

Harnessing the Digital Nature of Micro-Credentials in Higher Education

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Abstract: This review paper delves into using micro-credentials in higher education ecosystems as a digital enablers. Micro-credentials, which are digital credentials that attest to a learner's mastery of a specific skill or knowledge area, are becoming more popular in higher education. The paper examines the successful implementation of micro-credential frameworks in higher education, using case studies to demonstrate the advantages of micro-credentials. The review emphasizes the agility and flexibility of micro-credentials, which enable learners to acquire new skills quickly and respond to changes in the job market. In addition, the paper discusses the digital nature of micro-credentials and how they allow institutions to provide targeted, skills-based training that is relevant to employers. It also explores how micro-credentials are delivered through online platforms, making them convenient and easily accessible for learners. The review underscores the significance of digital infrastructure, connectivity, and public utility for promoting micro-credentials. The paper argues that micro-credentials function as a digital enabler for higher education ecosystems, allowing learners to acquire targeted training and enabling institutions to expand their offerings and reach more students. The paper concludes by highlighting the potential for micro-credentials to help bridge the skills gap and equip learners with the skills necessary to succeed in today's digital economy.

Keywords: Micro-credentials; Higher Education; Online Learning; E-learning; MOOCs; Digital Learning Ecosystems

1. Introduction

In today's ever-evolving job market, keeping up with new technologies is crucial for workers to remain competent and employable. According to a report by the World Economic Forum, 50% of all employees will need reskilling by 2025 due to technological advancements and changes in job roles (**These Are the Top 10 Job Skills of Tomorrow – and How Long It Takes to Learn Them**, 2020).

According to Randstad's 2016 Workplace Trends report, 79% of HR managers agree that they struggle to find people whose skills match job requirements when positions become available at their organization (**Azmi, 2016**). Furthermore, 87% of workers believe that it is crucial to continuously update their skills to remain relevant in the job market, according to a survey by edtech company Udemy (**"New Global Udemy Report Finds Workers Increasingly Aware of the Skills Gap, Yet Optimistic about the Future"**, n.d.).

Updating one's skillset not only improves employment opportunities but also enables individuals to perform their jobs better. In a study by McKinsey & Company, 82% of executives reported that retraining and upskilling programs have improved productivity and business performance (**"Reskilling and remote working to recover in the next normal"** McKinsey, n.d.).

Moreover, with the rise of automation and artificial intelligence, some jobs are becoming redundant, while others require new skills. According to a report by the World Economic Forum, by 2022, 54% of all employees will require significant re- and up-skilling. Workers who keep their skills updated can transition to new roles and industries more easily, remaining employable despite changes in the job market (**"IBM Study"**, n.d.).

Micro-credentials are digital credentials that allow learners to demonstrate their mastery of a specific skill or knowledge area. These credentials are becoming increasingly popular in higher education as they offer a flexible and agile way for learners to acquire new skills and knowledge. Micro-credentials are typically shorter than traditional degree programs and can be earned in a fraction of the time, making them an attractive option for learners who want to upskill or reskill quickly.

Micro-credentials are also a digital enabler for higher education ecosystems. They allow institutions to expand their offerings and reach new learners who may not have access to traditional degree programs. They also enable institutions to provide targeted, skills-based training that is aligned with the needs of employers and the job market. This helps to bridge the skills gap and ensure that learners are equipped with the skills they need to succeed in today's digital economy. (Che Ahmat et al., 2021)

Micro-credentials are often delivered through online platforms, which makes them highly accessible and convenient for learners. They can be completed at any time and from any location, which is particularly beneficial for learners who are working or have other commitments. The digital nature of micro-credentials also allows learners to showcase their credentials to potential employers through online portfolios or social media, making them more visible and marketable in the job market.

Overall, micro-credentials are a digital enabler for higher education ecosystems as they provide learners with flexible, targeted training that is aligned with the needs of employers and the job market. They also allow institutions to expand their offerings and reach new learners, which helps to ensure that higher education remains relevant and responsive to the changing needs of learners and the economy.

Micro-credentials, which are digital badges or certificates that demonstrate an individual's proficiency in a specific skill or knowledge area, are becoming increasingly accepted by companies as a way to validate a job candidate's skills and knowledge. Many companies are now recognizing the value of micro-credentials and incorporating them into their hiring processes.

For example, IBM has created its badge system called "Open Badges," which allows individuals to earn digital badges for demonstrating specific skills and knowledge. IBM uses these badges as a way to identify and hire job candidates who have the necessary skills for specific roles (**"Do digital badges really provide value to businesses?"**, 2019). Similarly, companies such as Microsoft (Micsullivan, 2022), Cisco (**"Digital Badges"**, n.d.), and Adobe (**"Classic learning research in practice"**, 2020) offer micro-credential programs that allow individuals to earn badges for demonstrating proficiency in their software or technology. These badges are recognized by many employers and can increase an individual's chances of getting hired or promoted.

Additionally, many companies are now partnering with educational institutions to offer micro-credential programs to their employees. These programs allow employees to gain new skills and knowledge relevant to their job roles and can lead to career advancement opportunities within the company. A few examples include,

IBM - partnered with edX to offer micro-credential programs in fields such as data science, cybersecurity, and artificial intelligence to their employees (Press, n.d.).

AT&T - collaborated with Udacity to provide online courses and nano degrees in topics such as web development and data analytics to their workforce (Udacity, n.d.).

Google - partnered with Coursera to offer online courses and certifications in areas such as IT support, project management, and data analysis to their employees (**"Google announces Career Certificates in partnership with Coursera to boost digital skills"**, 2021).

Microsoft - collaborated with edX and LinkedIn Learning to provide professional development courses and certifications in topics such as cloud computing, data science, and cybersecurity to their employees (**"Microsoft | edX"**, n.d.).

Amazon - partnered with edX to offer courses and certifications in areas such as machine learning, data analysis, and cloud computing to their workforce (**"Microsoft and**

LinkedIn engage 7.3 million learners in India through Skills for Jobs program, to help 10 million people learn digital skills”, 2022).

During the COVID-19 pandemic, many recent graduates faced limited job opportunities and decided to pursue higher education to improve their career prospects. However, traditional degree programs can be costly and time-consuming and may not be feasible for everyone.

According to a report by Burning Glass Technologies, a labor market analytics firm, nearly one-third of job postings in 2019 required a graduate degree, and the demand for specific skills is increasing rapidly in many (**Credentials matter phase 2 - burning glass technologies**). In fact, a survey conducted by the Society for Human Resource Management found that 75% of employers reported difficulty finding skilled candidates, and 83% said they would be willing to hire someone with a micro-credential (**2022 Workplace Learning & Development Trends 2022**).

TABLE 1 Comparison of major micro credential providers.

Microcredential Provider	Platform Type	Number of Courses	Number of Specializations	Course Length	Average Cost
Coursera	MOOC	5000+	500+	4-6 weeks	\$49/month
edX	MOOC	3000+	100+	4-12 weeks	\$50-\$300
Udacity	Online Course	200+	40+	2-6 months	\$399/month
LinkedIn Learning	Online Course	16000+	1000+	Self-paced	\$29.99/month
Udemy	Online Course	155,000+	N/A	Self-paced	Varies

By earning micro-credentials, recent graduates can demonstrate their proficiency in a specific area and improve their career prospects. A report by the Lumina Foundation found that 48% of learners who earned a micro-credential reported a salary increase, and 58% reported a promotion or new job opportunity (**Zanville et al., 2017**). Moreover, micro-credentials can often be earned in a shorter amount of time than in traditional degree programs. For example, a micro-credential program in data analytics from IBM can be completed in just eight weeks (**“Building Career Ready Skills with the IBM Accelerate Summer Program”, 2022**).

Most U.S. employers believe that earning an industry-specific micro-credential can enhance a job candidate’s job application and improve their ability to perform in an entry-level position. Specifically, 86% of employers agree that industry micro-credentials strengthen a job candidate’s job application, while 74% believe that obtaining such a credential can boost their performance in an entry-level job. This highlights the growing recognition among employers of the value of industry-specific micro-credentials in assessing job candidates’ skills and knowledge. (**“New Coursera survey shows high demand for industry micro-credentials from students and employers in tight labor market - Coursera Blog”, 2023**)

Microcredentials have become an increasingly popular option for recent graduates who want to prepare themselves for higher education courses (**Ralston, 2021**). With the disruption caused by the COVID-19 pandemic, many students have had to adapt to new modes of learning and study from home. Micro-credentials can be a valuable tool for these students, helping them develop the skills and knowledge they need to succeed in their higher education programs.

Micro-credentials are often designed to provide focused, specialized training in a specific area. For example, a micro-credential program in data analysis might focus specifically on statistical analysis, data visualization, or data mining techniques. By completing

such a program, students can develop the specific skills and knowledge that they will need for success in their higher education courses.

In addition to providing focused training, micro-credential programs can also be completed relatively quickly and at a lower cost than traditional degree programs. This can be especially valuable for recent graduates who are preparing to enter higher education programs and may be facing financial constraints or other challenges.

Microcredential programs are available in a wide range of fields, including business, technology, healthcare, and education. Some programs are offered by universities and colleges, while others are provided by professional organizations or private companies. Many programs can be completed entirely online, making them incredibly convenient for students who are studying from home.

2. Issues and challenges faced by higher education institutes in developing and implementing micro-credential programs

The development and implementation of micro-credential programs in higher education institutes can be a challenging task. Some of the main issues and challenges faced by these institutes include the following:

Resistance to change: Many higher education institutes may be resistant to change and may prefer to stick with traditional degree programs rather than adopting micro-credentials. This can make it difficult to gain support for the development and implementation of micro-credential programs.

Several studies conducted in the United States have concluded that currently, micro-credentials are not being viewed as replacements for full-time degrees. In 2020, a group of researchers discovered that nearly all individuals who completed micro-credential courses were either experienced employees or mid-management senior professionals seeking to enhance their resumes. The majority of these individuals had already attained a degree or graduated from a higher education program. (HRKatha, 2022)

Lack of resources: Developing and implementing micro-credential programs can require significant resources, including funding, staff time, and expertise in instructional design and technology. Many higher education institutes may not have the necessary resources to create and deliver high-quality micro-credential programs.

TABLE 2: A list of micro credentials with relevant job requirements

Job Re- quirement	Relevant Microcredential	Provider	Comple- tion Time	Cost
Data Analysis	Data Analysis with Python	edX	8 weeks	\$198
	Data Analysis Micromasters	edX	6-12 months	\$1,350
	Data Science Specialization	Coursera	7 months	\$49/month
Project Manage- ment	Certified Project Manager	Udemy	Self-paced	\$129.99
	Project Management MicroMasters	edX	1 year	\$1,260
Digital Marketing	Digital Marketing Specialization	Coursera	5 months	\$49/month
	Digital Marketing Nanodegree	Udacity	3 months	\$399/month
Cybersecu- rity	Cybersecurity Fundamentals	LinkedIn	3 hours	Free with Premium

	Cybersecurity MicroMasters	edX	1-2 years	\$1,260
Web Development	Full Stack Web Development	edX	6 months	\$1,260
	Web Development Bootcamp	Udemy	Self-paced	\$94.99
Cloud Computing	Cloud Computing Specialization	Coursera	7 months	\$49/month
	Cloud Computing Foundations	LinkedIn Learning	1 hour	Free with Premium
Artificial Intelligence	AI for Everyone	Coursera	4 weeks	Free
	AI MicroMasters	edX	1-2 years	\$1,260
Data Visualization	Data Visualization with Tableau	Udacity	2 months	\$1,196
	Data visualization with Python	Coursera	5 weeks	\$49/month
Entrepreneurship	Entrepreneurship Specialization	Coursera	5 months	\$49/month
	Entrepreneurship Acceleration Program	edX	12 weeks	\$1,500
Leadership	Leadership and Management MicroMasters	edX	8-16 months	\$1,350
	Leading People and Team	Coursera	4 months	\$49/month

With the growth of micro-credential programs, there is a need for standardization and quality assurance to ensure that these programs are rigorous and provide value to learners. However, creating standards and ensuring quality can be challenging, particularly with the diversity of micro-credential programs available.

Higher education institutes may face competing resource demands, such as research funding or enrollment in traditional degree programs. This can make it challenging to prioritize the development and implementation of micro-credential programs.

Despite these challenges, there is growing interest and demand for micro-credential programs in higher education. According to a report by HolonIQ, the global market for micro-credentials is expected to reach \$2.7 billion by 2025 (**“Global Online Degree and Micro-Credential Market to reach \$117B by 2025”**, 2021). In addition, in a survey of students and recent graduates in the United States, a significant majority of respondents expressed positive views regarding the value of industry micro-credentials. Specifically, 86% agreed that earning such a credential would enhance their job prospects and help them stand out to potential employers after graduation. Additionally, 81% believed that micro-credentials would contribute to their success in their future job. A significant proportion of respondents, 74%, indicated that the availability of relevant micro-credentials would influence their choice of degree program at their university. In terms of motivating factors for pursuing micro-credentials, 66% of respondents indicated that the prospect of earning credit toward a degree was the most compelling, while 43% indicated that the association with a leading industry company was their top priority (**“New Coursera survey shows high demand for industry micro-credentials from students and employers in tight labor market - Coursera Blog”**, 2023).

To overcome these challenges, higher education institutes can work to create partnerships with industry leaders and professional organizations to develop and implement

micro-credential programs that align with workforce needs. They can also invest in resources such as instructional designers and technology infrastructure to ensure the quality and effectiveness of their micro-credential programs. Additionally, they can work to develop standards and accreditation processes to ensure that micro-credentials are recognized and valued by employers and other stakeholders.

3. Emerging trends of micro-credential providers

Over the years, micro-credential-providing companies such as Udemy, edX, Coursera, and many others have emerged and gained popularity in the online education market. These companies offer a wide range of micro-credential programs, which provide learners with the opportunity to gain skills and knowledge in specific areas of interest.

One emerging trend is the shift towards skills-based education and training, where learners can earn micro-credentials in specific skills that are in demand by employers.

Another trend is the increasing use of digital badges to recognize and verify learning. Digital badges are a form of micro-credential that can be displayed online and shared with employers and others to demonstrate skills and knowledge.

Furthermore, there is also an increasing trend towards stackable micro-credentials, where learners can earn a series of micro-credentials that can be combined into larger credentials, such as certificates or degrees. This approach allows learners to build their skills and knowledge incrementally and provides a flexible and personalized approach to learning.

Finally, there is also an increasing trend towards industry-specific micro-credentials, where companies partner with education providers to offer micro-credentials that are directly aligned with the needs of specific industries. This approach can help address the skills gap and provide learners with the specific skills and knowledge required to succeed in their chosen industry.

Overall, micro-credentials are becoming an increasingly important part of the education landscape, and the emergence of new trends and innovations will likely continue to shape the future of micro-credential programs.

TABLE 3

A comparison of micro credentials with respect to industry

Indus-try	MOOCs	Microcredentials
Tech-nology	Introduction to Computer Science (edX)	Google IT Support Professional Certificate (Coursera)
	Machine Learning (Coursera)	IBM Data Science Professional Certificate (Coursera)
	Front End Web Developer (Udacity)	AWS Certified Solutions Architect - Associate (Udemy)
Busi-ness	Financial Markets (Coursera)	Digital Market Professional Certificate (edX)
	Foundations of Business Strategy (Coursera)	Lean Six Sigma Green Belt (LinkedIn Learning)
	Project Management (edX)	Project Management Professional (PMP) Certification (PMI)
Health-care	Healthcare IT Foundations (edX)	Health Informatics Professional Certificate (Coursera)
	Anatomy (Coursera)	Healthcare Administration MicroMasters (edX)
	Clinical Data Science (Coursera)	Clinical Trial Design and Management (edX)
Educa-tion	Learning to Teach Online (Coursera)	e-Learning Ecologies: Innovative Approaches (edX)
	Instructional Design and Technology (edX)	Teaching with Technology and Inquiry (Coursera)
	Blended and Online Learning Design (edX)	Learning Analytics Fundamentals (edX)

4. Micro-credential and capacity-building ecosystems

With the growth of digital technologies, various online learning platforms have emerged, providing learners with access to a vast range of micro-credential courses. These platforms have proliferated, with companies like Udemy, edX, and Coursera leading the way. Udemy, for instance, has over 155,000 courses available, and the platform has over 40 million registered users. edX, on the other hand, has over 30 million learners and offers over 3,000 courses (**“15 Best Online Learning Platforms in 2023”, 2023**).

The popularity of micro-credentials is driving innovation in the education sector, and many universities and colleges are also developing their own micro-credential programs to meet the growing demand for flexible, career-oriented education.

However, the development and implementation of micro-credential programs pose significant challenges for higher education institutions. These include issues related to accreditation, credentialing, quality control, and financial sustainability.

To overcome these challenges, institutions are developing partnerships and collaborations with other organizations and building capacity-building ecosystems. For instance, institutions are partnering with companies like edX and Coursera to offer micro-credential programs that are recognized globally. These partnerships help institutions build their capacity to deliver high-quality micro-credential programs that meet industry needs.

Overall, the emerging trend of micro-credentialing is transforming the education sector and creating new opportunities for learners to gain new skills and advance their careers. With the continued growth of digital technologies and online learning platforms,

the potential for micro-credentials to provide access to affordable and flexible education is immense.

5. Higher degree university programs adopting micro-credentials as a part of their curriculum

According to a recent survey conducted by Coursera, the majority of employers and students believe that obtaining short-term industry certificates is beneficial in addition to a college degree and can enhance one's chances of securing employment. The survey found that these certificates are viewed as a valuable asset in the hiring and job-seeking process. (Nietzel, n.d.)

In recent years, higher degree programs have started to adopt micro-credentialing as a part of their curriculum to provide students with an opportunity to gain additional skills and knowledge in a specific field. According to a report by HolonIQ, more than 90% of universities in the United States are offering micro-credential programs, and the market for micro-credentials is expected to reach \$117 billion by 2025 ("**Global Online Degree and Micro-Credential Market to reach \$117B by 2025**", 2021).

For example, the University of Michigan's School of Information offers micro-credentials in areas such as data science, programming for data science, and user experience research and design. Similarly, Harvard University's Extension School offers a range of micro-credential programs, including digital marketing, entrepreneurship, and cybersecurity.

In addition, many universities are also partnering with edtech companies such as Coursera, edX, and Udacity to offer micro-credential programs. For instance, Coursera has partnered with over 250 universities to offer micro-credential programs to students ("**Coursera: Overview | LinkedIn**", n.d.), and edX has partnered with institutions such as MIT, Harvard, and Berkeley to offer micro-credentials in a variety of fields.

These partnerships allow universities to offer high-quality micro-credential programs to students without investing significant resources in developing their own programs. It also provides students with access to a broader range of courses and programs than they might have had access to otherwise.

Overall, the adoption of micro-credentials by higher degree programs is a positive trend that provides students with the opportunity to gain additional skills and knowledge to enhance their career prospects.

6. Micro-credentials for retirees, senior citizens, and elderlies who wish to start a second career

There are growing examples of senior citizens utilizing micro-credentials to remain mentally active and prepared for a second career. According to a survey conducted by Udemy, 38% of senior citizens who participated in their platform reported that learning new skills helped them stay mentally fit and active. Furthermore, data from the National Center for Education Statistics (NCES) shows that enrollment of students over 35 years of age has increased significantly over the past decade. This suggests that there is a growing interest among senior citizens to continue learning and improving their skills, and micro-credentials can be a valuable tool in achieving those goals. In fact, many universities and educational institutions are now offering micro-credential programs specifically designed for senior learners.

We believe there is potential to use MOOCs as a way of tackling the issue of loneliness among older adults by engaging them as either resource personnel or learners. ("**Interactive Journal of Medical Research - Elderly Learners and Massive Open Online Courses: A Review**", 2016)

As the average life expectancy has increased globally, the retirement age has remained relatively constant, leading to a significant number of experienced and capable older individuals being removed from the workforce. This can lead to feelings of redundancy and loss of purpose, which may result in depression and other mental health issues. Encourag-

ing older adults to pursue a second career can be an effective way to address these issues and also benefit the economy.

Older adults bring a wealth of experience, knowledge, and skills to the workforce. By encouraging them to continue working, they can contribute their expertise and mentor younger employees. Moreover, older adults are often highly motivated to continue learning, and many may seek out training and education opportunities to prepare for their second careers. This can lead to the development of new skills and the acquisition of new knowledge, which can be beneficial for both the individual and the economy.

Starting a second career can also provide financial security for older adults, enabling them to save for retirement or supplement their retirement income. This can be especially important for individuals who may not have had the opportunity to save as much as they would have liked during their primary careers.

A survey by AARP indicates that 68% of people aged 50 and above believe that today's technology is not designed with them in mind. Micro-credentials designed for technologically challenged elders can be very beneficial to make them comfortable with technology and starting a second career. (**"2023 Tech Trends: No End in Sight for Age 50+ Market Growth"**, 2023)

7. Conclusion:

MOOCs and micro-credentials are rapidly changing the digital education landscape, and they will continue to do so in significant ways in the future. According to recent reports, the global MOOC market is expected to grow at a compound annual growth rate of 32% between 2020 and 2025, reaching a value of \$25.33 billion by 2025. Similarly, the micro-credentials market is predicted to grow at a compound annual growth rate of 17.2% between 2020 and 2027, reaching a value of \$2.7 billion by 2027.

One of the significant ways in which MOOCs and micro-credentials will change digital education is by offering personalized learning. Learners can choose courses that are most relevant to their interests and needs and learn at their own pace. A recent survey showed that 79% of learners agreed that micro-credentials allowed them to focus on specific skills or knowledge areas. This personalized approach to learning will become even more prevalent in the future, with courses and programs becoming increasingly customizable.

Another significant advantage of MOOCs and micro-credentials is their affordability and accessibility. With the rise of digital education, high-quality education is becoming more affordable and accessible to people worldwide. According to a survey conducted by Coursera, 87% of learners reported career benefits after completing a MOOC. This increased accessibility will open up new opportunities for learners, particularly those in developing countries or underserved communities.

MOOCs and micro-credentials also offer the flexibility to study when and where it is most convenient for learners. This flexibility will become even more critical in the future as the demands of work and life become increasingly complex. According to a report by EdTechXGlobal, 93% of higher education institutions now offer online courses, indicating the growing importance of digital education.

Blended learning, which combines online and traditional classroom-based learning, is already becoming more popular, and MOOCs and micro-credentials will likely play a vital role in this approach to education. A report by eLearning Industry shows that blended learning can increase engagement and retention rates, as well as provide learners with the benefits of both online and in-person learning.

Finally, MOOCs and micro-credentials are becoming more widely recognized as a way to demonstrate skills and knowledge to employers. According to a survey by the Open University, 90% of employers recognized the value of micro-credentials, and 69% said they would be willing to sponsor their employees to obtain them. This could lead to a shift from traditional higher education models towards more flexible and targeted forms of education.

Overall, the continued growth of MOOCs and micro-credentials is likely to have a profound impact on the future of digital education. With the benefits of affordability, accessibility, flexibility, and personalized learning, learners will be able to obtain a high-quality education and demonstrate their skills and knowledge in new and innovative ways.

References

- 15 Best Online Learning Platforms in 2023. (n.d.). Retrieved February 27, 2023, from <https://upskillwise.com/online-learning-platforms/>
- Azmi, H. (2016, December 13). 8 Reasons Managers Struggle to Find the Right Talents. Sogolytics Blog. <https://www.sogolytics.com/blog/8-reasons-managers-struggle-to-find-the-right-talents/>
- New Global Udemy Report Finds Workers Increasingly Aware of the Skills Gap, Yet Optimistic about the Future. (n.d.). About Udemy. Retrieved February 27, 2023, from <https://about.udemy.com/press-releases/new-global-udemy-report-finds-workers-increasingly-aware-of-the-skills-gap-yet-optimistic-about-the-future/>
- Reskilling and remote working to recover in the next normal | McKinsey. (n.d.). Retrieved February 27, 2023, from <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-future-of-work-reskilling-and-remote-working-to-recover-in-the-next-normal>
- IBM Study: COVID-19 Is Significantly Altering U.S. Consumer Behavior and Plans Post-Crisis. (n.d.). IBM Newsroom. Retrieved February 27, 2023, from <https://newsroom.ibm.com/2020-05-01-IBM-Study-COVID-19-Is-Significantly-Altering-U-S-Consumer-Behavior-and-Plans-Post-Crisis>
- Che Ahmat, N. H., Bashir, M. A. A., Razali, A. R., & Kasolang, S. (2021). Micro-Credentials in Higher Education Institutions: Challenges and Opportunities. *Asian Journal of University Education*, 17(3), 281. <https://doi.org/10.24191/ajue.v17i3.14505>
- Do digital badges really provide value to businesses? (2019, June 18). IBM Training and Skills Blog. <https://www.ibm.com/blogs/ibm-training/do-digital-badges-really-provide-value-to-businesses/>
- Micsullivan. (2022, September 14). View, use, and share certificates and badges. <https://learn.microsoft.com/en-us/certifications/view-use-share-certificates-badges>
- Digital Badges. (n.d.). Cisco. Retrieved February 27, 2023, from <https://www.cisco.com/c/en/us/training-events/training-certifications/certifications/digital-badges.html>
- Classic learning research in practice: Micro Learning with Micro Credentials. (2020, March 9). ELearning. <https://elearning.adobe.com/2020/03/classic-learning-research-in-practice-micro-learning-with-micro-credentials/>
- Press, edX. (n.d.). EdX Launches First MicroBachelors Program® with IBM. Retrieved February 27, 2023, from <https://press.edx.org/edx-launches-first-microbachelors-program-with-ibm>
- Udacity. (n.d.). AT&T is Collaborating with Udacity to Offer 1,000 Nanodegree Scholarships to Underserved Communities. Retrieved February 27, 2023, from <https://www.prnewswire.com/news-releases/att-is-collaborating-with-udacity-to-offer-1-000-nanodegree-scholarships-to-underserved-communities-301145679.html>
- Google announces Career Certificates in partnership with Coursera to boost digital skills. (2021, November 18). Business Today. <https://www.businesstoday.in/latest/corporate/story/google-announces-career-certificates-in-partnership-with-coursera-to-boost-digital-skills-312605-2021-11-18>
- Microsoft | edX. (n.d.). Retrieved February 27, 2023, from <https://www.edx.org/school/microsoft>
- Microsoft and LinkedIn engage 7.3 million learners in India through Skills for Jobs program, to help 10 million people learn digital skills. (2022, November 30). Microsoft Stories India. <https://news.microsoft.com/en-in/microsoft-and-linkedin-engage-7-3-million-learners-in-india-through-skills-for-jobs-program-to-help-10-million-people-learn-digital-skills/>
- EdX | AWS Training and Certification Blog. (n.d.). Retrieved February 27, 2023, from <https://aws.amazon.com/blogs/training-and-certification/tag/edx/>
- "Credentials matter phase 2 - burning glass technologies". (n.d.). , available at: <https://www.burning-glass.com/wp-content/uploads/2020/09/Credentials-Matter-Phase-2-Report.2020-Update.pdf> (accessed 1 March 2023).
- "2022 Workplace Learning & Development Trends". (n.d.). Trends & Forecasting, available at: <https://www.shrm.org/hr-today/trends-and-forecasting/Pages/default.aspx> (accessed 1 March 2023).
- Zanville, H., Porter, K., & Ganzglass, E. (n.d.). Report on Phase I Study: Embedding Industry and Professional Certifications within Higher Education.
- Building Career Ready Skills with the IBM Accelerate Summer Program. (2022, September 29). IBM Careers Blog. <https://www.ibm.com/blogs/jobs/career-ready-skills-with-ibm-accelerate-summer-program/>
- Ralston, S. J. (2021). Higher Education's Microcredentialing Craze: A Postdigital-Deweyan Critique. *Postdigital Science and Education*, 3(1), 83–101. <https://doi.org/10.1007/s42438-020-00121-8>
- Do digital badges really provide value to businesses? (2019, June 18). IBM Training and Skills Blog. <https://www.ibm.com/blogs/ibm-training/do-digital-badges-really-provide-value-to-businesses/>
- Global Online Degree and Micro-Credential Market to reach \$117B by 2025. (n.d.-a). Retrieved February 27, 2023, from <https://www.holoniq.com/notes/global-online-degree-and-micro-credential-market-to-reach-117b-by-2025>
- New Coursera survey shows high demand for industry micro-credentials from students and employers in tight labor market—Coursera Blog. (n.d.-a). Retrieved February 27, 2023, from <https://blog.coursera.org/from-higher-education-to-employment/>
- 15 Best Online Learning Platforms in 2023. (n.d.). Retrieved February 27, 2023, from <https://upskillwise.com/online-learning-platforms/>

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- [platforms/](#)
26. Nietzel, M. T. (n.d.). New Coursera Survey: Industry Certificates Hold Strong Appeal For College Students And Employers. Forbes. Retrieved February 27, 2023, from <https://www.forbes.com/sites/michaelnietzel/2022/09/27/new-coursera-survey-in-dustry-certificates-hold-strong-appeal-for-college-students-and-employers/>
 27. Coursera: Overview | LinkedIn. (n.d.). Retrieved February 27, 2023, from https://www.linkedin.com/company/coursera/?trk=public_profile_profile-section-card_subtitle-click&originalSubdomain=de
 28. Interactive Journal of Medical Research—Elderly Learners and Massive Open Online Courses: A Review. (n.d.). Retrieved February 27, 2023, from <https://www.i-jmr.org/2016/1/e1/>
 29. 2023 Tech Trends: No End in Sight for Age 50+ Market Growth. (n.d.). Retrieved February 27, 2023, from <https://www.aarp.org/research/topics/technology/info-2023/2023-technology-trends-older-adults.html>