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To cite this article: Henri Pirkkalainen, Ira Sood, Carmen Padron Napoles, Arttu Kukkonen & Anthony Camilleri (2022): How might micro-credentials influence institutions and empower learners in higher education?, Educational Research, DOI: [10.1080/00131881.2022.2157302](https://doi.org/10.1080/00131881.2022.2157302)

To link to this article: <https://doi.org/10.1080/00131881.2022.2157302>



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Published online: 21 Dec 2022.



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How might micro-credentials influence institutions and empower learners in higher education?

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ABSTRACT

Background: Micro-credentials are increasingly considered a key mechanism through which to empower learners by enabling flexible upskilling and reskilling. Despite their apparent importance for higher education institutions (HEIs) and learners, empirical research is limited. More needs to be understood, particularly about the ways in which micro-credentials can shape institutional practice and provide benefits to learners.

Purpose: Using a foresight approach, this study sets out to explore the potential for micro-credential adoption in relation to national and international policy initiatives and rapidly developing technologies. Its intention is to offer findings of interest internationally, particularly to those involved in strategic activities around micro-credentials.

Methods: A four-step Delphi study approach was used to explore how micro-credentials may shape higher education (HE) in the next 5–10 years. Educational experts undertook a consensus-building activity utilising workshops and surveys: (1) initial identification of enabling factors (i.e. drivers) and beneficial outcomes (i.e. impacts) of micro-credentials; (2) prioritisation based on importance; (3) identification of enabling factors considered essential for each beneficial outcome and (4) analysis of the extent to which micro-credentials might be accepted in HE, with participants reflecting on the importance of the previously identified enablers and outcomes for alternative scenarios.

Findings: The analysis sheds light on three alternative possible futures for micro-credentials. Expert consensus indicated that the potential of micro-credentials lies especially among educational institutions and the networks of institutions innovating beyond, and within, traditional study offerings and programmes. Future wide-scale adoption of micro-credentials was considered unpredictable, due to external factors at the ecosystem level, and beyond institutions' own strategies and control.

Conclusion: The findings suggest that, for the successful uptake of micro-credentials, the same benefits do not need to accrue for institutions and learners: a 'one-size-fits-all' approach is not necessary or optimal. In order for the wider-scale influence of micro-credentials to be felt, there is a need for considerable international and national strategy development and implementation to overcome a variety of policy- and technology-related barriers that HEIs cannot influence or tackle on their own.

ARTICLE HISTORY

Received 2 February 2022
Accepted 7 December 2022

KEYWORDS

Micro-credentials; learner empowerment; skills; competences; higher education; employment

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Introduction

The concept of micro-credentials is attracting increasing interest within the educational community, particularly in the context of higher education institutions (HEIs). Micro-credentials can play a crucial role in personalised learning opportunities, as they allow learners to upskill or reskill themselves with competences that are, or are likely to be, in demand in the labour market (European Commission 2020; Kato, Galán-Muros, and Weko 2020). As well as being developed for students across various levels of education, they have also been targeted at those broadly described as lifelong learners: i.e. individuals and professionals who may not have the necessary access or resources to participate in traditional education degree programmes (Msweli, Twinomurizi, and Ismail 2022; Ehlers 2018). Micro-credentials have become a major component, for instance, of the European higher education (HE) skills agenda (European Commission 2021) and are considered a core offering of multiple institutions and pan-European alliances of HEIs that are currently adopting and piloting micro-credentials (ECIU 2021; Fischer, Oppl, and Stabauer 2022; Msweli, Twinomurizi, and Ismail 2022).

Typically, the definition of micro-credentials encompasses the notion of ‘unbundling’ education (i.e. separating various components into different parts), and the idea of flexibility in terms of a choice of learning pathways. However, it is also the case that one unified definition of the concept is yet to be achieved (Consortium 2019; Oliver 2019; Rossiter and Tynan 2019). Practitioners and researchers have defined and characterised micro-credentials in a range of different ways. For example, some definitions emphasise the ‘proof-of-learning’ (i.e. documented certificate or evidence of participation and successful completion of learning activity) – such as for skills and competences (ECIU 2021; Ellis, Nunn, and Avella 2016; European Commission 2020; Oliver 2019; Rossiter and Tynan 2019), view micro-credentials as learning offerings (Pickard, Shah, and De Simone 2018), short learning programmes consisting of multiple short learning offerings (Kato, Galán-Muros, and Weko 2020) or focus on the management of personal data and portfolios of digital credentials resulting from short learning offerings (Kiiskilä, Hanafy, and Pirkkalainen 2022). Within Europe, the European Council’s ‘Proposal for a Council Recommendation on a European approach to micro-credentials for lifelong learning and employability’ (European Commission 2022) aimed to synthesise the characteristics of micro-credentials for European HE. In particular, it emphasised the role of learning outcomes in the European Credit Transfer and Accumulation System (ECTS) and the portability of the proof of learning outcomes and skills, followed by the completion of a short learning offering (European Commission 2022). Whilst acknowledging that definitions and descriptions of micro-credentials vary internationally, the study reported in this paper has utilised the definition of a micro-credential referenced by the European Commission, thus viewing it as a ‘record of the learning outcomes that a learner has acquired following a small volume of learning’ (European Commission 2022, 21).

In practice, micro-credentials are, thus, already woven into many areas of education and employment. They can enable individuals to prove their competences and knowledge to employers and other parties and have a major emphasis in the new European Educational Credentials for Learning (EDC)-system (European Commission 2020). However, research into micro-credentials is only just starting to catch up with practice. The valuable scholarship that does exist includes research into views on micro-credentials

from the perspective of employers (Gauthier 2020; Young, West, and Nylin 2019), professionals (Young, West, and Nylin 2019) and platforms (Kiiskilä, Hanafy, and Pirkkalainen 2022). It also explores the barriers and benefits arising in practice (Kato, Galán-Muros, and Weko 2020), reflecting experiences in various educational settings including those in the United States (Kato, Galán-Muros, and Weko 2020), England (Oliver 2019), New Zealand (Fisher and Leder 2022) and Europe (Fischer, Oppl, and Stabauer 2022).

Previous research has widely acknowledged the potential of micro-credentials. It has, too, drawn attention to recent policies and initiatives worldwide which have called upon institutions to take action. However, steps towards micro-credential adoption tend to be uncertain and unpredictable, due to the quickly evolving technological and policy landscape (Mac Lochlainn et al. 2022; Fisher and Leder 2022), questions about the ways micro-credentials might be applied in practice, and the types of support structures that might evolve around them. In an HE context, there is a clear need to better understand the conditions that may lead to certain types of micro-credential adoption and/or the appropriacy of wide-scale implementation of micro-credentials. With these issues in mind, the study reported here took a foresight approach to understanding the potential enabling factors (i.e. drivers) and beneficial outcomes (i.e. impacts) of micro-credentials that may open up alternative scenarios for micro-credential adoption in HE. It represented a proactive way to consider and explore how micro-credential adoption may be achieved in the context of national and international policy initiatives and rapidly developing technology. Before presenting our study in greater detail, however, we situate our work with reference to the relevant literature and underpinning concepts.

Background

Overview of micro-credentials

As mentioned above, while interest in micro-credentials is on the rise (Ellis, Nunn, and Avella 2016; Krauss 2017; Rossiter and Tynan 2019), it has been difficult to achieve one unified definition of the concept (Consortium 2019; Oliver 2019; Rossiter and Tynan 2019). Whilst definitions vary, each reflects specific considerations that, in many cases, represent perspectives that differ from the broader issues surrounding micro-credentials (Selvaratnam and Sankey 2021). Micro-credentials have many characteristics, ranging from the size of the workload or ECTS, the provision of accredited or certified learning, the provision type (in terms of online or blended modes) and clearly articulated learning outcomes (e.g. European Commission 2022; Microbol 2021). The quality criteria and characteristics are likely to differ depending on whether the focus is on the outcomes that a learner receives from participating in short learning opportunities (e.g. competence proofs via digital credentials for learning) or the short learning opportunity itself (e.g. a study module that is provided in an online setting). Some clarity or synthesis is beginning to evolve in this rapidly developing field: for example, via the European Council recommendation that emphasises the importance of the credit-bearing aspect of micro-credentials. This reflects how a record of the learning outcomes is both an aspect of the learning activity that leads to the micro-credential (i.e. short learning opportunity) and the portable, digital proof that is issued to the learner (e.g. EDC-based digital credential or badge) and that the learner owns (e.g. portfolio and identity management).

Our study has a particular focus on this perspective (Kato, Galán-Muros, and Weko 2020; European Commission 2022; Fischer, Oppl, and Stabauer 2022), viewing micro-credentials as credit-bearing provisions of accredited institutions or study programmes, and aligned with national qualifications frameworks.

The basic premise of micro-credentials is that they can be either stand-alone certifications or parts of formal qualifications (Oliver 2019). They can be issued by traditional education institutions, industry providers or private providers of learning, whether online, onsite or both (Milian 2021; Oliver 2019). The awarding of micro-credentials in a digital format to the learner has been raised as one of the key considerations in the literature (Microbol 2021; Kato, Galán-Muros, and Weko 2020; Oliver 2019). More work is required to differentiate between the various forms of micro-credentials. Different types of digital proof, such as EDC digital certificates or digital badges, can be highly relevant for capturing the skills that the learner has achieved and to ensure authenticity and verifiability to make sure that these proofs cannot be falsified or tampered with (Kiiskilä, Hanafy, and Pirkkalainen 2022; Oliver 2019). However, micro-credentials are currently considered particularly as an aspect of formal education and, in Europe, in relation to ECTS (European Commission 2022), which is one reason why conceptual differences are evident. For instance, whilst badges are often awarded for non-formal learning as a means of acknowledging participation in learning activities or progress in them (similar to certificates of participation) (Elliott, Clayton, and Iwata 2014), micro-credentials (i.e. verifiable digital credentials) are awarded upon the completion of certain learning outcomes as a part of certified learning by distinguished professional bodies and accredited educational institutions or study programmes that adhere to the quality of learning and the legal conditions of the credentials. Thus, while digital badges may, in some cases, be considered as micro-credentials, they may not, in their current forms, adhere to the formal and credit-bearing aspects that are currently being emphasised as characteristics of micro-credentials (e.g. Microbol 2021; Kiiskilä, Hanafy, and Pirkkalainen 2022).

Drivers and impacts of micro-credentials

Empirical and practice-based insights stemming from the adoption of micro-credentials are still limited in the HE context. Thus, the potential impacts of micro-credentials, that is, how micro-credentials could positively change, affect or benefit educational institutions and learners, as well as the driving factors that may enable favourable outcomes, are still largely unclear. Literature does, though, provide some indications of the potential benefits that may arise via micro-credentials. One example is the enhancement of degree-oriented thinking with skill-oriented thinking, using upskilling and reskilling approaches. The main reason for such a development is evident across various industries: employers may value job applicants' skills more than the degrees they have accumulated (Lam 2015; Purbasari Horton 2020), and there is a growing demand for workforce reskilling and upskilling due to rapid changes in the job market (Microbol 2021; Kato, Galán-Muros, and Weko 2020; Lewis and Lodge 2016). For instance, Gallagher (2018) examined the value of micro-credentials in relation to the recruitment practices of companies. The study indicated that human resource (HR) leaders are already tending to prioritise skills over degrees, and that companies' awareness of micro-credentials has been consistently increasing in the past few years.

These factors, in addition to the diversification of student learning needs, have galvanised HEIs to consider micro-credentials and begin experimenting with them (Milligan and Kennedy 2017), due to their flexibility in comparison with conventional degrees. Indeed, it has been proposed that micro-credentials could complement bachelor's, master's and doctoral level curricula, while also providing value to professionals who already hold certain degrees (European Commission 2020; Oliver 2019). The benefits of micro-credentials over traditional study programmes were further reflected in an empirical study by Ghasia, Machumu, and DeSmet (2019) that explored micro-credentials in Tanzania, through interviews with lecturers, students and educational technologists from four Tanzanian universities. Their findings suggest that micro-credentials can benefit both learners and institutions by encouraging lifelong learning, although it is also clear that policies and infrastructure must be in place to ensure successful implementation.

Such findings point towards the importance of policy actions and technical developments that can act as *drivers* of micro-credential adoption. Similarly, in an extensive conceptual paper, Oliver (2019) presents potential drivers and standards in relation to micro-credentials. Elsewhere, in a qualitative study of micro-credential platforms, Kiiskilä, Hanafy, and Pirkkalainen (2022) maintained that opportunities to utilise digital proofs from short learning experiences could help institutions verify prior learning more easily and build trust and authenticity in the field. Miller et al. (2020) further argued for the potential of digital credentials in the area of active citizenship. These possible influences of micro-credentials emphasise the verifiable credentials related to formal educational settings. Open badges, especially when connected to a credit-bearing provision of HE, can become a motivational addition for the learners' benefit (Young, West, and Nylin 2019).

Empirical studies focused on the adoption of micro-credentials for the benefit of learners are limited. Early insights from a field study by Milián (2021) suggested that micro-credentials can indirectly motivate students, promote employer recognition and mitigate equity-related concerns. A related study of massive open online courses (MOOCs) by Calonge et al. (2019) observed that, overall, micro-credentials could be highly value-adding for students. Furthermore, a project inquiry (Consortium 2019) revealed students' expectations of the benefits of micro-credentials that they believed would help them personalise their studies, gain skills that are in high demand in the labour market, obtain up-to-date information and receive more focused content. Microbol (2021) further proposed that micro-credentials can enable students to access interdisciplinary skills and knowledge. This, in turn, could help meet the labour market's need for an increasing share of employees to have expertise in more than one area (Lewis and Lodge 2016).

In addition to the identification of potential benefits for institutions and learners, studies have identified multiple barriers that may stand in the way of such benefits being realised. For instance, successful micro-credential adoption requires considerable effort in areas including quality assurance and recognition (Mac Lochlainn et al. 2022); standardisation and awareness-building within universities and the labour market (Kato, Galán-Muros, and Weko 2020); platform and digital credential usage and adoption (Kiiskilä, Hanafy, and Pirkkalainen 2022); financing and resourcing, such as in the balance between cost-efficiency and offering education of the highest quality (Lemoine, Wilson, and Richardson 2018; Puhakka, Rautopuro, and Tuominen 2010); dealing with universities' rigid administrative models that can cause inertia in adoption (Che Ahmat et al. 2021) and alignment with existing study offers (Fischer, Oppl, and Stabauer 2022).

Purpose

The study reported in this paper sought to build on and add to the body of literature discussed above. We aimed to offer a contribution to the field by exploring the potential for micro-credential adoption in relation to national and international policy initiatives and rapidly developing technologies. Three interconnected research questions were considered: (1) How might micro-credentials enable beneficial outcomes for institutions and learners? (2) What enabling factors are essential for the realisation of the benefits? and (3) How likely is it that these benefits will emerge comprehensively?

Methods

Study background

The study was conducted in the context of a larger project¹ (MacLochlainn et al. 2022) which was focused on micro-credential adoption. The project's international consortium consisted of HEIs and consultancies that examine micro-credentials in a HE context. Overall, the project's scope covered the technological factors, and the strategic and political steps that can make micro-credentials relevant for institutions and end-users. The stepwise study of micro-credentials that is presented in this paper was one of the main activities of the project.

Methodological approach

We used a Delphi study approach to address the research questions. There were four steps in total, with each requiring input from several experts. These experts took part in consensus-building activities to analyse the benefits that could be attained via micro-credentials and to explore the enablers and likely alternative scenarios that could unfold during the next steps of micro-credential adoption. The Delphi approach involves eliciting and refining group judgements (Dalkey, Brown, and Cochran 1969). Linstone and Turoff (1975, 3) characterised Delphi as a 'method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem'. Over the years, the use of Delphi methodology has evolved from its use in technological research and development foresighting to penetrate into governance, environment, healthcare and academia. Foresighting refers to 'a process of systematic inquiry into the future, the results of which affect the dynamic adjustment of the far-reaching options of the future to changing environments' (Magruk 2011, 701). Delphi is regarded as an especially useful method of building consensus on topics that are not widely accepted or examined in the literature. We followed the guidelines for conducting Delphi studies provided by Linstone and Turoff (1975) to contextualise the Delphi study in the HE context and, especially, to study micro-credentials, while acknowledging the limited practices in HEIs in this regard. Thus, we sought to identify experts in the area of micro-credentials to participate in the study. We paid special attention to allowing disagreements and differing opinions to surface by including multiple stages in our study, using a combination of focus group approaches with group discussions, and giving opportunities for individual reflection through questionnaires. We adjusted the foresight activity to the 5–10-year timeframe due to the acknowledged optimism–pessimism bias

(Buschmann 1969), which includes a bias towards over-pessimism in long-range foresights (e.g. low appreciation of micro-credentials in long-term) and over-optimism in short-range foresights (e.g. rapidly maturing credentialing technologies).

Research design

Based on the existing research in the area of micro-credentials and their use in HE, four main themes were identified to serve as the foundation for the study. Two of them focused on the impacts of micro-credentials and two focused on the key drivers that could potentially make the impacts realisable. The impacts were first identified based on a synthesis of literature that indicated the necessity for institutional change (focus on institutions) and influence on the ways individuals learn (focus on learners) (West and Cheng 2022; Ghasia, Machumu, and DeSmet 2019; Lemoine, Wilson, and Richardson 2018; Puhakka, Rautopuro, and Tuominen 2010). Due to the purpose of the research project and the weight of prior literature indicating that change will not come easily (Kato, Galán-Muros, and Weko 2020; Oliver 2019), the focus on impacts was preceded by a consideration of technology and policy enablers, emphasising them as drivers for the sake of clarity, in terms of ‘pushing’ the change forward in practice. The four themes were as follows: (1) Technology as a driver of micro-credential adoption; (2) Policy initiatives as a driver of micro-credential adoption; (3) Impact of micro-credentials on institutional practices and (4) Impact of micro-credentials on learners. As highlighted in the scope of the study, we acknowledged that the impact on learners may, in many cases, be accomplished via changes at the institutional level – for example, via changes in the study programmes of HEIs.

The main focus of the study was to generate a fixed number of impact and driver statements applicable to the next 5–10 years (Steps 1–3), which was addressed in a foresight exercise (Step 4). Thus, the exploration of the themes took place in four participatory stages, during which the collection and analysis of data was undertaken. Specifically, Step 1 involved a futures workshop event for the identification of potential impacts and drivers of micro-credential adoption; Step 2 was an online survey requiring participants to rank the statements from each theme based on importance; Step 3 was a second online survey which aimed to understand the association between drivers and each of the identified impacts and, finally, Step 4 was an online workshop to evaluate the potential of the identified impacts and potential scenarios that may be realised in the next 5 – 10 years. The collection of data, in its entirety, was undertaken in English. The procedures we carried out during these four steps are detailed below.

Ethical considerations

In the invitation to take part in the Step 1 event, the prospective participants were informed that the futures workshop would be the basis for the study and that the workshops would be documented for research purposes. Participants’ consent was further confirmed during the Step 1 event. They were informed that any personal- or affiliation-related information would not be recorded in the study data materials, beyond the original contact list of potential participants. Those who were interested in being involved in the study were invited to participate in the further steps.

Data collection

Step 1: Futures workshop

This event served as a gateway for the follow-up steps of the Delphi study. It was a two-day workshop on micro-credentials (October 2019) organised by the membership of the larger project. The event was labelled as a 'Digital Credentials Masterclass' to focus on the portability and stackability of micro-credentials evident in the EU's definitions. The workshop participants were selected via a collaborative stakeholder list, which consortium members actively maintained throughout the project. This list was constantly updated by all members of the consortium and served as the central repository for experts in HE and related industries. It gave details of stakeholders' knowledge, backgrounds and expertise. Based on the stakeholder analysis, the potential participants were identified with the aim of gathering together as wide a range of expertise as possible. Forty invitations were sent to the European Commission, quality assurance agencies, policy initiatives, technology initiatives, the private sector and to HEI personnel (both professors/educators and administrators) to achieve a balanced representation of experts.

The four micro-credential themes of the study were spread over both days of the event. Whilst the first day focused on *drivers*, the second focused on *impacts*. In total, 29 experts participated in the 'Digital Credentials Masterclass'. Of these experts, 15 were male and 14 were female. Overall, 14 participants represented universities or research institutes (two professors, six researchers, four directors of units, and four project managers or experts), seven represented IT consultancies/companies (two directors, one business development manager, four IT experts) and six represented associations (four directors, two specialists). There was also one European Commission policy officer, and one educational freelance expert (on ECTS).

During the workshop, each Delphi theme was addressed in its own session. The sessions included speakers who had been invited to introduce topics and motivate the experts to adopt the workshop's methods of working. The experts were divided into four groups; each discussed the same set of drivers and impacts, depending on the session in hand. Each group was accompanied by two consortium members, who served as a moderator and an additional rapporteur to facilitate and document the discussion. The goal of each group was, first, to discuss the theme presented to them based on a guiding question. Through discussion, the participants developed a number of driver statements (Themes 1–2) and impact statements (Themes 3–4). To ensure output consistency, the statements were produced in a common format; for example, for Themes 1–2 (i.e. on drivers), the template emphasised '[policy initiative or technology] enables adoption of micro-credentials in HE via____'. For example, a sample statement might be expressed as follows: 'Blockchain technology enables adoption of micro-credentials in HE because it offers forgery-proof credentials via immutability'. The moderators guided the participants to avoid conditional statements (i.e. the use of 'if' and 'or') because the next steps of the Delphi included the identification of conditions (e.g. barriers) on the realisation of a driver or impact. Eight to twelve statements were identified in each of the four groups discussing a particular theme. This meant that, in all, up to 50 statements were identified pertaining to each theme.

Steps 2 and 3: First and second online survey

In total, 21 of the experts (11 male, 10 female) who had undertaken Step 1 participated in the follow-up steps. Eleven represented universities or research institutes (two professors, four researchers, three directors of units and four project managers or experts), five represented IT consultancies/companies (one business development manager, four IT experts) and five represented associations (four directors, one specialist). In Step 2, which was aimed at consensus-building, the statements for the four themes were incorporated into an anonymised online survey, which required participants to rank the impact statements from each theme, based on their perceived importance. They were asked to rank statements based on how significant they considered a particular theme and to state their understanding of why micro-credentials are important. Twenty responses were collected from this Step 2 survey.

The same participants were invited to take part in a second anonymised online survey (Step 3) to continue the consensus-building. During this step, the emphasis switched from the prioritisation of statements to gaining understanding of the association of drivers for each of the impacts. Thus, this second survey was designed to gather experts' feedback regarding the most important drivers (top five in the order of priority) pertaining to every impact statement that they identified as relevant in the previous stage. The respondents were asked to prioritise the drivers for each statement. In total, as five of the 20 experts did not participate in this step, 15 detailed responses were collected.

Step 4: Online workshop

Due to the pandemic situation, the workshop was carried out as an online interactive virtual event via a video conferencing platform (November 2020). Based on the analysis of the previous steps, it became evident that, according to participants, micro-credential adoption depended on several policy and technical developments, alongside institutions' approaches to applying micro-credentials in practice. Thus, three potential scenarios that could be realised in the next 5–10 years (depending on the degree/extent of the impacts being realised), were discussed. These were as follows:

Scenario 1: HEIs fully embrace micro-credentials (i.e. wide-scale adoption of micro-credentials);

Scenario 2: HEIs partially embrace micro-credentials (i.e. partial adoption);

Scenario 3: HEIs minimally embrace micro-credentials (i.e. minimal adoption).

The scenario approach was enriched with the levels of adoption described in theoretical terms as diffusion of innovations (DOI) (Rogers 2003). In brief, DOI presents a theoretical lens that describes how an innovation may be adopted incrementally by proportions of a population at each level of adoption – for instance, to account for the extent that micro-credentials might be adopted in the HEIs. We tied minimal adoption (Scenario 3) to the innovator level, which refers to a level of DOI in which only a few are adopting an innovation (Rogers 2003). The partial adoption (Scenario 2) focused on early adopters of DOI. In this scenario, micro-credential adoption would remain limited to certain networks, not extending more widely. In contrast, the wide-scale adoption (Scenario 1) foresees that the gap between early adopters and larger majorities is bridged, meaning that larger parts of a population are adopting an innovation (Rogers 2003).

The proposed scenarios indicate a gradual transformation of HEIs in Europe regarding the adoption of micro-credentials. Each scenario is introduced below.

In *Scenario 1*, it would be assumed that HEIs would fully adopt micro-credentials as a means of developing and demonstrating high-demand skills and competences on a European level for most, but not all, study programmes. Micro-credentials would have been integrated into formal education in a large majority of programmes within institutions in Europe, with a strong emphasis on the transferability of proof-of-learning (e.g. digital credentials), allowing portability of micro-credentials (e.g. mutual recognition of short learning offers among HEIs).

The main actors involved in this scenario would be innovators, early adopters and the early majority, according to the DOI. The adoption would be achieved via changes in institutional policy and the governance mechanisms of HEIs (Theme 3). This would also have a certain impact on learners (Theme 4). Technology (Theme 1) and policy initiatives, both regional and European (Theme 2), would serve as effective drivers of this goal.

In *Scenario 2*, HEIs would adopt micro-credentials as a means of developing and demonstrating high-demand skills and competences within small networks: for instance, when a few institutions within a network had mutually co-created and accepted micro-credentials. Micro-credential integration into formal education would take place only in selective networks within institutions in Europe. The main actors involved in this scenario would be the innovators and early adopters. Adoption would be achieved via a few changes in the institutional policies and governance mechanisms of HEIs (Theme 3). This will also have a certain impact on learners (Theme 4). Technology (Theme 1) and policy initiatives, both regional and European (Theme 2), would serve as partially effective drivers of this goal.

In *Scenario 3*, only certain HEIs would adopt micro-credentials as a means of developing and demonstrating high-demand skills and competences at an institutional level. Micro-credential integration into formal education would not take place within institutions in Europe. The main actors in this scenario would be the innovators. Minimal changes would be witnessed in the institutional policy and governance mechanisms of the HEIs (Theme 3). Such changes would lead to a limited impact on learners who are beneficiaries of those HEIs (Theme 4). Technology (Theme 1) and policy initiatives, both regional and European (Theme 2), would be absent or otherwise fail to serve as effective drivers of the adoption of micro-credentials.

The goal of this final stage (Step 4) was the analysis and validation of these scenarios during the online workshop. Each of the participants from the prior steps was invited to attend. Altogether, 28 participants attended this event, representing the same roles as in the first workshop event (i.e. the 'Digital Credentials Masterclass' in Step 1). During the event, the participants were split into three breakout groups, with each group tackling one scenario. Once in the breakout room, the participants (1) familiarised themselves with the scenario and discussed its content and implications, (2) elaborated on the likelihood of the realisation of each impact (Themes 3–4) in view of the scenario at hand, (3) re-examined the technological and policy drivers of each impact (participants were able to reconsider the drivers and impacts) and (4) identified the barriers (i.e. further conditions) that were either overcome (in terms of realised impacts) or not.

Data analysis

In Step 1, the moderators of the four groups consolidated the statements of each theme based on content analysis that identified the similarities between the groups and

prioritised research validity. During the event, these moderators shared the consolidated statements with the experts for comment and adjustment, collecting and aggregating the statements as part of the preparation for Step 2. As noted above, the approach to analysis in Step 2 focused on consensus-building, via the first online survey. At the end of Step 2, five statements per theme were obtained and ranked in the order of their significance by the participants. By the end of Step 3 (the second online survey), we had gathered experts' feedback regarding the most important drivers (top five in the order of priority) pertaining to every impact statement that they had identified as relevant in the previous stage. Although further analysis of the prioritisation was not necessary, at least two researchers reviewed the inputs of the participants.

In Step 4, the groups themselves handled much of the analysis during the workshop, as they evaluated the scenarios by the likelihood of the impacts' emergence and discussed the relevant barriers that may prevent a given scenario unfolding. The differences and similarities between scenarios and key messages that were discussed with the participants of the event were then summarised.

Findings

The Delphi study approach that we applied, described above, allowed us to address the three interconnected research questions under consideration. In this section, we describe the main findings that emerged from the analysis of this process. We have consolidated the lessons learned from the experts' reflections on the prioritisation and ranking exercises (i.e. Steps 3 and 4 above). Altogether, the findings represent five prioritised impacts of micro-credentials on institutions, and five more on learners. The experts highlighted the importance of a combination of technical and policy drivers to realise each of the impacts. The findings will be discussed firstly in relation to the key impacts and drivers of micro-credentials. Secondly, we focus on the potential future scenarios of micro-credential adoption and how they relate to various developments in the technology and policy landscape, and in the HE arena.

Prioritised impacts and drivers – institutional level

Providing more flexibility for students was considered to be the most important impact statement about micro-credentials in relation to institutions: 'Micro-credentials can have an impact on the flexibility of institutions by meeting students' need for more flexible and personalised learning'. The experts emphasised that the inclusion of micro-credentials in European agreements on standards and quality of education (i.e. the Bologna process (Council of Europe 2005)) would be the single most important driver for this impact by standardising and ensuring high-quality micro-credentials. The second and third ranked drivers emphasised the role of portability, by allowing seamless data exchange with secure platforms, such as the European Digital Credentials for Learning (EDC). The fourth and fifth ranked drivers drew attention to strong technological support to allow personalised recommendations (via artificial intelligence) and the management of personal identity (via blockchain).

The second key institutional impact was determined as the way micro-credentials could support the recognition of skills and competences: 'The granularity and focus on

learning outcomes enable the impact of micro-credentials on the easier recognition of skills and competences among students and teachers'. Out of five identified and ranked drivers, three emphasised common standardised EU-level technologies to foster common ways of exchanging and verifying micro-credentials among institutions. Further, it was considered that defining the levels of micro-credentials in accordance with national qualification frameworks and inclusion in European agreements on standards and quality of education (the Bologna process) would be vital for allowing administrators to work on the recognition practices and policies of micro-credentials with common scope and guidelines.

The third institutional impact emphasised business renewal by allowing universities to explore new ways of co-creating or co-delivering short learning opportunities, together with other stakeholders (e.g. businesses): 'Mainstream stackable micro-credentials will facilitate new business models for existing universities, professional bodies ... , new entrants ... , tech-start-ups and associations'. Although the experts identified a range of driving factors, it is noteworthy that technological aspects were ranked amongst the five most important enablers of this impact by building on shared infrastructures and EU-wide platforms (e.g. blockchain and EDC), and utilising and adapting existing credential technologies, such as open badges. Furthermore, the experts identified the growing importance of connecting commercial employment platforms to European educational institutions, in order to allow new entrants and cooperations to unfold.

The fourth key impact on institutions was strongly related to the previous one. It was considered that cooperation between, or at least indirect involvement of, stakeholders in the micro-credential ecosystem would allow enhancement of the quality and diversity of educational opportunities and even open up possibilities for different types of businesses: 'Educational ecosystems based on stackable micro-credentials involving universities, employers and MOOC providers will enhance educational offerings and create new markets'. In comparison to the previous business-related impact, this type of new market creation would not only rely on technical ecosystems and innovations but also articulate national-level strategies created in cooperation between ministries, HEIs, and employers.

The potential of reducing student drop-out rates was reflected in the fifth prioritised impact on institutions: 'Institutional openness to micro-credentials has the potential to reduce drop-out rates'. In their identification and ranking of the enabling factors, the experts observed that this would only be possible if micro-credentials become more widely accepted and standardised, meaning that national strategies would need to be strengthened, micro-credentials aligned with national qualifications systems and the policies for the common assessment strategies of micro-credentials outlined. Further, the experts emphasised the need for improved recommender systems, the development of personalised study pathways (via artificial intelligence) and facilitation of the exchange of micro-credentials on more commonly accepted platforms.

Prioritised impacts and drivers – learner level

The experts felt that micro-credentials could offer several benefits for learners. They ranked improved employability or, specifically, the opportunity for targeted skill development as the most important impact of micro-credentials on learners: 'Micro-credentials will decrease skills mismatch and enhance employability'. The alignment of strategy

developments between government ministries, HEIs and industry was seen as the key prerequisite for the impact, especially in terms of improving cooperation on micro-credential joint delivery and allowing improved acceptability and recognition of student-owned, unbundled records of learning. The prioritised drivers reflected the credentialing, personal identity and digital wallet solutions that would foster the portability and shareability of learner-owned credentials. Better alignment of employment platforms and artificial intelligence (or recommender systems in general) with educational institutions' portfolios was perceived to be critical in terms of allowing closer matching of targeted and acquired skills.

The second key impact was the opportunity to increase motivation on learning: 'The recognition of micro-credentials can enhance student motivation, responsibility and determination, enabling more effective learning'. This impact was regarded as only possible via improved recognition of micro-credentials. Along with such developments, it was considered that the common or shared credentialing technologies, alignment with employment platforms (i.e. for skill matching) and a better understanding of what a micro-credential is, and what it consists of, needed to be rooted in institutions before learners' motivational needs can be served.

The third key impact related to the previous one. As it stands, learners typically cannot trace their skill development from their studies. Therefore, it was considered that a major potential of micro-credentials would lie in proving, or verifying, the skills and other achievements learners have acquired: 'The underlying metadata on skills and competences contained in micro-credentials enables learners to express learning outcomes beyond simple participation certification'. This impact would be mainly enabled by the credentialing technologies for the management of credential metadata, although the experts did highlight how the portability or exchange of such data would require alignment with national qualifications frameworks, national level guidelines and the recommendations and extension of certain recognition policies for the assessment of micro-credentials. Finally, the experts also underscored the importance of linking learning with personal identity beyond institutional student information or learning management systems.

The opportunity for improved inclusive practice in HE represented the fourth key impact: 'Micro-credentials can have a positive impact on the participation of disadvantaged people in the population through lifelong learning and making learning more flexible, thus contributing to the wellbeing of society'. The drivers or enablers of this aspect of inclusion were perceived as very similar to the second impact of increased motivation. The adaptability requires, firstly, the improved recognition and largely disseminated awareness of micro-credentials so that supply and demand can exist. Secondly, the experts emphasised that data exchange and the easier verification of digital credentials (e.g. via open-source technologies) would be critical, along with recommender systems and artificial intelligence systems that make it possible to find relevant learning opportunities.

The fifth prioritised impact related to employability, too: 'Micro-credentials can have a large impact in terms of helping students prepare for jobs that do not exist yet and anticipating future needs'. In comparison with the other employability impacts, the experts emphasised the opportunity to be proactive in upskilling for emerging (e.g. societal) themes that have not yet manifested as mainstream jobs but for which

institutions typically have degree programmes. Here, it was considered that better alignment would also be required with commercial employment systems, so as to match learning offerings with employment and allow recommender systems (e.g. via artificial intelligence) to emerge for the personalisation of learning pathways.

As several drivers appeared essential to the potential emergence of multiple impacts, [Table 1](#) distinguishes the technology and policy drivers and summarises the extent to which one driver could act as an enabler for several effects of micro-credentials. The table lists the drivers in relation to their importance for the impacts, based on a score that indicates how highly the respondents ranked each driver regarding the various impacts. Although a driver can be an effective enabler in relation to achieving one particular benefit (i.e. impact), it is important to note that some of them were considered more influential than others for yielding many of the benefits. For instance, aspects of technical platforms and credentialing technologies stood out from the other technology drivers and were perceived as highly important from the perspectives of both institutions and learners. Among policy drivers, the co-created national-level strategies stand out as a critical step for the realisation of both institution- and learner-specific impacts. An effective driver seems to improve the transparency of micro-credentials beyond institutional boundaries from the technical, strategic or policy perspective.

Potential future scenarios for micro-credential adoption

As noted above, during Step 4 of the process, the identified impacts were discussed in reference to each possible scenario (1–3) by the groups of experts (full details in [Table 2](#)). Here, we summarise the extent to which the impacts were perceived as relevant, relative

Table 1. Overview of the drivers and experts' evaluation of relevance for multiple impacts.

Type of driver	Driver	Appearance of impacts (Step 3)	Overall importance score*
Technology drivers	A reliable, portable and secure technical platform for data exchange.	Key driver for 5/10 impacts	4.2
	Open badges and other credentialing technologies that enable transparency and recognition.	Key driver for 6/10 impacts	4.0
	Making use of artificial intelligence to personalise the learning and teaching experience.	Key driver for 6/10 impacts	2.0
	Open-source tech based on commonly agreed-upon European standards.	Key driver for 2/10 impacts	1.6
	Building upon existing infrastructure instead of 'reinventing the wheel'.	Key driver for 2/10 impacts	1.0
	Making use of blockchain to link learning to a learner's identity.	Key driver for 2/10 impacts	0.4
Policy drivers	National-level strategies created with cooperation between ministries, HEIs and employers.	Key driver for 7/10 impacts	6.4
	Defining levels of micro-credentials in accordance with national qualification frameworks (NQFs).	Key driver for 3/10 impacts	2.4
	Inclusion of micro-credentials in the standards and guidelines for quality assurance in the European Higher Education Area (i.e. Bologna process).	Key driver for 4/10 impacts	2.4
	Europe-wide trusted platform.	Key driver for 6/10 impacts	2.4
	Connecting commercial employment platforms to European educational institutions.	Key driver for 4/10 impacts	1.8

* The score indicates how highly the expert participants ranked each driver in relation to the various impacts.

Table 2. Experts' evaluation of potential impacts and barriers for the three alternative scenarios.

Theme	Impact	Scenario 1/2/3*	Impact realised	Key barriers for the impacts
Impact on institutions	Institutions offer flexible and more personalised learning opportunities.	1	Yes	Lack of trust in micro-credentials. Resistance towards further digitalisation in terms of micro-credential adoption.
		2	No	Strategies are missing to allow implementation. Absence of mutual trust between HEIs, especially at an international level.
		3	Yes	Lack of a trusted list of micro-credential issuers.
	Institutions utilise micro-credentials as a means of recognising the skills and competences of learners and teachers.	1	Yes	Lack of common format for describing learning. Lack of portability for credentials.
		2	Yes	Lack of job market studies to determine which skills are industry-demanded.
		3	No	Lack of common recognition frameworks. Setting up (quality) frameworks necessitates large-scale collaboration and agreement, which is very challenging if only a limited number of HEIs become involved.
	Stackable micro-credentials have enabled the adoption of new business models for HEI professional bodies.	1	Yes	Lack of consensus among the traditional HE community.
		2	Yes	Lack of clear definition and agreements about the roles the different institutions will play in the micro-credential value chain.
		3	No	Reputation of issuing organisations will dominate the market and contribute on formation of monopolies.
	New educational ecosystems have emerged, consisting of universities, employers and educational content providers.	1	Yes	Cooperation in defining the skill requirement. Establishment of a dialogue regarding an ongoing timeframe.
		2	Yes	Absence of means of direct collaboration between industry actors and HEIs.
		3	No	Setting up collaborative educational models requires sufficient members on a level playing field, which will not be the case in this scenario.
	Dropout rates are reduced.	1	No	Bachelor's and Master's degree programmes are seen as the only measure of educational competence.
		2	No	The non-flexible composition of study programmes versus the flexible nature of micro-credentials.
		3	Yes	Learners in the most disadvantaged circumstances will require local support (possibly from community organisations, charities, etc.).

(Continued)

Table 2. (Continued).

Theme	Impact	Scenario 1/2/3*	Impact realised	Key barriers for the impacts
Impact on learners	Skill mismatch is decreased and employability is enhanced.	1	Yes	Lack of trust in micro-credentials.
		2	No	Industry endorsement of skills and competences within the reference framework.
		3	No	Employer would need to understand how to submit skills for validation or request information on new skills developed in certain occupations.
	Student motivation, responsibility, and determination are increased, enabling effective learning.	1	Yes	Underestimating the importance of micro-credentials in learning and motivation.
		2	No	Lack of awareness about micro-credentials and their importance.
		3	Yes	The various platforms used to display and claim badges and credentials make it difficult to collect the various achievements in one place.
	The underlying metadata on skills and competences contained in micro-credentials has enabled learners to express learning outcomes beyond simple participation certification.	1	Yes	A common understanding and usage of vocabulary for standardised metadata describing micro-credentials and learning management systems.
		2	No	The semantics and competence mappings are very different across organisations and complex systems are difficult to implement, given wide adoption.
		3	Yes	Open badges may not be viewed as credible by some providers.
	Participation of disadvantaged people is increased through lifelong learning and flexibilisation of learning, thus contributing to the well-being of society.	1	Yes	<i>None identified by the group.</i>
		2	No	Differences in study benefits and the costs of studying between countries; general goals of accessing any studies on a large scale are problematic. Differences in learning needs (as in special educational needs).
		3	No	Free learning opportunities do not contribute to inclusiveness, per se; often, the more expensive programmes have better visibility and have better job placements available, depending on the skills one wants to learn.
Students are more prepared for jobs that did not previously exist and are able to anticipate future needs.	1	Yes	<i>None identified by the group.</i>	
	2	Yes	<i>None identified by the group.</i>	
	3	No	The high fees of some micro-credential offers made them unaffordable or unattractive. Stackability does not work: HEIs and professional bodies are reluctant to recognise micro-credentials. Information problem: learners find it difficult to identify suitable online courses/micro-credentials.	

*Scenario 1 = HEIs fully embrace micro-credentials (Wide-scale adoption); Scenario 2 = HEIs partially embrace micro-credentials (Partial adoption); Scenario 3 = HEIs minimally embrace micro-credentials (Minimal adoption).

to different adoption (diffusion of innovation or DOI) conditions. It is important to note that the previously discussed impacts might not be relevant for all three alternative future scenarios. This is particularly reflected in examples in which the minimal adoption of micro-credentials (Scenario 3) could witness impacts that were not foreseen in wider-scale adoption (Scenario 1).

Impacts 1 to 5 related to impacts on institutions. In the discussion, it was considered that the first impact, 'Institutions offer flexible and more personalised learning opportunities', was essentially associated with institutions' curriculum designs and strategies. If such an impact were realised, it could manifest itself in such a way that students would have access to an extensive curriculum from outside their own university or that content would be aligned with long-term employability and oriented towards individual education goals, interests and needs. Interestingly, expert group 2 considered the realisation of HEIs partially accepting micro-credentials (e.g. in a university alliance network) highly problematic because 'strategies are missing to allow implementation' and because of the 'absence of mutual trust between HEIs, especially at the international level'. Here, the most common barrier identified was a lack of trust within different systems that may arise from the differences between educational systems and an overall lack of awareness about micro-credentials.

Experts believed that the second impact, 'Institutions utilise micro-credentials as a means of recognising the skills and competences of learners and teachers', could manifest itself as the development of twenty-first century skills/in-demand skills that learners can prove via digital credentials. While, under Scenarios 1 and 2, the use of micro-credentials for the recognition of skills among both teachers and students was declared a realisable impact, it was thought to be unlikely in the case of minimal adoption (Scenario 3). The reason was that it would require large-scale collaboration between different stakeholders to reach an agreement on common frameworks, which is not really possible if there are very few collaborators in the network to begin with (as is the case in Scenario 3).

According to the expert participants, the third impact, 'Stackable micro-credentials have enabled the adoption of new business models for HEIs' professional bodies', could help new entrants, tech start-ups and associations to enter the market. The participants, especially in groups 1 and 2, considered this not only a realisable impact but also a cornerstone of micro-credential adoption and the overall unbundling process. In the case of minimal adoption, this impact was not seen as realisable, because setting up (quality) frameworks necessitates large-scale collaboration and agreement, which is very challenging if only a limited number of HEIs become involved, as in the case of the minimal adoption of Scenario 3.

The fourth impact, 'New educational ecosystems have emerged, consisting of universities, employers, and educational content providers', could manifest itself in upcoming projects aiming to co-create short learning cycles that are recognised in HEIs. While, in Scenarios 1 and 2, the emergence of new educational ecosystems was declared a realisable impact, this was thought to be unlikely in the minimal adoption case. The underlying reasons for the latter appear to be the same as discussed regarding the second impact – that is, the low possibility of large-scale collaboration in small networks.

The fifth and final impact on institutions, 'Dropout rates are reduced', was considered non-realizable in both larger-scale adoption scenarios – that is, Scenarios 1 and 2.

However, interestingly, the experts in Scenario 3 elaborated the strong likelihood of using micro-credentials as a local way to tackle the issue of dropout rates. Thus, although Steps 1–3 suggested that dropout rates were likely to be affected by the widespread adoption of micro-credentials, experts considered that this may be a more local effect of micro-credentials.

Impacts 6–10 related to impacts on learners. The sixth impact, ‘Skill mismatch is decreased, and employability is enhanced’, was perceived to be realisable only for the large-scale situation in Scenario 1. For Scenarios 1 and 2, participants identified a strong relationship between the implementation of recommended changes in curriculum design and the reduction of skill mismatch. Hence, they suggested that the same barriers as for the first impact needed to be surmounted for the realisation of this impact: in other words, overcoming a lack of trust, having proper incentives systems in place, and institutional and regional strategies to facilitate the process. However, this impact was considered unrealisable for Scenarios 2 and 3, due to the lack of sufficient critical mass for employers to engage within a smaller community.

In terms of ‘Student motivation, responsibility, and determination were increased enabling effective learning’ (the seventh impact), participants held the collective opinion that, although this could be a realisable impact, predictions should not overestimate the role of micro-credentials in learners’ intrinsic motivation to learn. The experts held differing views on the realisation of this impact. Although it was not regarded as possible in partial adoption in Scenario 2, the experts in Scenarios 1 and 3 suggested that motivation could be boosted by both the small- and large-scale adoption of micro-credentials.

The eighth impact, ‘The underlying metadata on skills and competences contained in micro-credentials has enabled learners to express learning outcomes beyond simple participation certification’, was, similarly to the previous impact, seen as implantable in large-scale and minimal adoption Scenarios 1 and 3. However, the experts in Scenario 2 commented that the semantics and competence mappings were very different across organisations and complex systems and were considered difficult to implement on a large scale. The potential of open badges and digital credentials was, though, perceived to be high.

Ninth, the impact of ‘Participation of disadvantaged people is increased through life long learning and the flexibilisation of learning, thus contributing to the wellbeing of society’ was reconsidered from the perspective of micro-credentials. Although the large-scale adoption scenario regarded this impact as becoming realisable, the experts for Scenarios 2 and 3 were of the mind that free and flexible learning opportunities would not necessarily contribute to inclusiveness.

Finally, in terms of the tenth impact, ‘Students are more prepared for jobs that did not previously exist and are able to anticipate future needs’, participants considered the use of micro-credentials as a means of improving access to upskilling/reskilling opportunities, only when they are widely or, at least, partially adopted (Scenarios 1 and 2). In the case of minimal adoption (Scenario 3), this situation was considered only likely if there were pioneers within certain departments who would volunteer and take responsibility for using micro-credentials with their students in this way, provided that there was a holistic system to identify suitable online courses that were visible to learners, and that guidelines for the recognition of micro-credentials and assessment practices were to exist.

Key transferrable messages from the alternative scenarios

Partial adoption as the most likely scenario

Each of the three focus groups reached a consensus that partial adoption (Scenario 2) would be the most likely outcome. However, the differences of perception in relation to what it would mean 'to be widely adopted' were notable. The groups observed that, in wide-scale adoption, 'most universities utilising micro-credentials as a strategical offering' versus 'most universities having some of their teaching staff, units, or even faculties emphasising micro-credentials' were palpably different aspects and end goals. Transnational policies (such as the European Council Recommendation adoption for micro-credentials (European Commission 2022)) can be influential in broadening the use of micro-credentials, but this may still be highly contextual and limited to certain disciplines or study programmes that have a tendency to experiment with new approaches and change more rapidly than many others would.

External barriers create 'bottlenecks' for strong impacts

It was noteworthy that the barriers that were identified were similar between the alternative scenarios and that barriers to higher levels of adoption tend to lean increasingly towards external factors beyond one institution's control. Therefore, the alignment and strategy development of micro-credentials needs to be guided from the top down. However, it was felt that this should not be interpreted as a barrier to the successful implementation of micro-credentials in smaller networks, single institutions or even faculties.

Micro-credentials will not change everything and should not have to

The groups agreed, to a large extent, that not all the outlined impacts would have to materialise to make a substantive change or transformation in the current HE landscape. As indicated in Table 2, some of the impacts have significant 'bottlenecks' on the strategic and implementation levels. Even for a large-scale adoption, dropout rates might not be affected by micro-credentials, though they may have significant influence on the flexibility of traditional study programmes and degrees and, therefore, may have positive effects on learner motivation.

Discussion

As noted earlier, although micro-credentials are increasingly considered to be a significant way to empower learners in HEIs, scholarship in this area is limited. Our research offers a contribution in this regard, as it aimed, via a Delphi study, to better understand how micro-credentials may shape HE over the next 5–10 years. In this section, we consider the implications for HEIs and the micro-credentials movement that are suggested by our research.

Our findings on impacts and drivers augment the literature on institutional and learner perspectives. It is notable that the foresight activity we undertook points to similar impacts on institutional (job market fit, flexibility and personalisation) and learner (employability and motivational increase) perspectives that authors such as Gallagher (2018), Kato, Galán-Muros, and Weko (2020), and Kiiskilä, Hanafy, and Pirkkalainen (2022)

have proposed in their analyses. Our study adds to understanding of the drivers of micro-credentials, as a deep understanding was reached through the identification of conditions for each of the potential benefits. It has afforded fine-grained, context-specific insights on micro-credential adoption, considering the alignment of drivers, impacts and barriers in the scenario-building exercise. The findings shed light on alternative possibilities for micro-credentials in the future. Broadly, it seems that the possibility of wide-scale adoption is leaning towards a more unpredictable future. This is considered to be mainly due to adjustments that need to happen beyond an institutional level in the ecosystem, within business partnerships and industries, to acknowledge micro-credentials as an aid for workforce skill development. These are, essentially, changes pointed out at the macro-level (West and Cheng 2022) that are more difficult to control and anticipate. The findings of the Delphi study indicate that the barriers at an institutional level tend to be trickier to overcome, due to their external nature – for example, due to a lack of strategic and practical appreciation of micro-credentials within an ecosystem or national context.

The findings also suggest that not all the impacts are necessary for the successful uptake of micro-credentials. As noted in recent publications (e.g. Fischer, Oppl, and Stabauer 2022; Selvaratnam and Sankey 2021) and the European Council Recommendation (European Commission 2022), micro-credentials have versatility in terms of thematic and delivery-related focuses and might be carried by different technological solutions (Kiiskilä, Hanafy, and Pirkkalainen 2022). These are important considerations for HEIs, as the implication is that micro-credentials may not have to follow a fixed, ‘one-size-fits-all’ mould: rather, they can be created and co-created without too many boundary conditions for their acceptability. This limits the number of drivers that need to be in place and the barriers that would stand in the way of micro-credential implementation and adoption. However, whether micro-credentials offer such freedom of choice in terms of design and approach remains a crucial question to be addressed.

In practical terms, we suggest that HEIs could use these findings to help reshape their strategies for the adoption of micro-credentials. This can be carried out on at least two levels, with an emphasis on short learning cycles and digital credentials as ‘proof-of-learning’. The findings may not offer a strategic tool as such, but they can, nonetheless, be utilised as a mechanism with which to leverage strategic discussions with administrators and teachers on both the benefits of micro-credentials and the means of reaching such benefits (for example, by estimating the likelihood of the alternative scenarios for an institution, as well as reflecting on the absence or availability of the drivers and whether similar barriers lie ahead). First and foremost, the findings could be helpful as an awareness-building tool with which to study the relevance of the impacts on institutions, prioritise them and evaluate the drivers of each. For instance, HEIs could utilise the scenarios to focus on local developments, in comparison with collaboration on a network level. In addition, institutions might consider whether the role of digital credentials is limited to short learning cycles or, alternatively, could be used as a recognition mechanism and digital transformation to give students ownership over their digital credentials for learning, even beyond short learning opportunities. This could enable the diffusion of digital proof-of-learning.

In all, our study highlights a need for the micro-credential movement and policy initiatives to focus on spreading awareness about the possibilities for micro-credential adoption and pursue the validation of these initial findings. Thus, micro-credential

initiatives and alliances will likely help in building credibility and trust among institutions and organisations utilising micro-credentials. These findings may also allow micro-credential platform providers to make clear their support for the particular goals of HEIs' micro-credential strategies. As indicated by the experts in our study, technological drivers are extremely relevant for multiple impacts.

Limitations and future research

It is important to acknowledge that the scenarios and potential impacts of micro-credentials may not manifest themselves as proposed in this study. We aimed to mitigate this limitation during the consensus-building activities by allowing a broader view of alternative adoption pathways (i.e. the diffusion of innovations perspective) in the final step of the Delphi study. Further, for several reasons, it was not possible to ensure the continuous involvement of each participant throughout the four stages of the study. The pandemic complicated the data collection and the various roles and prior engagements of the participants led to the decision to allow a larger pool of experts to join in the final step of the study. We also recognise the limitations of a qualitative study that investigated perspectives on the early stages of micro-credentials' evolution: the study does not, therefore, aim at generalisation. However, we believe that the strength of the study is in the rich analysis of the data derived from experts in the field. These findings can provide an interesting basis for analysing the extent to which certain drivers unfold in terms of micro-credentials. Future research efforts could usefully attend to the later stages of micro-credential adoption to validate the proposed alternative pathways suggested in this research. The investigation of institutional strategies and policies in relation to micro-credentials will be vital, too, as a way of exploring interest in scaling up micro-credentials, which is of relevance internationally.

Conclusion

Our research sought to explore the potential for micro-credential adoption in relation to national and international policy initiatives and rapidly developing technologies, using a Delphi study approach. With the help of experts in the field, a consensus-building activity resulted in the critical analysis of the extent to which micro-credentials might be accepted in HE, with participants reflecting on the importance of previously identified enablers and outcomes for alternative scenarios. It was evident that the variety of potential outcomes enabled by micro-credentials are not necessarily dependent on wide-scale adoption or national alignment. The consensus of the experts points especially towards the likelihood of micro-credentials gaining importance among educational institutions that seek to innovate, as well as the networks of institutions that seek alternative approaches to traditional study offerings and programmes. Although the findings are not intended to be prescriptive and normative for upcoming developments in micro-credentials, we believe that our analysis offers a strong foundation and a benchmark for discussing the importance of micro-credentials within and beyond Europe, in local, national, and international educational institutions and forums. It can also enable strategic discussion at an institutional level, supporting efforts to move gradually towards the adoption of micro-credentials in a meaningful way for students at all stages of their learning journeys.

Note

1. Co-funded by Erasmus+590161-EPP-1-2017-1-DE-EPPKA3-PI-FORWARD.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This research was co-funded by Erasmus+ project MicroHE - Support Future Learning Excellence through Micro-Credentialing in Higher Education (590161-EPP-1-2017-1-DE-EPPKA3-PI-FORWARD).

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