Are Research Universities Meeting the Educational Challenge of the New Economy?

Tanya Zlateva(✉)

Boston University Metropolitan College, Boston, MA 02215, USA
zlateva@bu.edu

Abstract. Rapid technological change is affecting workforce structure and deepening employment polarization. Driven by automation, data science, and increasingly artificial intelligence and cyber-physical systems, new employment opportunities require knowledge and skills in emerging fields or higher technical level that are in short supply in the current workforce. Closing this gap challenges traditional universities to develop diverse portfolios of accessible and affordable programs of industry-relevant content available to working adults for part-time study. As the pace of technological change continues to accelerate and working lifespans continue to increase, successful careers are predicated on lifelong learning, upskilling, and reskilling. Academia, recognizing this challenge, is moving continuing professional education, especially online learning, into the university's core mission. However, there are significant hurdles to integrating online programs into traditional research departments. This paper identifies the main difficulties and proposes approaches for their resolution.

Keywords: Online and hybrid education · Educational modalities · Workforce transformation · Alternative credentials · Job polarization · Artificial intelligence in education · Online at-scale · Continuing education · Professional education

1 Introduction

Academia is confronting a fundamental challenge—creating educational programs and environments for continual, accessible, and affordable learning while preserving the tradition of research and teaching that provides students with the foundational knowledge to last a lifetime. Sparked by the computing revolution of the last century, automation, global networks, data science, and, more recently, artificial intelligence and cyber-physical systems are transforming the economy and the structure of the workforce [1]. While job destruction is not expected to outpace job creation in the next five years, new employment opportunities also require new knowledge and skills, usually at a higher technical level or in an emerging field. Both are in short supply in the current workforce. Technological change, already the highest in history, has continued to increase over the last five years. This trend, along with longer life spans, means that a sustainable career requires continued learning, upskilling, and reskilling to keep pace with the rate

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of change [2]. There is no doubt there is a significant skill gap in the workforce—the question is only about its extent (estimates range from 40% to 70%) and how to address it (a bewildering number of proposals from corporate training to professional certifications and new credentials, to traditional for-credit programs.)

The complexity of the technological and social disruptions does not allow for a single solution. It will require a diverse portfolio of programs of different lengths (intensive short skills program to multiple-year degrees), credentials (certificate, specialization, micro-/nano masters, badges), and modalities (in-person, hybrid, online). However, traditional research universities have little to no experience outside the in-person undergraduate and graduate degrees. The majority of the faculty had no experience with remote learning until the covid-19 epidemic forced transitioning online. The results are mixed. Against this complex background, the inescapable reality remains that the new economy needs a novel educational paradigm, a reimagining of the teaching and learning space to deliver industry-relevant knowledge and skills supporting career success over a working life of more than fifty years.

One source for insights, expertise, and experience for approaching this task are continuing education schools. Their core mission is expanding university access to lifelong learners. Listening to student needs, they have developed professional programs and flexible delivery and emphasized the incorporation of industry tools and approaches in the academic curriculum. In the process, extension schools have accumulated considerable experience in teaching working adults, e.g., by increasing interactivity and developing supporting materials to bridge gaps in prerequisite knowledge. A collaboration between traditional departments and continuing education units that leverages research strengths with flexible, accessible teaching for working professionals would be a powerful approach to creating a new learning space. This paper explores the drivers for the change, the educational need, and the hurdles for achieving a transformation of the traditional university.

2 The Gap Between Educational Need and Availability

To understand the need, nature, and urgency for academic change, we briefly consider the causes driving the restructuring of the workforce from the technology, demographics, and social point of view.

Technology has been the root cause for change, specifically the expansion of computing into (i) automation and robotization of production and (ii) ubiquitous use of analytic and collaboration tools even in traditionally non-technical fields (e.g., managerial tasks, construction work) thanks to the increased ability and ease of processing large amounts of data. As in previous industrial revolutions, existing jobs are destroyed, and new ones are created. But there are two significant differences. First, the pace of change is at a historical high, and with the progressive adoption of artificial intelligence and its integration with physical systems, it will continue to accelerate. Second, unlike previous industrial revolutions that replaced mainly manual labor and created better paying white-collar jobs, the current change affects traditionally safe middle-class occupations such as office work, data entry, paralegal, or, more generally, jobs with well-defined routine activities. In contrast, some low-paid occupations in the service sphere (personal

care, security personnel, cleaning services) increased, leading to a more pronounced polarization. The qualifications required for careers in emerging sectors or with highly changed skill profiles are heavily tilted toward data and business analysis, data science, machine learning, and AI, digital strategies and transformation [1, 2].

While demographic factors vary across countries and economies, global life expectancy increased by six years in the twenty pre-covid years. Even with the losses of the last two years, it remains ca. four years higher than in 2000 [3, 4]. Healthy life expectancy exhibits a similar pattern, confirming that people, living longer, healthier lives, need sustainable employment. Country-specific factors may also substantively affect the educational landscape. For instance, in the United States, college enrollments have been declining since 2010, except for graduate professional registrations that increased in the pre-covid years and then held steady [5, 6]. The losses are not uniformly distributed. For-profit universities were the hardest hit, and some smaller liberal colleges faced serious financial problems. However, the overall instability—economic and social—compelled virtually all academic institutions to seek novel programmatic and delivery approaches that will broaden access and expand their student population.

Table 1. .

Economy & Workforce	**Higher Education**	
Computing, Automation, Data Science, AI, cyber-physical systems	Quantitative Knowledge & Skills, Analytical & Innovative Thinking, Complex Problem Solving, Critical Thinking, Technology Use & Design, Collaboration & Leadership,	
Fastest pace of change in history, and increasing	Continual timely curriculum innovation	Foundational degrees that build disciplinary knowledge to last a lifetime
Longer career lives: 50+ years	Lifelong learning to sustain successful career with variety of program formats (certificates, degrees, badges) and modalities (hybrid, online)	One-time immersive degrees: bachelors and doctoral, more recently master's and some online
	Extension Schools	*Traditional Research Departments*

Table 1 summarizes the new demands on higher education and how academia is currently meeting them through its traditional and continuing education programs. The main content areas—computing, automation, data science, learning and AI, cyber-physical systems—are all included in the curriculum of both research and extension schools. The

difference is in the positioning of the programs. Traditional schools prioritize foundational knowledge and building a deep disciplinary framework to last a lifetime. The premise is that this academic foundation, typically acquired in an immersive learning environment, gives students the ability to stay abreast of their professional field through self-study. In contrast, extension units focus on programs for improving existing skills or providing paths to a new field and a new career. The premise is that there is a need to repeatedly come back to school and engage in a formal learning experience while attending part-time. While the value of an academic foundation is indisputable it is also clear that the program and delivery formats developed for part-time students are better suited to meet the demands of the new economy.

3 Higher Education Response to the Challenge

The educational challenge of the new economy and the danger of social destabilization that can result from continued workforce polarization are well understood in academia. Both research universities and extension schools have rapidly developed, implemented, and tested a variety of educational initiatives. It is worthwhile to explore the differences in approach. Continuing education schools through their immediate and direct contact with professionals understood the learning needs much earlier and became centers for experimentation and innovation for curriculum, formats, and modality. Figure 1 illustrates this trend on the example of Boston University's Metropolitan College. MET was the first to introduce an MS in computer science in the early 1970s, led curricular updates on programming languages (C instead of Pascal, object-oriented programming with C++ then Java) in the 1990s, and after 2000 developed specialized graduate programs in cybersecurity, health informatics, business and data analytics. Program format innovation included the introduction of stackable for-credit certificates in the mid-1990s and non-credit preparatory laboratories in 2015. As early as the mid-1990s the college was offering video-conferencing courses through PictureTel for corporate partners. The first hybrid graduate certificate with 75% online content and video lectures was delivered in 2000, and fully online programs were launched in 2002.

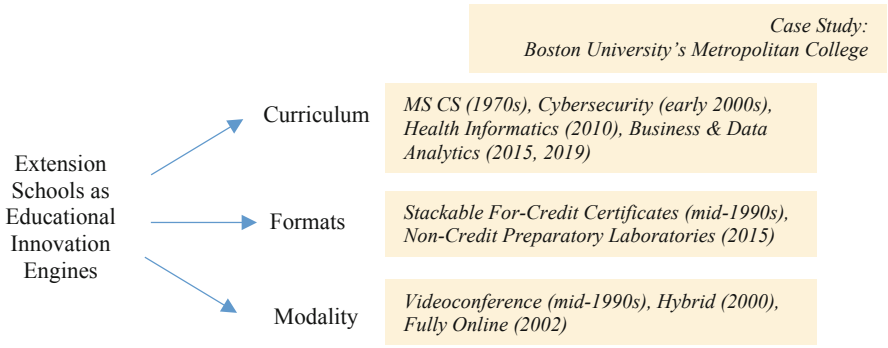

Fig. 1. Educational innovation at Boston University's Metropolitan College

Research departments entered the continuing education space in the early 2000s. The visionary goal of massive open online courses was for free education from the best researchers in the field, available to everybody in the world. It was an explosion of masterly content and creative design, and the world took notice. The first massively open online course (MOOC), an AI course by Sebastian Thrun and Peter Norvig from Stanford, attracted 160,000 students. More courses followed, developed by brilliant scientists and scholars, some reaching half a million students in one session (e.g., Justice by Harvard's Michael Sandel). But soon, two major problems surfaced—(i) completion rates were low, and the majority of students were not from disadvantaged backgrounds but had completed or were in the process of completing a degree; and (ii) the initial business model was unsustainable. A series of adjustments were introduced to address these problems, including low-cost verification certificates, micro- and nano-degree as entry to full degrees, and finally, online for-credit master's degrees (Fig. 2). The tuition of the latter currently ranges from a disruptively low $7,000 to $15,000 (multiple times lower than the in-person version) to a premium of $80,000 to over $110,000 (the same as the in-person version).

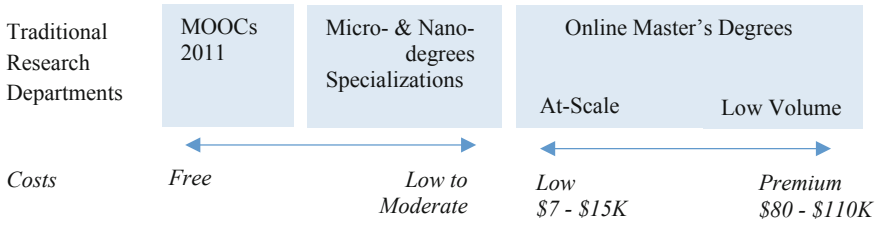

Fig. 2. Evolution of massive open online courses

Both extension schools and research departments have demonstrated a high level of innovation. But it is interesting to note that the style of the innovation is strongly influenced by the institutional culture. Traditional continuing education departments developed programs that directly answered student career needs—emphasizing applications and industry tools and skills, low development cost, and short, affordable programs. The research department approached continuing education as a research project—global vision, emphasis on originality and creativity, consciously disruptive, financial solutions delayed to a later phase.

4 Organizational Hurdles

Recent surveys show that a substantial majority of university leadership support the expansion of continuing education and online programs (e.g., 66% of respondents in a 2021 survey by Modern Campus [7] agree or strongly agree they have support and buy-in to expand from senior leadership.) However, there are serious organizational and cultural hurdles to the faster adoption of continuing education by research departments. Beyond the obvious expansion of educational technologies and support, and adding resources for instructional design and production, there are differences in departmental and faculty

priorities, student profile, pedagogy, and program format that are not well understood and therefore not addressed.

Research departments prioritize the creation of new knowledge and expect faculty to devote considerable time to research and scholarship and mentoring doctoral students. Course development and teaching are almost exclusively in the area of research interests of the faculty and primacy is placed on disciplinary depth. Promotion and tenure are strongly dependent on the quality and impact of the publication record. In contrast the deciding factor for continued employment in continuing education units is teaching teaching quality, course updates and curriculum innovation to integrated emerging fields and industry-relevant skills and approaches, and online course development (Table 2).

Table 2. Differences in faculty priorities, student profile, and programs between traditional research departments and continuing education schools

	Traditional research departments	Continuing professional units
Faculty Expectations and Priorities	• Research & Scholarship • Creation of New Knowledge	• Teaching • Industry-Relevant Curriculum
Students	• Selective • Substantial Financial Investment • Full-time Study, (Part-Time Job) • Limited size student body	• Accessible • Affordable • Full-Time Job, Part-Time Study • Large size student body
Curriculum	• Academic Foundational Knowledge Framework • Disciplinary breath & depth	• Applied Knowledge & Skills • Professional tools, applications & techniques
Format & Delivery	• Degrees • On-campus—day • Online, Hybrid	• Degrees, Certificates, • On-campus—eves, weekends • Online, Hybrid

The differences in student profiles can be even starker. Students in traditional research departments are admitted through a rigorous selection process, they attend full-time, are immersed in the academic community, and their main stated goal and responsibility is learning. Continuing education students attend part-time and typically must divide attention between responsibilities for their full-time jobs, family, and learning. A significant percentage are career changer with no prior knowledge of the field they intent to enter. To achieve the same or equivalent learning outcomes for both student populations faculty needs to account for these differences in teaching style and supporting teaching materials, e.g. more extended online materials for prerequisite knowledge for part-time students, more formal guidelines for team and research projects.

Finally, continuing education implies not only flexibility of the delivery modality, but also a range of short programs that can be stand-alone or lead to a degree. The frequency of offering is also important—cohort programs are too rigid, and limiting

program start to once or twice per year is insufficient for working adults who often have uneven workload.

5 A Look to the Future

Continuing education has moved into the main mission of the university. It is not yet fully integrated into the fabric of the teaching and learning process, but there is a clear institutional understanding of its strategic significance.

The obstacles to an effective online continuing education operation led and overseen by the research departments are still not well understood and only partially addressed. While it is accepted that faculty needs to be supported by instructional designers, videographers, and developers of graphics and simulations, questions about the level of in-class instructional support are wide open. To give a few prominent examples: Is peer-to-peer grading an adequate substitute for teaching assistants? Is automated grading a sufficient measure for learning? Can AI tools significantly reduce or even eliminate the need for instructor involvement? Georgia Institute of Technology successfully deployed and used "Jill Watson," a virtual teaching assistant and continual free learning resource [7]. However, generic AI tools are limited in number and are not broadly adopted. Answers to the above questions will not be uniform. Schools vary in their academic profile, history, culture, organizational structure, and strategic goals. Each will forge a path to online and continuing education that best fits its profile and resources. But there are some overreaching themes and questions common to all that must be addressed.

Table 3. Continuing education in the mainstream – goals and solutions

Goals	Solutions
• **Meaningful access to faculty for large number of students**? • **Continual curriculum innovation** – new programs in emerging fields & frequent updates of existing curricula with the latest industry tools and approaches • **Extensive hands-on online learning resources** to provide prerequisite knowledge for students with widely diverse background ranging from *recent graduates to seasoned professionals, to career changers with no background in the new field, to practitioners who have been out of school for many years*?	• **From single faculty to teaching teams** • **Collaboration with continuing education departments to leverage experience in teaching working adults** • **Expansion of Teaching Faculty**

Table 3 provides an overview of the goals in bringing continuing education programs into the core educational mission of the university and some solutions for their realization. While a natural extension of the teaching mission the integration of continuing programs

in research departments requires significant changes and will have a profound impact on the university as we know it today. The faculty who has been traditionally fully in charge of their course material and teaching will need to transform into leaders of a diverse teaching team including facilitators or section instructors, instructional designers, and administrative support. An expansion of the teaching faculty, needed to manage the large course enrollments, increased the complexity of faculty structure and faculty governance. Developing expertise and experience in teaching part-time students require additional time investments and bridging institutional boundaries. Overall, the expansion is student- and teaching-centered with very limited overlap with the primary research mission. Thus, reconciling demands on faculty time will require creative solutions. However, despite the difficulties, the importance and significance of continuing professional learning for future economic progress and an equitable society remain indisputable.

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