

Micro-credentials and reflections on higher education

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Abstract

Purpose – Micro-credentials, which have been widely used in re-skilling and skills development, provide advantages for improvement in the professional career. As a complementary approach to career and professional development in formal education, it can be said that micro-credentials are preferred for supporting professional development and/or to acquiring new skills to find a job in a new field (Fisher and Leder, 2022). This study aims to provide a detailed perspective on conceptual framework and the use of micro-credentials in higher education.

Design/methodology/approach – Many questions have arisen regarding micro-credentials, applicability, quality assurance, inclusion in formal educational settings and how to include them in traditional education systems, especially in higher education institutions. Oliver (2019) emphasizes that there is little research on micro-credentials or their derivatives in the literature. There is still uncertainty on micro-credential on behalf of students, employers or employees. In addition, although there are studies on micro-credentials in the USA, Europe and Australia, there is very little research around countries such as Turkey (Yilik, 2021). This study discusses the use of micro-credentials in the world and their reflections on higher education.

Findings – As it is shown in this article, micro-credentials have the potential to challenge or complement traditional ways of how learning is taking place, understood, recognized and certified. Research on micro-credentials is still in its infancy and could benefit a lot from more research. Especially research on employers' recognition and appreciation of digital credentials needs to be studied. Also, empirically confirming propositions of literature on micro-credentials could be beneficial.

Originality/value – This study is original in terms of discussing the use of micro-credential in the world and their reflections on higher education and presenting suggestions on this subject.

Keywords Micro-credentials, Lifelong learning, Higher education

Paper type Research paper

Introduction

Developments in digital technologies and their effects in many areas bring new developments and challenges to educational organizations. With the increase in the application of current



technologies in our everyday lives, including in education, digital technologies have become more critical and even essential in updating individuals' knowledge and skills and increasing their lifelong learning potential. Many courses are organized today to boost lifelong learning potential. Micro-credentials come to the fore in determining the framework and validity of these courses, and valid certificates have an important place in the sector. Employers, industries and countries foresee that micro-credentials offer a solution to the rapid change in the job market requirements, fulfilling the needs of lifelong learners by allowing them to gain industry skills for the 21st century (Oliver, 2019). The job markets in Industry 4.0 will need specialists in their professions (Schwab, 2016). By contributing to the digital transformation of education, micro-credentials change society's perspective on learning and redefine the roles of educational institutions/organizations. This process allowed learners to increase their knowledge and skills by participating in short, low-cost and flexible online training courses.

Micro-credentials appear as a diminutive modular form of a diploma, or a certificate. A micro-credential includes skills or competence in certificates, nano-degrees, micro-masters, badges and memberships (Milligan and Kennedy, 2017). Learning in micro-credentials is shaped in a shorter time and a flexible structure aimed at more people's needs. Learners' easy access to digital learning materials such as digital books, online tutorials, video courses and various learning websites contributes to the global transformation of learning. The transfer of learning from school desks to lifelong learning brings a new system change in education and the independence of time and place. This change aims to keep learners up-to-date with technological and economic developments.

Many questions have arisen regarding micro-credentials, applicability, quality assurance, inclusion in formal educational settings and how to include them in traditional education systems, especially in higher education institutions. Oliver (2019) emphasizes that there is little research on micro-credentials or their derivatives in the literature. There is still uncertainty on micro-credential on behalf of students, employers or employees. In addition, although there are studies on micro-credentials in the USA, Europe and Australia, there is very little research around countries such as Turkey (Yilik, 2021). This study discusses the use of micro-credentials in the world and their reflections on higher education.

What are micro-credentials?

Micro-credentials are defined as "a certification of assessed learning that is less than a formal qualification" (Oliver, 2019, p. 19) or as short courses or credentialing and the learning activity completed with a certificate of achievement. Today, micro-credentials emerge as an alternative approach to getting a career and/or professional development in the existing one. There is no consensus for the term "micro credentials" in the literature, and many different terms are commonly used synonymously or associated with the word. These are digital badges, alternative competency, digital competency, nano-degrees, digital certificates, micro-masters, MOOCs or short online courses (Milligan and Kennedy, 2017). Even if the alternative versions of the term is used, it refers to the term micro-credential, which describes any short time and stackable learning experience, regardless of type, model and size (Beirne *et al.*, 2020).

In the UNESCO report published in 2018, the term "micro credential" is defined as an umbrella term covering a variety of competencies, including "nano-degrees", "micro-master competence, "certificates", "badges", "licenses" and "approvals" (UNESCO, 2018). On the other hand, the International Council for Open and Distance Education (ICDE) and Organisation for Economic Co-operation and Development (OECD) use the term as "alternative competency", which both encompass and distinguish between academic certificates, professional certificates, digital badges and micro-credential (Kato *et al.*, 2020). Therefore, learners who want to acquire micro-credentials can attend short courses, modules and so forth, focused on industry skills, complete them and receive certificates.

In short, micro-credential is a detailed certificate demonstrating that one has mastered the skills or competencies that one wants and aims, gained through the completion of short and purposeful skills-based learning experiences. Obtaining a nationally recognized certificate indicates that the holder meets the knowledge and skill standard set by the relevant organization (Nemec and Legere, 2008). It is verified by professional associations, universities or industry partners, increasing the credibility of this certificate and the employability of certificate holders. Uses of digital competencies include online diplomas, degrees, certificates or licenses. In general, micro-credential certificates, course content and achievements can be easily shared and placed on online platforms.

A digital badge is a type of digital competency usually given after completing a micro-credential knowledge. It is a type of digital competence in the form of an emblem that represents and communicates the winner's achievement in learning, skills and competencies. We can compare badges to a series of accomplishments or badges in digital games. Each time a player accomplishes a specific task, they receive a small digital badge (Greene, 2019). Digital badges can be embedded with verifiable metadata, including information about the badge issuer, criteria and supporting evidence. An electronic emblem or badge is awarded to those who complete the micro-credentials successfully. The badge includes metadata such as who gave it, what was done to earn it, the date it was issued and its validity period (Hunt *et al.*, 2020).

Thanks to the learning design enhanced by digital technologies, micro-credential, a fast, adaptive and cost-effective way to update learners' skills in targeted areas, enables the acquisition of advanced knowledge and skills in a flexible learning environment. As the cost of university education increases in many countries, and even getting a university education cannot guarantee a job, it is seen that young people and adults are looking for alternative ways for business success (Horton, 2020). Although micro-credentials have an increasing momentum, a study in the USA reveals that only 40% of employers had encountered people with micro-credential certificates on their resumes, and only 16% have hired someone with a micro-credential certificate (Gallagher, 2019). However, in recent years, there has been an increasing need for continuous learning and technology education-oriented certificates, digital badges and so forth. There is also a significant increase. Therefore, micro-credentials function in addition to university degrees in the labour market. Studies show that micro-credentials are frequently used, especially in technically oriented professions and professional development pieces of training (Fisher and Leder, 2022). Another study at the University of Melbourne emphasizes that seeing micro-credentials only as short online courses will cause us to overlook their importance and trend (Kevey, 2019). In an age where education and experience are integrated, micro-credentials that offer sector-oriented and competency-based education are gaining reputation daily. They have started to be a permanent part of universities.

All individuals who want to continue their lifelong education, from university students (Yilik, 2021) to teachers (Hunt *et al.*, 2020), show interest and participate in micro-credential courses. University students mostly prefer micro-credentials to support them in getting a job after graduation (Yilik, 2021). Obtaining such certificates by students and learners increases students' employability and advancement in their later business life (Fisher and Leder, 2022).

Micro-credentials

Since both higher education institutions and private companies and organizations grant micro-credential certificates and these organizations do not act according to a common framework or determined standards, efforts have emerged to create a common framework for establishing the quality assurance procedures for micro-credentials. Brown *et al.* (2021a) analyzed 149 publications on micro-credentials between 2015 and 2021. He found that 85.1% of the publications on micro-credentials were about higher education, 28.4% of them were

about vocational education, 17.6% of them were about industry and institutions, 10.1% of them were about MOOCs, 1.4% of them were about community organizations and 5.4% of them were about K-12. In his report, [Oliver \(2019\)](#) states that the critical information summaries of micro-credential will facilitate the assessment to be made about the content of micro-credential and the skill it represents. Critical information summaries include the following ([Table 1](#)).

Defining and evaluating success in micro-credentials

Research on micro-credentials show that the students believe that micro-credentials provide them with better chances for employability as well as easy access for courses, thus supporting their career development ([Yilhk 2021](#)). Two elements are required to ensure reliability in the outcome evaluation process of micro-credential. The first is high-quality criteria and measurement procedures (typically with a rubric) for evaluating evidence.

Title and short description (30 words)	Add the name of the certificate
Certified learning	In up to 100 words, describe what a successful student knows and can do based on their assessed learning
How did the student participate?	Choose from: online-only, onsite only, both onsite and online
Required effort (including assessment)	Add the number of hours (for the typical learner)
The complexity of the main assessment task	Choose one (best fit) No rating Testing recall of facts Application of a skill to a routine problem Application of a skill to a complex problem Application of multiple skills to routine problems Application of multiple skills to complex problems Reflective evidence for portfolio and qualification validation
Auditing and competency verification	Choose one (best fit) Unsupervised, no competency verification Audited online or onsite, competency not verified Audited online, competency verified (one factor) Audited online, competency verified (two factors) Onsite, competency verified (one factor) Onsite, competency verified (two factors)
If assessed, equivalent level (main task)	Choose one Not at degree level/pre-bachelor/bachelor/pre-master/master/doctorate
Quality assurance	Adding the names of management or approval bodies
Successful student	Choose one
• Entry to a degree programme	No/Yes- state degree(s) and institution(s)
• Earns credit for a degree programme	Choose one No/Yes- state degree(s) and institution(s)
- If yes, how much credit?	Government credit in units (a unit is a typical period of study in a degree programme) For example Credit is less than one unit 0.4 units Credit is a unit 1.0 unit Credit is more than one but less than two units 1.5 units

Source(s): [Oliver \(2019, p. 25\)](#)

Table 1.
Critical information summaries of micro-credentials

The second is a robust, consistent process for evaluators' training and self-rating (Tooley and Hood, 2021).

- (1) The rubric should define the criteria for the successful attainment of micro-credential with standards including failure. The rubric should clearly state how each requested evidence will be graded.
- (2) Determining the appropriate weight for each requested piece of evidence is a crucial consideration for rubric design.
- (3) The scale used to evaluate evidence and provide greater accuracy in rating micro-credentials needs to be sensitive (for example, a five- or seven-point scale).
- (4) Educational assessments form the basis for reliable scoring in evaluating evidence. It requires evaluators to practice applying the rubric and compare their scores to a "master" score (a score assigned to the same set of evidence by an expert evaluator). A reviewer should align their post-review scoring with their "master" score.
- (5) Given that evidence of micro-credential often requires skill application in practice, evaluation of submissions needs to occur quickly to provide initially unsuccessful candidates with an opportunity to resubmit after making improvements.
- (6) Evaluating resubmissions by the same evaluator helps ensure continuity of feedback and minimizes candidate frustration. A candidate should not receive new or different input on parts of the initially deemed acceptable submission.
- (7) There are different advantages to using internal and external evaluators.

Who are the providers of micro-credentials?

As a means of providing competence, micro-credentials are the definition of an individual's ability to perform a job and a way of determining the skills individuals possess. With the certificate obtained at the end of the training, the level of knowledge or competence of the individual in a particular industry or profession is certified by a third party. A formal institution or organization works with industry-leading certification providers to successfully market their programs by providing industry-specific certification exams (Certiport, 2017). Candidates take the exam held by the certification authority, and those who are successful are given information technology certificates. "Certification programs are generally supported or supervised by some certification authorities such as a professional association" (Certiport, 2017, p. 2). Certification authorities are for verifying that the certificate holder has passed the examinations in technical subjects or in a particular area of expertise. One such certification authority, Pearson VUE, manages electronic testing services for information technology certification programs worldwide (Certiport, 2017).

Some certification exams, such as CompTIA, the developer of information technology certification exams, are more general in practice, regardless of the specific manufacturer. It offers many certifications in computer hardware, networking, web development, cyber security and so forth, not identified by any manufacturer's product. A CompTIA exam is an A+ certification programme that validates general computer setup, repair and customization knowledge and capabilities.

Some certificates are related to a manufacturer's software, hardware or operating systems. More prominent PC software and hardware vendors provide a certification programme to install and support their products, such as Microsoft's Certified System Administrator (MCSA) for Windows operating systems or Cisco's Certified Network Manager (CCNA) for computer network routers and firewalls. Generally, a combination of certifications means a broader variety

of skills than a single certification. Some firms or employers may require proof of validity and timeliness of certificates based on certain products, versions or techniques, even if the certificate does not expire. Microsoft, Apple and National Instruments are among the certifiers.

Gallagher (2019) emphasizes the importance of education and solving a specific problem in evaluating human capital. Thus, in many MOOC (massive open online courses) and online education certificate programmes, information technology students and learners can develop a solution to a real-world problem using real-world data and can make a design or write a programme for the problem. For example, training was provided by integrating real-world problems and projects in the Experiential Network (XN) project at Northeastern University. In this project, approximately 10,000 students actively worked and completed 2,000 projects for companies such as Pfizer, General Electric, Raytheon and Costco.

Digital Promise, authorized as the National Research Center in Advanced Information and Digital Technologies in 2008, issues micro-credential certificates and provides a platform for other institutions and organizations' micro-credentials. Today, over thirty-five organizations offer micro-credentials through the Digital Promise, including Arizona State University, Teaching Matters and National Geographic. Funders for the organization include the Bill and Melinda Gates Foundation, the Chan Zuckerberg Initiative, Google, the Michael and Susan Dell Foundation and Laurene Jobs' XQ Institute (Greene, 2019). Alongside the Digital Promise, Bloomboard is another example of a platform that offers a variety of micro-credentials. Bloomboard mainly works on teacher education.

Many states in the USA have included micro-credentials in professional development programmes for teachers (Hunt *et al.*, 2020). Micro-credentials are offered jointly by providers such as Coursera, EdX, Udacity and Future Learn, often collaborating with leading universities (Horton, 2020).

Accrediting organizations

A critical issue of micro-credentials is finding a valid and reliable measure of the competence acquired by the individual (Greene, 2019). According to Adelman (2000), primary vendors/companies (Microsoft, Sun, Cisco, Novell etc.) or industry associations (International Information Systems Security Consortium, National Communication System Engineers Association) set the standards. They act as de facto accrediting bodies when they authorize other organizations to serve as "educational partners" or "authorized training centers". For example, Sun Microsystems signed an agreement with New Horizons Computer Learning Centers in August 1998. As a result of the signed agreement, the trainers in the "training partners" gained knowledge of the curriculum but obtained a certificate that any traditional accreditation body does not demand much.

Chauncey Group, a subsidiary of ETS, provides the CTT (Certified Technical Trainer), the core certification of technical trainers, through both a computer-based exam and a performance evaluation. Large firms also offer separate certifications for instructors, and the instructor must first hold one or more of the content certifications provided by the firm (in 1998, for example, 55% of Microsoft Certified Instructors [MCT] were also MCSEs).

To be UNIX certified, completing the undergraduate preparatory programme and taking a 5-day (7 h a day) introduction to UNIX training is necessary. Cyber Learning, on the other hand, offers an 80-h fast-paced MCSE programme for "experienced network professionals and university IT and Engineering seniors and graduates" and a 172-h MCSE programme with a "college degree [desired]".

Common micro-credential framework (CMF)

It is seen that the age distribution of those who apply for micro-credentials has decreased, and they are more preferred by those who do not have a bachelor's degree. In job application

processes in information technologies, these certificates add value to applicants. The issuing institution/organization must certify its instructors for content, teaching and assessment. In addition, the Council on Computing Certification was established to accredit certificate programmes and set standards (Adelman, 2000).

Some higher education institutions are working to include multiple certificates in undergraduate degrees by linking their “exams” to credits. Higher education institutions have actively participated in certificate programmes with different cooperation models by giving their certificates with curriculum packages obtained from non-profit developers (Adelman, 2000). The certificate sponsor authorizes the organizations that provide the course work to ensure that the course is conducted.

In creating a portable credit system for lifelong learners, how employers will understand and compare many different micro-credentials comes to the fore. For this, a consistent method of comparison and reward is needed. To solve this problem, international organizations such as UNESCO (Chakroun and Keevy, 2018) and OECD (Kato *et al.*, 2020) focus on micro-credentials such as the “Common Microcredit Framework” that the European Commission and the European MOOC Consortium have created. The European MOOC Consortium collaborates on a Common Microcredit Framework (CMF) to be used voluntarily by these platforms, which can be translated into a formal qualification or standard for use by a wider group of universities.

According to Oliver (2019), a proliferation of micro-credentials led to a degree of chaos and confusion for students and employers and providers. Employers seek support to understand, judge and compare the plethora of micro-credentials presented by potential employees as evidence of talent. Few micro-credentials have common standards or taxonomies for required skills and competencies, which may prevent competency from being portable. Similarly, there have been calls and actions such as the AQF Review Panel, New Zealand Qualifications Authority for quality assurance of micro-credential, including compliance with national qualifications frameworks. In the United States, an advanced competency initiative map has been created so that various agencies can balance their projects (Samson, 2019; Zanville, 2019).

Another common micro-credential preparation framework is Credential Transparency Description Language (CTDL). It provides a common, unified, consistent and transparent vocabulary for describing competency (including diplomas, badges, certificates, licenses and degrees of all types and levels) (Grann *et al.*, 2018). In March 2019, Credential Engine announced the Competency Information Transparency partner programme’s launch with other organizations (Credential Engine, 2019). In Europe, the Common Micro-credential Framework (announced by Future Learn, France Université Numérique, Openup Ed, Miriadax and EduOpen in April 2019) aims to increase the consistency, quality and portability of micro-credentials (European MOOC Consortium, 2019).

How widely used in which field

By offering flexible learning pathways, using non-traditional modes of delivery and encouraging a sense of autonomy for learners, micro-credentials integrated into higher and adult education and beyond, by actors at the national, regional and supranational. According to the report prepared by Shah (2021), who analyzed MOOCs based on the 2021 Class Central data, the modern MOOC movement has reached 220 million students, excluding China. In 2021, providers launched more than 3,100 courses and 500 micro-credentials. The MOOC providers in the top 5 according to the course participants of the learners were Coursera, edX, Future Learn and Swayam (Table 2). According to the same report, the vast majority (40%) of courses are in business/business and technology, offering more accessible employment or higher salaries (Figure 1).

According to the study conducted by Fisher and Leder (2022) on the use of micro-credential in vocational education in New Zealand, the sector-based representation of the number of micro-credentials registered in New Zealand is as follows (Table 3).

The data show that micro-credentials are predominantly used in the business and informatics sectors and that micro-credentials are preferable to support professional development or find a job.

Comparison with certificate programmes

Historically, the first area where micro-credentials were seen can be considered certificates in information technology professions. Therefore, certificate programmes in informatics fields can be shown as an example of training for specific skills in different contexts from formal

	Learners (million)	Courses	Micro-credentials	Degrees
Coursera	97	6,000	910	34
edX	42	3,500	480	13
FutureLearn	17	1,400	180	22
Swayam	22	1,465	0	0

Table 2.
Top 5 MOOC providers by users and offers in 2021

Source(s): Shah (2021), <https://www.classcentral.com/report/mooc-stats-2021/>

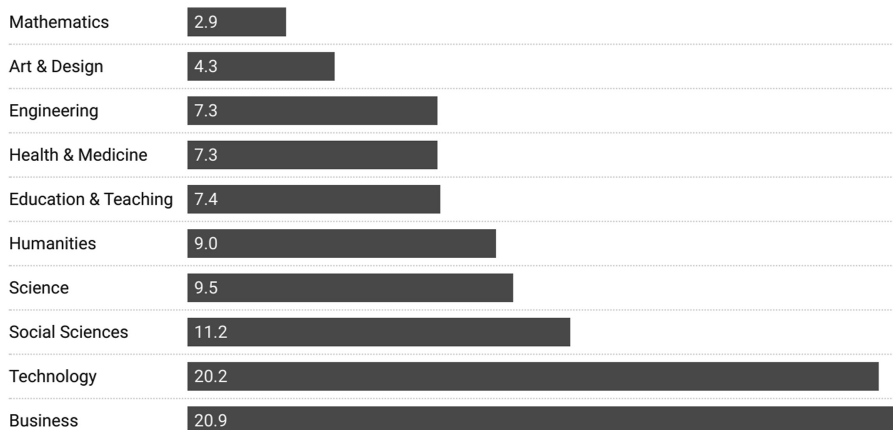


Figure 1.
Distribution of courses by subject in 2021, excluding China

Source(s): Shah (2021), <https://www.classcentral.com/report/mooc-stats-2021/>

Sector	Number of micro-credentials information	Levels covered	Credit range
Hospitality	47	2–8	5–38
Commerce	41	3–4	5–40
Primary industries	32	2–5	10–40
Health/Well-being	30	2–7	5–30
Informatics	15	2–7	5–20
Implementation/Regulation	5	4–5	10–30

Table 3.
Sector-based representation of the number of registered micro-credentials in New Zealand between 2018 and 2022

Source(s): Fisher and Leder (2022, p. 9) (<https://www.nzqa.govt.nz/nzqf/search/microcredentials.do>)

education channels. The first certification in information technology was given in 1989 for Novell Engineering (Certified Novell Engineer or CNE). This certificate documented that the conditions required to be a Novell engineer were met, and the necessary skills were acquired (Adelman, 2000). In early 2000, approximately 1.6 million people worldwide obtained approximately 2.4 million information technology certificates (Adelman, 2000), and these certificates have rapidly multiplied. In technology-focused fields, millions of different certificate programmes have been created in a very short time by both corporate and industry/professional associations.

Adelman (2000) stated that in the 1990s, a parallel education and training structure emerged after high school education, which is transnational and competency-based, out of the control of governments that offer certificates instead of degrees. This situation is seen in job advertisements. Micro competency-based certifications are mostly concentrated in information technologies and telecommunications (Adelman, 2000), but there are also chemical engineering, medicine and social fields. In some occupations, certifications outline career ladders that define industries and guide employers and students in the skills needed to advance.

Public schools train electricians, welders, plumbers and other vocational-technically oriented career disciplines, and their certification is based on meeting minimum performance standards. These often include additional (or concurrent) industry board, apprenticeship and/or professional agency certification (League for Innovation in the Community College, 2021). In some cases, graduates may also be required to be certified by a supervisory authority beyond public schools.

Like certificate programmes, micro-credentials also cover the training made to gain some skills outside the formal higher education system. These trainings are mostly found in the fields of information technology professions in both certificate programmes and micro-credentials. They are preferred more in areas that do not have a diploma programme in higher education, such as information technology professions, which constitutes similar aspects to certificate programmes and micro-credentials.

Strengths of micro-credential courses

According to the report prepared by Brown *et al.* (2021a, b), the strengths of micro-credentials are.

- (1) Flexibility: Provide self-paced learning (action, community building and self-paced depending on whether or not a quick response is requested/expected) anytime, anywhere, on any device.
- (2) Personalization: Individual learning paths, special education and instruction offerings, continuous feedback/learning and data collection to improve the learning experience.
- (3) Optional: Offering timeless access to knowledge, skills and competencies.
- (4) Omnichannel: Presenting post-, during and pre-campus programme offerings.
- (5) Peer learning/Collaborative learning: Having close exchanges with other students, sharing ideas, discussing problems and helping each other.
- (6) Modularity and stackability: Opening more extensive qualifications/education programmes allows students to pick and stack according to individual needs/interests (putting together their own “education playlist”), with the possibility of obtaining a full degree if needed later. It offers stackability and the ability to combine formal and informal courses (credit and non-credit) into a single competency knowledge (Olcott, 2022).

- (7) Increasing employability: Micro-credentials can provide value-added capacity for graduates who cannot find the job they want or jobs in a restricted academic discipline. A shorter duration of competency may mean less cost for the student. Being more focused on work/professional development and shorter time will attract many students and employees (Olcott, 2022).
- (8) Reducing education and training costs: Student debt is expressed as the second critical factor in the increase in the use of micro-credentials in the USA (Brown *et al.*, 2021a, 2021b).
- (9) Supporting lifelong learning

Weaknesses of micro-credential courses

Certifications are divided into “door openers” that help new entrants enter the job market and “career ladders” that pave the way for the upward mobility of experienced workers (Markow *et al.*, 2018). In the IT industry, certifications are used to document skill levels in employment, career ladder or salary increase. Therefore, it benefits the job seeker, information technology employee and employer. In his report, Oliver (2019) emphasizes that students, employers and providers are cautious about investing in a new competency knowledge and states the following three items for micro-credentials have become critical issues.

- (1) Building confidence in the authenticity of certificates
- (2) Adding value to areas that matter and
- (3) To ensure sustainability.

As Oliver states, the major problem with micro-credentials is the issue of trust. How to combine micro-credentials from different places/institutions and how to confirm their accuracy and quality are essential questions that are yet to be answered.

Blockchain technology might become a solution to the issue of authenticity or the certificate. If all courses an individual attended to create a consistent ledger, they will have only one person, continuously updated blockchain-based diploma available to them. Such a diploma provides benefits in many areas. Blockchain technology-supported digital diplomas guarantee their originality. Moreover, digital certificates can be a solution for immigrants or refugees who do not face difficulties such as not being able to get their credentials from their country of origin. Some institutions are already started working on blockchain-based diplomas, like the Open University’s Knowledge Media Institute in the UK (they started the Quali Chain project) and The Financial University in Moscow in Russia.

Earning a certificate or badge in micro-credentials represents the development of one’s expertise and becoming a community member. It will help develop a professional competence for disenfranchised minorities in a particular discipline or community, and diplomas and certificates that cannot be accessed due to force majeure such as natural disasters will be accessible from different countries of the world. Discussions continue about how effective micro-credentials will be in the future and whether they can replace diplomas. Whatever the future of education, the demands for one type of skill-based micro-credential and other educational applications are increasing. They include new opportunities for the business world. As open and distance education evolves with digital technologies, how to provide and address skill-based, distributed, flexible and low-cost learning becomes career-critical. It is anticipated that micro-credentials will offer the opportunity to explore technological possibilities in this regard.

According to the report prepared after a two-day workshop on the use of micro-credentials in university admissions hosted by the University of Michigan Information School in May

2017, several issues that require attention were identified to make micro-credentials or badges part of the university admissions process. These problems are (Fishman *et al.*, 2018).

- (1) *Agency and accuracy*: University student affairs officers who review student applications at North American universities value verifiability in students' prior learning. Although still in the early stages of development, blockchain technology has the potential to increase confidence in micro-credentials and qualification certificates (Oliver, 2019). Nine universities announced a joint initiative to build a global infrastructure for more secure digital academic records (Day, 2019).
- (2) *Equality*: Whether the certificates earned from taking a micro-credential from two different providers will be equally valued/respected? What about taking the same course from a formal institution? Will they be counted equals? Will the badges offer students new opportunities to represent "non-traditional" achievements only? Will micro-credits takers be stigmatized or feel humiliated?
- (3) *Validity and approval*: If badges are used in the college admissions process, student affairs officers must know that they represent what they claim to represent. Traditional measurement principles validate the validity of standardized tests as evidence of academic potential. By contrast, badges contain information about how that evidence was obtained and may contain links to additional evidence and information. Therefore, their validity as evidence of academic potential is validated by the perceived reliability of the information they hold. Whether the student affairs officers are at a level to make these judgments, whether some valuable badges will gain credibility as traditional competencies gain (or loses) credibility over time create validity and approval problems.
- (4) *Need for infrastructure*: A technical infrastructure focused on privacy control and data protection, openness and interoperability should be established. Providing the infrastructure to be created from a single source may present risks. It is crucial to avoid over-reliance on a single platform or commercial providers and protect open access to move forward.
- (5) *Scalability*: Successful use of badges in university admissions requires systems that support the large-scale processing of micro-credentials. Badges must have a holistic review process for university admission officers to evaluate them.

Reflections of micro-credentials in higher education

Technological and economic developments are also dynamically changing the skills employers expect from employees. This change creates the need to examine higher education programmes at regular intervals and align the skills that graduates will have with the expectations of the business world (Hernández-March *et al.*, 2009, p. 1–2). OECD member countries report higher education concerns as employment, skills, cost, completion and assessment (OECD, 2019). These concerns have also recently caused questions about the value of degrees to rise. Micro-credentials are seen as one of the solutions in preparing for the future professions (Centre for New Economic and Society Insight, 2019).

The positive implications of micro-credentials in higher education are low-cost skill acquisition, employability and support for barrier-free learning. Microcredentials offer a solution to the problem of low-cost skill acquisition, by presenting an alternative way for students' access to higher education due to economic reasons (Brown *et al.*, 2021a, b; McGreal and Olcott, 2022), which is one of the problems experienced in higher education. Focused and short-term micro-credentials make micro-credentials more attractive for many students and employees, as it means less cost (Olcott, 2022). According to Olcott (2022), the preference for

micro-credentials forms the basis of the economy and competition. Employers compete for talented employees, and employees compete for jobs. Micro-credentials expand the competitiveness and capacities of both groups by providing opportunities for employees in both recruitment and professional development processes. It gives the second positive reflection, employability. Universities can adopt barrier-free learning paths to maximize opportunities in the industry. Micro-credentials support the third positive reflection, barrier-free learning, as one of the barrier-free learning options in higher education (Selvaratnam and Sankey, 2021) by providing convenience, flexibility, ease of movement, portability and mobility (Czerniewicz, 2019).

There are also discussions on the use of micro-credentials in higher education. Olcott (2022) divides these into time, credit equivalence, stackability and micro-credential consolidation. The first issue is expressed as micro-credentials removing time, a traditional variable in academic credit acquisition. Micro-credentials are framed according to the competency-based assessment model. According to proponents of competency-based assessment, the time factor will become less critical if competency can be verified and evaluated at the minimum performance level. However, the minimum period for students to have the required credit is important for acquiring competence in higher education. Olcott (2022) argues that micro-credentials do not eliminate the time factor since micro-credential assessments are determined according to specific knowledge and skill levels. The second issue is the validation and evaluation of micro-credentials. Faculty and departments are reluctant to recognize the value of micro-credentials gained elsewhere. The decision-making process regarding the equivalence of micro-credentials is of critical importance. For those who will undertake this task, deciding on the equivalence will create a significant workload (McGreal and Olcott, 2022). This workload is whether the micro-credential meets the minimum time requirement and whether the academic work level meets the university credit requirements (McGreal *et al.*, 2021). The third is the problem of combining micro-credentials and stackability. Qualifications must be clarified if micro-credentials are accepted for credit in formal qualifications. Micro-credentials should include an assessment of learning achievement. The time spent and effort of the student should be proportional to the credits earned (Olcott, 2022). Blockchain technology is presented as a solution to the problem of combining and stacking micro-credentials (McArthur, 2018).

Micro-credentials in higher education are not new, despite their recently expanding scope. Core frameworks for micro-credentials (the application of competency-based skill areas based on minimum levels of student-student performance and according to established quality standards) have been used for years (Brown *et al.*, 2021a, b). Many institutions offer online certificate programmes; however, a limited number of higher education providers offer mini-degrees, mini-qualifications known as micro-credentials (Ahmat *et al.*, 2021). As part of compliance with the Every Student Succeeds Act, many states in the United States include micro-credentials in teacher professional development programmes (Hunt *et al.*, 2020). Institutions such as the State University of New York have introduced micro-credentials as part of their training packages' competency information or qualifications. Micro-credentials are offered by providers such as Coursera, EdX, Udacity and Future Learn, often in partnership with leading universities in the UK and elsewhere (Horton, 2020).

Leaders in higher education should ask whether preparing for micro-credentials is a mission-critical goal for the institution. Committed to sourcing micro-credentials will significantly affect personnel, financing, digital and infrastructure capacity, and corporate vision and mission. For any corporate leader, preparing for micro-credentials is an important decision and should be evaluated by considering the strengths of the organization and the competitive environment (Olcott, 2022).

How to ensure ECTS equivalency

The Bologna Process, which created a common European Higher Education Area (EHEA) in Europe, was initiated to compare the higher education systems of various countries, develop standard solutions to similar problems and ensure regional cooperation (Şen *et al.*, 2016). Bologna enables credit transfer between universities, increases the transparency of education systems and facilitates mobility. With Bologna, student workload throughout the academic year/semester, achieving the targeted learning outcomes of 60 credits for every student, is implemented.

According to the report prepared by Fishman *et al.* (2018), systems that support the processing of micro-credential information on a large scale are required to successfully ensure the equivalence of micro-credentials according to the ECTS equivalence/university credit system. However, it is stated that it is possible to solve the problems around equality, validity and accuracy/reliability and integrate badges into the existing challenging admissions workflow. The commissions that will take part in the admission process to universities or in the evaluation and acceptance of the equivalence of credit must have sufficient arguments and equipment to make a valid and reliable assessment of what micro-credentials claim to represent.

Oliver (2019) states that the standards that micro-credentials should have to represent an official qualification or provide the opportunity to obtain credit should be clarified. In addition, he divides micro-credentials into credit-bearing micro-credentials and non-credit micro-credentials (Table 4).

According to the report presented by Oliver (2019), one of the difficulties that formal education may face is the completion time of the education. Learners who receive formal education cannot obtain their desired degree without graduating. Graduation time is usually fixed according to the policy followed at the university, and it may inadequately respond to the student’s desire to work harder and finish in a shorter time. If learners cannot graduate, their learning achievement is usually expressed as “credits for degree”. There is a possibility that different institutions do not accept the equivalence of the loan, and there may be a statute of limitations on loans. Micro-credential systems generally do not offer time constraints to the learner, and the student can adjust the learning process speed according to his/her paste. If equivalence is ensured by meeting the necessary validity and reliability in universities, it will be possible for the learner to graduate earlier.

Reflection on lifelong learning

Oliver (2019) states in his report that it would be in the interest of every country to have a national digital repository where the recognized credits of each country’s citizens are kept.

Credit-bearing micro-credentials	Non-credit micro-credentials
Credit-bearing micro-credentials involve assessment aligned to a formal qualification level. Achievement of learning outcomes leads to an offer of admission or credit to at least one formal qualification, regardless of whether the student accepts the offer	Non-credit micro-credentials involve assessment, which may or may not align with a formal qualification level. Achievement of learning outcomes does not lead to an application for a formal qualification or an offer of credit
Credit-bearing micro-credentials reflect and contribute to the academic standards required in target qualifications. The time and effort spent by the student correspond to the number of credits earned in the target qualifications	Non-credit micro-credentials may or may not meet academic standards, including the time and effort required of a formal qualification

Table 4.
Comparison of credit-bearing and non-credit micro-credentials

Source(s): Oliver (2019, p. 20)

Similar studies like the Korean Academic Credit Bank System (ACBS) in South Korea, Singapore's Future Skills credit system, Academic Credit Bank System in China and Europass in Europe represent skills and qualifications clearly and easily can be given as examples.

These studies offer lifelong learning accounts and necessary precautions are taken to collect data and ensure confidentiality. These systems provide policymakers with tools to map and match learning with industry skills and use the techniques to encourage citizens to invest in continuing education. Employers are offered the opportunity to retrain their existing employees and find new talent, and incentives are made to offer courses at the explicit request of providers.

Conclusion

Micro-credentials aim to provide learners with advanced knowledge and skills in a flexible learning environment, thanks to the learning design enhanced by digital technologies. They are a fast, flexible, cost-effective way to update learners' skills in designated areas. An alternative approach to career and professional development has emerged with micro-credentials. Through a certificate, a person creates a micro-identity that shows that he/she has mastered aimed skills and has acquired purposeful skills-based learning experiences. Micro-credential information is the digital equivalent of a paper-based certificate or an entirely digitally issued competency information (Nemec and Legere, 2008). Therefore, digital competency information can be easily shared and placed on online platforms. Obtaining nationally or internationally recognized micro-credentials indicates that the person meets the qualification standard determined by the relevant institution or organization.

As it was shown in this article, micro-credentials have the potential to challenge or complement traditional ways of how learning is taking place, understood, recognized and certified. Research on micro-credentials is still in its infancy and could benefit a lot from more research. Especially research on employers' recognition and appreciation of digital credentials needs to be studied. Also, empirically confirming propositions of literature on micro-credentials could be beneficial.

The authors present the following suggestions about the steps before integrating micro-credentials into the higher education system.

- (1) Institutions or organizations that provide micro-credential courses should cooperate with universities and harmonize them with ECTS for micro-credentials to be counted toward credits for a degree.
- (2) It is important to use blockchain technology in order to consolidate, update and ensure the reliability of micro-credentials from different institutions and organizations.
- (3) It would be beneficial to work with higher education accreditation institutions to ensure the validity and reliability of micro-credentials' training and evaluation activities.

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