and misinformation throughout the years, and generative models are not exempt from falling victim to such tricks.[39] Generative AI still has to progress a long way before it can detect misinformation on its own, but an increase in funding and development since 2022 has begun to mitigate such issues. In the workplace, generative AI models trained on internet data may contribute to not only biases but also blatant plagiarism when generative AI falls into the hands of dishonest individuals.[40] **Businesses can fight these risks by informing employees and management about the downsides of blindly following recommendations or suggestions from generative AI software** and instead using it as **a tool to enhance output while continuing to conduct independent research**. Spreading awareness and encouraging the proper use of generative AI technologies are the keys to preventing its misuse.

Lastly, another risk is **increasing competition** as more companies embrace AI technology adoption and as more workers partake in occupational shifts. With many displaced workers who are willing to learn new skills to maintain job market relevance, businesses must return by making adequate investments in training. Just like resources, technology can be unevenly distributed. Businesses that are unable to adapt quickly enough are signaling that they will be unable to compete against their more innovative and productive rivals, who are rapidly incorporating AI into their workplaces. Thus, the link between finding human capital from a shifting labor market and succeeding is very tangible.[41] According to McKinsey, this "will require widespread access to training programs, effective job matching, different hiring and training practices by employers, and better geographic mobility."[42] Businesses can prepare by identifying and preparing to hire workers with transferable skills to meet evolving demand.

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[39] Business Insider
[40] McKinsey & Company: Generative AI and the Future of Work in America
[38] Springboard
[39] Pew Research
[40] Ibid.
[41] International Labor Organization
[42] McKinsey & Company: Generative AI and the Future of Work in America

5.5 Addressing Generative AI Risks within the Workplace

There are multiple examples of companies that have begun preparing for the onset of generative AI in their respective industries. Nuvalence is a company whose CEO mentions that they have already shifted their company procedures, staff, and management toward an AI-centric direction. In doing so, they are also simultaneously training individuals to become more conscious and aware of the potential risks and implications of incorrect generative AI usage.[43] As workplaces push towards mass adoption of AI technologies, awareness and the spread of information will remain key to ensuring it isn't abused. Other companies, however, have **decided to halt AI usage in the workplace entirely until more research can be conducted regarding its capabilities and impact.** For example, Larry Feinsmith, the JPMorgan Head of Global Tech Strategy, Innovation, and Partnerships, mentioned that implementation of generative AI technologies in offices would cease until "[they] can mitigate all of the risks" due to the lack of knowledge company officials hold on the technology.[44] Furthermore, many large companies are hesitant to use generative AI due to **implicit privacy concerns**—the security risks of inputting potentially sensitive and confidential data into a tool built to reuse such information in other outputs. A CNN interview conducted with Mark McCreary, part of the law firm Fox Rothschild LLP, records McCreary mentioning that monitoring the spread of learned information from generative AI model is impossible and that the "opportunity for company trade secrets to get dropped into these different various AI's is just going to increase". While experts are still attempting to cover the full extent to which generative AI models can handle such information, McCreary and other high-ranking company officials have reason to worry.[45]

6. Future of Education

6.1 Current Applications of Generative AI in Education

As there is more and more excitement generated surrounding GenAI, the applications of the technology must also be explored within the space of education. GenAI in education offers a multitude of possibilities, not limited to asking ChatGPT or Google Bard the answers to a quiz question. Through the expert interviews, **5 out of 8 experts indicated that the proliferation of AI provides opportunities for educational equity as it will facilitate access to more personalized education.**

The introduction of Class Companion, a new AI platform, represents a step in providing a **tailored education for all**. Using this technology, students can gain immediate feedback and educators can quickly identify areas of improvement.[46] The idea of adaptive learning would point out areas that individual students succeed in and could create personalized content in a dedicated learning environment. This also saves time for educators, since they can more easily assess student learning and skills.

One of the biggest applications of generative AI in education is in **translation and language learning**. Two such companies that have leveraged generative AI in this space are **Grammarly and Duolingo**. Grammarly's products use machine learning with various natural language processing techniques to analyze and process text. Using this technology, Grammarly products can offer suggestions to improve writing and point out grammatical errors. The reason why the technology works is due to the extensive data training that the model undergoes. Through its training, the model learns what proper punctuation looks like and the various flags that are present in improper sentences.[47] Similarly, to match increasing competition, Duolingo

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[43] Business Insider
[44] ITPro
[45] CNN Business
[46] Forbes
[47] Grammarly

launched Duolingo Max in March 2023, which utilizes GPT-4 to explain wrong answers to users and allows users to practice conversations in different scenarios.

6.2 Generative AI Impact on Educators

While there is a consensus that GenAI can bring a lot of positive change, this positive change is reliant on the proper and responsible use of the technology. **8 out of 8 experts interviewed agree that integration of GenAI into education is inevitable.** As generative AI begins to permeate more areas of society, it would be counterproductive for education systems to prohibit it completely. Moreover, as businesses and workplaces identify the advantages of streamlining certain tasks with GenAI, many entry-level positions will become obsolete. For instance, Dr. Jim Samuel, an informatics specialist at the Rutgers Bloustein School of Planning and Public Policy, highlights that "every industry is bound to be impacted eventually" and "nothing will escape the impact of AI."[48] In addition, according to a survey conducted at Texas A&M University on the perceptions of students and faculty on GenAI, common themes are that "Generative language tools (like ChatGPT) will increasingly become part of our everyday lives" and that "AI technology is not going away."[49] These perspectives underscore the obligation for professors to modify their curriculums and help their train their students to work with and alongside Generative AI. Dr. Badri Nath, a professor in the Department of Computer Science at the Rutgers School of Arts and Sciences, echoes this sentiment and that "educators will have to think about how to use [GenAI] with respect to how to evaluate intrinsic capabilities of students," which will be a challenge.[50]

However, other educators share their concerns about the integration of GenAI in the classroom. For instance, many worry that an **overreliance on GenAI will diminish students' critical thinking skills** as it is easier to have GenAI complete certain assignments such as simple writing tasks than to put the effort in individually. In addition, Dr. Lauren Goodlad, a Distinguished Professor of English and Comparative Literature at Rutgers School of Arts and Sciences, notes that "many classrooms have gone deviceless for fears that students are not talking to each other."[51] But, since GenAI will remain a crucial component of students' work life in the future, it would be unwise to prohibit it from the classroom entirely. For instance, an article from the International Journal of Agricultural and Biological Engineering regarding generative AI in education asserts **the need for professors to redesign their curriculum continuously to emphasize** skills that cannot be easily replaced such as **creativity, critical thinking, and problem-solving through project-based learning**.[52]

On the positive side, many professors welcome the integration of generative AI in the classroom. For instance, Dr. Badri Nath believes that "**there will be a more level playing field.**" Through generative AI's ability to design modules and content individually, educators would be able to tailor course materials adequately. The International Journal of Educational Technology in Higher Education discusses the results of a study in which the impact of ChatGPT on productivity was measured in completing a mid-level writing task. **Those with the lowest skill levels were the ones that benefited the most from using ChatGPT.** This indicates the potential of ChatGPT and other forms of generative AI to "bridge productivity gaps and reduce productivity inequality."[53] In addition, the inclusion of generative AI will take some of the workload from educators such as grading, allowing them to spend more time with students.

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[48] Interview with Jim Samuel
[49] Texas A&M University
[50] Interview with Badri Nath
[51] Interview with Lauren Goodlad
[52] International Journal of Agricultural and Biological Engineering
[53] International Journal of Educational Technology in Higher Education

6.3 Student Perspectives

The Rutgers Consulting Group surveyed students across the New Brunswick campus and measured overall sentiment about the use of generative AI and how it impacts education. Students largely identified the positive aspects of GenAI in the classroom and all students had some knowledge of generative AI. Within the survey, **100% of respondents identified that they knew at least one GenAI platform**, most notably ChatGPT. Overall, this is a strong indication of the explosive growth of GenAI, and how it has already begun to influence education systems. The Exhibit 7 shows responses when students were asked about the activities that GenAI would potentially assist in. This supports the view that **GenAI could be key in getting administrative tasks done, as 74% of students listed creating summaries as a primary activity**. The results of this question also underscore the potential that GenAI has to be an assistant that is able to make processes more efficient.

In the survey, one specific area that saw a large usage of GenAI was in **technology-related majors**. This group consists of respondents whose majors were mainly business analytics, information technology, and computer science. The question asked was "Yes or No: The introduction of Generative AI technology has made my time in school significantly easier." Within these responses, **69% of technology-related majors responded with "Yes", compared to only 29% and 42% for Life Sciences/Engineering and Humanities majors, respectively.** These results underscore how GenAI can be key in augmenting and improving current processes within coding and data analysis tasks in these fields.

The RCG survey not only identified the benefits that GenAI could bring students, but also evaluated how concerned students were with the limitations and potential harm it could bring. The RCG team wanted to better understand how one's pre-existing knowledge of GenAI systems could influence how concerned they were with its usage. As can be seen in Exhibit 9, **most students rated a high level of concern with misinformation**
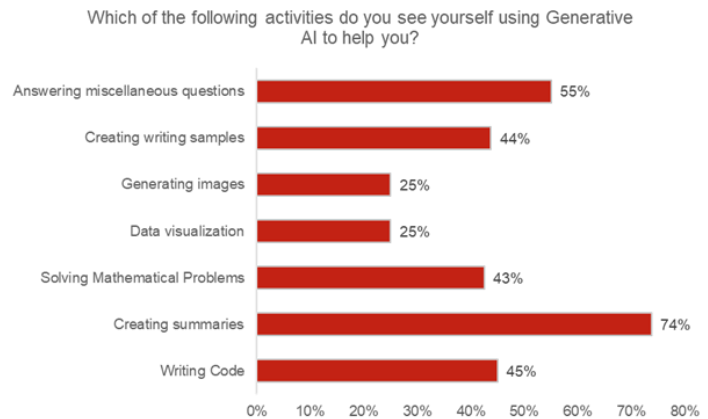

Exhibit 7: GenAI and Student Tasks
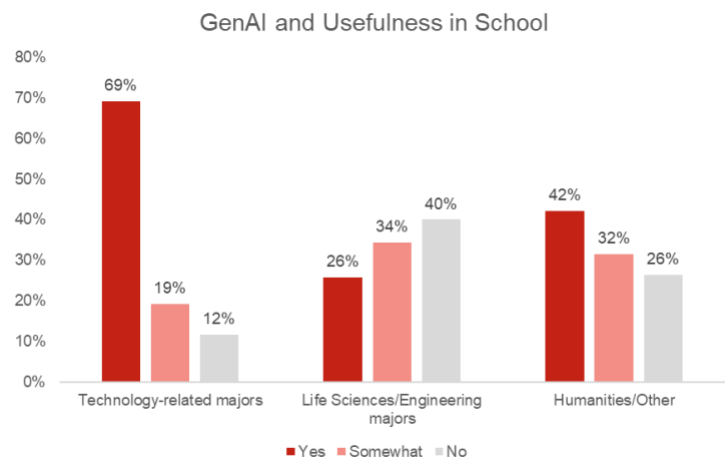*Source: RCG Student Survey and Analysis*

Exhibit 8: GenAI Usefulness Across Major
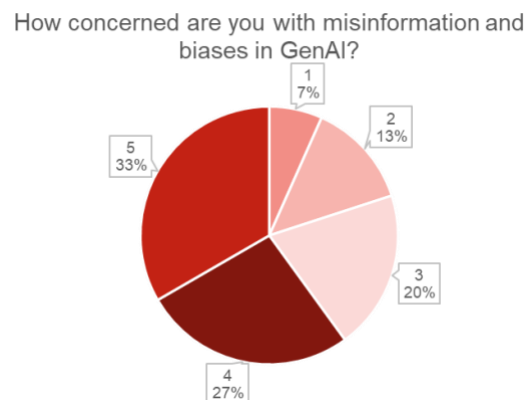*Source: RCG Student Survey and Analysis*

Exhibit 9: GenAI and Concern with Biases
Source: RCG Student Survey and Analysis

and biases in GenAI, with 60% of students rating their concern a 4 or a 5 on a 5-point scale. Additionally, RCG found that **students who were more familiar with GenAI (knew of 2+ platforms) had a higher average rating of concern for misinformation and bias** at 3.6/5 compared to 3.2/5 for students who were less familiar with GenAI and only knew of 1 platform. Though students exhibited concern over misinformation, 48% of students rated the frequency of their use of GenAI for school work at a 3 or above on a 5-point scale (*see Exhibit 10)*. Although **the largest portion of students (31%) indicated that they did not use the technology often**, it is clear that there is a trend toward GenAI adoption within education. Given the results of this research, the RCG team believes that the usage of GenAI in a school setting will only continue to increase. With the right tools in place, however, students can learn how to successfully navigate this new environment rather than solely relying on technology for learning.

Exhibit 10: GenAI Usage in School Work on a 1-5 Frequency Scale
Source: RCG Student Survey and Analysis
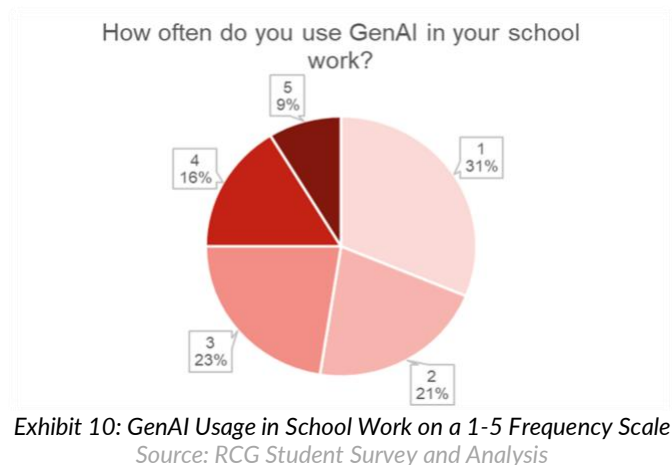
6.4 Generative AI Risks in Education

Not only is data privacy an issue, but there can also be various flaws in the models themselves in the way that these models process information. One notable problem is called **hallucination, in which the models perceive patterns or objects that do not actually exist.**[54] In practice, this looks like generative AI giving a wrong answer to a question such as "Who was the president in 1984?" If students are too reliant and eager to use generative AI to learn, it could lead to the propagation of false information. Suresh Venkatasubramanian, a professor at Brown University and an advisor to U.S. technology systems, states that generative AI tools are often trained to "produce a plausible sounding answer" to user queries.[55] Due to the nature of this process, it becomes difficult to discern what may be true or not since these tools offer convincing explanations regardless of the truthfulness.

The continuing issue of hallucinations ultimately correlates with the fact that many of these generative AI models are shrouded in mystery. Dr. Lauren Goodlad, a chair member of an AI initiative at Rutgers and distinguished professor, highlights the **lack of transparency** within generative AI. There is a promotion of a data-driven approach through the new technology; however, people are unaware of how the models are trained and which datasets are used. When people use generative AI to gain information and learn, it is uncertain where the resulting information is scraped from.[56] One increasingly concerning problem is the information that GenAI presents to its users. Currently, there are very few rules in place, which highlight what the technology should and should not be able to use. Issues of copyright infringement and intellectual property are raised when the models take online content from others to create a "unique" opinion or product. In particularly research-heavy fields, the question of originality comes into question. Do the answers GenAI provides offer different perspectives, or is it ultimately just the combination and recycling of pre-existing sources of information?[57]

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[54] IBM: What are AI Hallucinations?
[55] CNN Business
[56] Interview with Lauren Goodlad
[57] The International Journal of Management Education

One of the risks highlighted through interviews with professors is **the issue of competing incentives in our education system**. For instance, Isabel Gwara, a leader at The AI Education Project, highlights that in the midst of the "outcomes-focused, high pressure, anxiety-inducing" environment in which "we measure students," they are "trying to get the highest possible number they can at the expense of their learning."[58] Moreover, even when a student intends to complete assignments honestly, the looming burden of failure makes relying on AI more appealing.

6.5 Mitigating AI Risk in Education

Due to the various risks that generative AI poses in education, it becomes paramount for educators to understand the technology that they will be working with and guide students on the best course of action in its usage. The concept of **AI literacy becomes increasingly important** as people must learn how to effectively navigate the novel technological environment.

A Cengage Group employability survey showed that **46% of new graduates are feeling threatened by the growth of AI and question their workplace readiness**. As GenAI becomes ubiquitous, AI literacy must be emphasized as a key skill. New graduates will not lose their jobs to AI, rather, they may lose it to someone who knows how to leverage AI to reach productive results.[59]

6.6 To what extent should Generative AI be permitted in academia?

Generative AI can bolster student learning when used correctly, but it holds just as much potential to hinder student learning when used incorrectly. It becomes imperative that both educators and students work to find a balance in which AI usage and the benefits to academia can be maximized. A 2023 Goldman Sachs report claims that **around two-thirds of the United States occupations are expected to experience some degrees of AI automation.**[60] Due to its inevitability, it then becomes up to educational institutions to properly prepare students for the future.

At an institutional and educator level, however, it is necessary to set and maintain proper guidelines for AI usage. If used too liberally, students could abuse the conveniences that the technology provides, which diminishes the amount of learning opportunities. If students do not try to learn and develop skills for themselves and instead only produce outputs through generative AI, they become no better than the technology itself. An overreliance on AI would eliminate original human thought and would lead to a higher rate of job replacement. As expert Dr. Jim Samuel highlights, "**the act of thinking itself must not be outsourced to AI**."[61] In the research that the team has collected, most respondents found that generative AI has allowed for an easier time in school. Though it proves to be an extremely helpful tool, education systems must find ways to encourage responsible usage, one of which is through proper guidelines. Another method is to bring about **a paradigm shift within educational systems**. In many cases, students are incentivized to do whatever they can to be successful in the short-term, but this has dire consequences for long-term learning. This point is supported by Stanford Graduate School of Education Dean Daniel Schwartz, who remarks, "...AI is also going to automate really bad ways of teaching."[62] Thus, it becomes necessary to create new types of teaching around generative AI that can advance human learning and redirect the classroom focus toward skill and knowledge development rather than earning an A at all costs.

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[58] Interview with Isabel Gwara
[59] Employee Benefit News
[60] Ibid.
[61] Interview with Jim Samuel
[62] Stanford University

7. Conclusion

Generative AI has been on the rise and is an ever-expanding industry. Many companies have begun to utilize generative AI to automate small but essential tasks. Undergraduate students overall have also found generative AI to be convenient for completing miscellaneous tasks such as answering basic questions and generating writing samples; however, the nature of generative AI is still very unclear, and whether the use of generative AI is ethical remains ambiguous. RCG's research shows that **AI is creating a shift in the job market for most industries,** and **the best way that companies can prepare employees is by gaining a comprehensive understanding of the inner workings of generative AI**.

Generative AI has the potential to change the competitive landscape of every industry sector. Companies will have to familiarize themselves with AI to increase their profit margins and will have to hire employees who are well-versed in AI. Potential and current employees will have to go beyond the basics and be prepared to immerse themselves in generative AI and how they can use it to benefit the company that they hope to or already work for. Employees who work administrative jobs specifically will need to adapt to AI and learn how they can take advantage of AI to ensure that their employment status does not change. Universities will need also to change their policies to account for student usage of generative AI.

For companies to integrate Generative AI, they will need to take a **multidisciplinary approach, involving policymakers, ethicists, technologists, and communities to establish robust governance frameworks. These frameworks should prioritize ethical guidelines, data transparency, and inclusivity to ensure that GenAI serves the collective good and respects human autonomy and dignity**. Fostering collaboration and dialogue among stakeholders is also crucial to mitigate risks, promote responsible AI development, and steer GenAI toward a future that enhances human capabilities while safeguarding against unintended consequences.

Universities will need to adjust their curriculum and policies to account for the rise of generative AI. One future step could be to include specialized programs in AI to emphasize the ethical and technical aspects of AI to prepare them for the professional world. This may involve offering specialized programs, internships, and research opportunities in AI, machine learning, ethics in AI, and interdisciplinary studies combining AI with various fields like healthcare, finance, or environmental science. It would also be beneficial to provide these opportunities to alumni and professionals seeking to learn new skills. Then, after a university can gain a comprehensive understanding of AI, they will be able to utilize an interdisciplinary approach to create sound policy around student use of generative AI and make the necessary changes to the structure of courses at universities.

Overall, the impact of General Artificial Intelligence (GenAI) extends far beyond mere technological advancements; it fundamentally alters societal, economic, and ethical landscapes. **The trajectory of GenAI's impact hinges on the collective ability to navigate the complexities it presents, balancing innovation with ethical considerations to build a future in which artificial intelligence augments human potential and well-being.** It is important to adjust to generative AI and the changes it brings to society so that everyone can prepare for the effect it will have in the future.

8. About the Authors

Sam Fang
Sam is a senior studying Finance and Business Analytics at the Rutgers Business School, with a minor in economics. When he is not involved in RCG, he participates in a social entrepreneurship club that works with formerly incarcerated individuals. He is interested in the intersection between finance and technology. In his free time, Sam enjoys running and is training for his first half marathon!

Susan Johnson
Originally from Bergenfield, New Jersey, Susan is a junior studying Economics and Political Science with a minor in Health Administration at Rutgers University School of Arts and Sciences. Outside of RCG, Susan loves being a part of FACILE and RU Women's Pre-Law Society and serving as an Honors College Scholar First-Year Mentor. Her interests lie at the intersection of government and business. In her free time, she enjoys baking, hiking, and trying new restaurants.

Cynthia Pang
Cynthia Pang is a first-year student at Rutgers University from Manalapan, New Jersey. She is considering studying Healthcare Administration and Biology. Outside of RCG, she is involved in Scholars of Finance, the American Preventive Screening & Education Association, and the Rutgers Table Tennis team.

Brian Phu
Brian Phu is a first-year student at Rutgers University from Freehold, New Jersey, He plans to study Finance and Economics. Apart from RCG, Brian is a small business owner and oversees warehouse operations at an Amazon FBA store. In his free time, he enjoys traveling.

Anshul Voleti
Anshul Voleti is a first-year student at Rutgers University studying Cell Biology and Neuroscience. Outside of RCG, Anshul volunteers as an EMT and will be working as a Medical Scribe for the Robert Wood Johnson University Hospital. He enjoys soccer, listening to music, and biking.