

How Disruptive Technologies Are Maximizing Efficiency in Community College Apprenticeships

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ABSTRACT

This paper examines the AI revolution's impact on apprenticeship education, focusing on workforce development solutions that target the diverse and underserved populations prevalent in U.S. community colleges. Known for their agility in meeting economic demands, two-year schools are often praised for their rapid deployment of training solutions. The discussion emphasizes the potential of the cognitive apprenticeship model, a "learn and earn" approach, which aligns with modern educational needs and positions community colleges at the forefront of educational reform. We begin by looking at the general topic of AI before moving on to uses and tools, offering some specific examples showing how AI has been used to support the development of apprentice education in the tech industry. We will also address challenges that exist in moving forward. By fostering environments that encourage creativity and adaptability, community colleges can leverage disruptive technologies to drive educational reform and establish themselves as leaders in innovative education for the next century.

Keywords: AI, Apprenticeships, Gamification, Personalized Learning, Virtual Reality, Workforce Development

INTRODUCTION

When those in Generation X graduated from high school, education was a one-way street where teachers decided what students should know and how to learn it, often ignoring individual learning styles. Fast forward 30 years, and the landscape has transformed dramatically. Today, education is fueled by curiosity and

personalized learning. Real-world experiences and hands-on lessons are now seen as essential, challenging the old ways of traditional classrooms (Bass, 2012). The chalkboard era is fading, as a dynamic, student-centered approach to learning takes root with help from disruptive technologies.

Some would argue that a renewed appreciation for experience beyond the occasional university-offered summer internship and greater exposure to mentors and community make this an ideal time to invest in a workforce development strategy. For instance, the Survey of Student Engagement “high-impact practices,” including service and community-based learning outside the formal curriculum. (Bass, 2012). These practices align well with the ***Cognitive Apprenticeship Model***, *an instructional approach emphasizing learning through guided experiences and social interactions*. This model makes expert thinking processes visible and accessible, allowing learners to participate in the cognitive and metacognitive processes of skilled practitioners (Glasper, 2013). It combines traditional apprenticeship techniques with strategies focused on cognitive development, which bridge the gap between theoretical knowledge and practical application.

Considering the strength of community colleges to train technical workers and leveraging recently established theories and models about the power of experiential and informal learning, a new framework could emerge to enhance apprentice training at community colleges as a model for widespread change. This framework could offer hints to the larger academic pool for a more practical approach to education for the next century. The “learn and earn” model at community colleges, aligned with today’s needs to employ underserved and diverse communities, is well-positioned to spearhead the revolution in education reform.

LITERATURE REVIEW

In a January U.S. House of Representatives hearing on developing an AI-ready workforce, it was said there are not enough people who know AI and not enough educators who understand how to teach disruptive technology to the next-generation tech workforce, which is expected to be massive (Dembicki, 2024). Addressing this challenge requires a collaborative effort from individuals who can evaluate technology and pinpoint opportunities for change from multiple perspectives. The literature backs what many have seen firsthand in the fields of both nursing and teaching, which is that community colleges can change courses and adapt curricula, degrees, and certificates to support AI faster than any other higher educational institution (Dembicki, 2024). While the speed of training development is commonly accepted, the vision that is less shared is the power of community college registered apprenticeships to be pivotal drivers to enhance

engagement through immersive experiences, tailor learning paths, and facilitate real-time collaboration in such a way that changes the traditional paradigm.

Statistics for the AI industry

In the next 18 months, AI is poised to transform the labor market, which is good, but it also presents challenges for businesses and workers (Arabandi, 2024). To illustrate one issue, in 2018 14 million U.S. workers were employed in AI-related fields. Technical jobs in the industry are increasingly male-dominated and lack racial and ethnic diversity. While four-year college degrees, particularly in engineering and computer science, are common pathways to technical AI jobs, many non-technical AI roles can easily be filled by individuals without such degrees, often holding business or other non-technical qualifications. This open door for diversity in educational backgrounds suggests that AI workforce policies should incorporate a wide range of education and training pathways to address both technical and non-technical roles. (Rathinam, 2024)

Key Terms and Players

It is important to address key terms and what U.S. institutions are most widely leveraging AI for apprenticeships as leaders and scholars begin to think about potential solutions. As for key terms, this paper will focus on the IBM definition of AI and generative AI because they are a pioneer having launched the first-of-its-kind collaboration to create technology apprenticeships starting in California in 2019 (IBM, 2019). According to IBM's website, there is *weak AI*, which is what we see with task-oriented technology today; and then there is *strong AI*, like that of notional science fiction where AI takes on the executive function of a human to act and make decisions. IBM defines *AI, or artificial intelligence*, as technology that enables computers and machines to simulate human intelligence and problem-solving (IBM, 2024). It is often related to *machine learning* and *deep learning*. More specifically, *generative AI* refers to deep-learning models like ChatGPT that can generate high-quality text, images, and other content based on data they were trained on.

IBM and also Intel Corporation were early adopters of technology apprenticeship programs both having their start on the West Coast. The problem IBM had to address a decade ago is how to find and train a robust cybersecurity workforce. The result was shorter training for people without college degrees, which led to registered apprenticeship programs that cover more than 35 of IBM job specialties today (Dembicki, 2024). Conversely, Intel CEO Pat Gelsinger started their program from the perspective of community colleges as hotbeds of innovation, as it was where he started in the tech industry in his journey to lead

one of the top semiconductor companies in the world. Intel began collaborating with community colleges in 2020 with their AI Workforce Program and now has over 110 schools in the program in 39 states (IConnect007, 2021).

Other key players driving the integration of technology in modern apprenticeships include educational institutions, the tech industry, and government agencies responsible for oversight and policy. Community colleges like Maricopa County Community College District are at the forefront of working with corporate partners to facilitate practical learning processes for students entering and advancing in the job market. These institutions often collaborate with leaders such as IBM, which has pioneered virtual and AI-driven apprenticeship models, with sophisticated digital tools for training. Such partnerships that provide AI apprentices with access to cutting-edge technology and real-world applications, could significantly enhance community college registered apprenticeships in other industries that are critical to their regions.

Additionally, government agencies, particularly the Department of Labor (DOL), play a crucial role by providing policies and grants that fund the adoption of advanced technology in apprenticeship programs. The DOL's robust registered apprenticeship program grants ensure that community colleges can afford the high initial costs associated with training. Moreover, local businesses and industry organizations are critical partners, offering apprentices hands-on experience and mentorship opportunities in their communities to bridge the gap between classroom learning and practical application. By fostering collaboration among these key players, more community colleges can create a robust ecosystem that integrates technology more generally into apprenticeship programs, thus expanding their reach and effectiveness across the United States. This collaborative approach not only enhances diversity in the AI industry but also better prepares students for the evolving demands of the modern workforce.

Disruption

The greatest benefit of exploring training for these disruptive technologies in education as opposed to in-house corporate training programs is the potential to fundamentally transform the way we do education in America. Sir Ken Robinson, in "Changing Educational Paradigms," highlights the lack of creative thinking in students who go through traditional classroom instruction based on outdated educational models, arguing that education systems must evolve to meet future challenges (2010). Similarly, Harvard Business School professor Clay Christensen, in "Disruptive Innovation Explained," emphasizes that disruptive innovation relies on a workforce with a concrete and tangible perspective (Harvard Business Review, 2012).

In looking for a place for change to take off, Community College Apprenticeships are attractive as an alternative to four-year degrees and the associated debt, however, implementing disruptive technologies in these programs comes with significant obstacles (Glasper, 2013). One significant challenge is the high initial cost of adopting new technologies, such as VR equipment and software, which can strain limited budgets even with attractive Department of Labor funding. There is also resistance to change among faculty and administration accustomed to traditional teaching methods. Ensuring these technologies accurately reflect real-world scenarios and maintaining their relevance as industries evolve poses additional hurdles. Coordinating and integrating diverse technological tools into a cohesive learning framework can be complex and time-consuming as serious consideration is given to two-year schools (Glasper, 2013).

To address these challenges, several strategies have shown promise. Securing grants and partnerships with technology companies can alleviate financial burdens, as seen in collaborations between educational institutions and tech firms (IBM, 2016). Providing professional development and training for educators helps mitigate resistance by equipping them with the skills and confidence to integrate new technologies effectively (Glasper, 2013). Developing adaptive and updatable training modules ensures that content remains current and reflective of industry standards. Furthermore, fostering a culture of innovation and flexibility within the institution encourages the embrace of new methods and continuous improvement. By leveraging these strategies, community colleges can effectively integrate disruptive innovations into apprenticeship programs, enhancing their value and preparing students for future workforce demands.

When enhancing community college registered apprenticeships with AI tools, two main considerations emerge. Building on the foundation of how AI can transform educational approaches, we must address both the evolution of apprenticeship training methodologies and the balance between innovation and program integrity. First, apprenticeship training methodologies must evolve to incorporate digital tools while maintaining program integrity. As Sir Ken Robinson emphasized, conceptual learning is vital for acquiring marketable skills, so integrating AI should not compromise the personal connection essential in training (2010). Second, while virtual reality and gamification can broaden the training scope and boost engagement, even offering international experiences, it is crucial to balance these innovations with preserving the program's core integrity (Glasper, 2013).

The next sections of this article will showcase innovative real-world examples, and highlight best practices from institutions leading the way in maximizing the efficiency of disruptive technologies. This discussion will

demonstrate how these advancements can guide community college-registered apprenticeships. With the intersection of technology, apprenticeships, and community college education as a starting point to show quick wins, valuable insights can be gained about the future of workforce development and higher education.

Real-World Examples and Tools

Community college partners in increasing technology in apprenticeships are already revolutionizing various fields through innovative approaches. In the field of construction, virtual reality (VR) training modules have become an invaluable tool for vocational school apprentices. Software such as Virtual Construction Lab allows trainees to engage in immersive simulations of complex procedures like steel framework assembly and electrical system installations (IBM, n.d.). Similarly, in healthcare, VR platforms like SimX enable nursing and medical students to perform intricate medical procedures, such as emergency response and surgical techniques, in a controlled and safe virtual space. According to a study published in the *Journal of Medical Education*, these VR simulations significantly improve both competence and confidence among apprentices, leading to better preparedness and reduced on-the-job errors (Kneebone, 2003).

Likewise, industry leaders like IBM have opened new possibilities to learn from with their virtual apprenticeship program. The IBM program leverages cutting-edge communication and collaboration tools, allowing apprentices to work closely with international teams. Participants gain valuable skills in software development, cybersecurity, and data science by engaging in tasks that mirror actual industry challenges. For new professionals, this experience is particularly beneficial as it exposes them to a wide range of security practices and threat landscapes from different regions. According to IBM, this approach not only broadens the apprentices' exposure to global work environments but also enhances their problem-solving abilities and adaptability by working in diverse, cross-cultural teams (IBM, 2015).

The integration of advanced technologies in community college apprenticeship programs, such as VR training modules in construction and healthcare, along with virtual apprenticeships in fields like software development and cybersecurity, underscores a transformative shift in vocational education. These innovations enhance student engagement, skill acquisition, and confidence by providing immersive, hands-on experiences that mirror real-world scenarios. While challenges such as high initial costs, the need for continual updates, and cross-cultural communication barriers exist, the potential benefits far outweigh these obstacles. Community colleges that embrace these technologies are not only

improving the quality and relevance of their training programs but are also positioning themselves as pioneers in education. This proactive approach ensures that graduates are better prepared for the workforce, equipped with cutting-edge skills, and adaptable to the evolving demands of their respective industries. By doing so, I would argue community colleges reaffirm their role as leaders in innovative education, poised to meet the needs of the 21st-century labor market.

Lessons from Abroad

AI applications in education abroad offer additional insights and practices that the U.S. could benefit from integrating into community college apprenticeships. For instance, in India, AI-powered VR simulations are utilized to teach maintenance procedures for complex machinery, enhancing the learning experience through immersive, hands-on training (Kumar, 2022). Advanced algorithms analyze individual strengths, weaknesses, and learning styles to create personalized learning modules, addressing specific skills and knowledge gaps. AI can also provide personalized career roadmaps, guiding apprentices toward their career aspirations with tailored advice and support. This approach not only gamifies the learning process but also allows apprentices to gain practical experience in a safe and controlled environment, fostering creativity, data interpretation, and human-centric leadership skills essential for the future workforce.

In the article "Exploratory Apprenticeship in the Digital Age with AI Tools," the authors highlight best practices for improving traditional education by integrating AI tools (2016). These practices include personalizing learning experiences, providing real-time feedback, and facilitating adaptive learning paths tailored to individual student needs. The importance of combining AI with hands-on apprenticeship models is emphasized to enhance engagement and practical skills development, ensuring that education remains relevant in a rapidly evolving digital landscape. By adopting these strategies, traditional education can be transformed to better meet the demands of the modern workforce.

Examples of AI-supported apprenticeship programs in the tech industry in Europe further illustrate the potential benefits. In Germany, Siemens uses AI-driven platforms to train apprentices in advanced manufacturing and engineering, providing simulations replicating real-world scenarios (Petrovska, et. Al, 2024). In the UK, Rolls-Royce employs AI to offer apprenticeships in aerospace engineering, where AI systems assist in diagnosing engine faults and optimizing maintenance schedules. These programs demonstrate how AI can revolutionize apprenticeship training, making it more effective and aligned with industry needs.

By leveraging these international examples, U.S. community colleges can enhance their apprenticeship programs, better preparing students for the future workforce.

DISCUSSION AND CONCLUSIONS

Community colleges, historically pioneers of educational disruption, are uniquely positioned to lead the quest for an AI technology workforce that the US will need to stay competitive through registered apprenticeships. These institutions have consistently adapted to changing educational landscapes by embracing innovative approaches (Thorton, 2013). Disruptive technologies, such as immersive experiences, tailored learning paths, and real-time collaboration, can revolutionize education. The "learn and earn" model aligns with modern educational needs and places community colleges yet again at the forefront of education reform. However, challenges like high initial costs, resistance to change, and the need for technology to reflect evolving industry standards must be addressed. Strategies to success will take time and dedication. By fostering creativity, community colleges can leverage technologies to better prepare students for the AI technology workforce and drive educational reform even further, positioning themselves as leaders in innovative education for the next century.

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