



D2.2 Future Impacts of Modularisation and Micro-Credentials on European Higher Education and list of validated scenarios

WP2 Scenario Building for Micro-Credentials in Europe



Authors

Ira Sood, Carmen L Padrón, Henri Pirkkalainen, Anthony Camilleri

Contributors

Panel of experts listed in the Annex section

Editors

Carmen L Padrón, Ira Sood

Layout

Tara Drev

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1. Introduction

The key goal of MicroHE¹ is to provide a comprehensive policy analysis of the impact of modularisation, unbundling and micro-credentialing on European Higher Education. This goal was realised via the below mentioned activities also summarised in figure 1:

gathering the state of the art in micro-credentialing in European Higher Education today, by organizing the first European survey on micro-credentials in HE, surveying at least 70 institutions across the continent, with the aim of understanding the current level of provision, the types of micro-credentials offered and future trends in provision of micro-credentials

forecasting the impacts of continued modularisation of Higher Education on HEIs by using forward-scanning techniques, specifically through the use of DELPHI methodology

examining the adequacy of European recognition instruments for micro-credentials in particular ECTS, the diploma supplement and qualification frameworks

proposing a 'credit supplement' to give detailed information about micro-credentials in a way compatible with ECTS, the diploma supplement and qualification frameworks

proposing a meta-data standard and developing an online clearinghouse to facilitate recognition, transfer and portability of micro-credentials in Europe

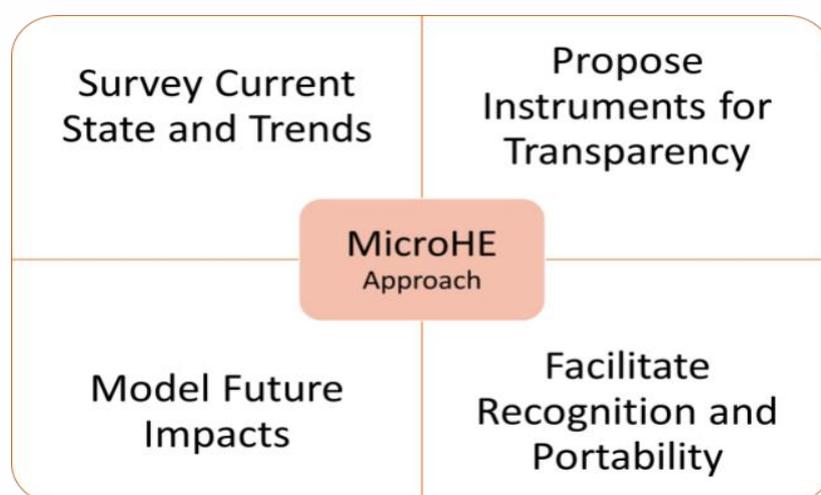


Figure 1. MicroHE Approach based on 4 Pillars

¹ More information at : <https://microcredentials.eu/outputs/microhe-outputs/>

In this document the following definition of micro-credentials will be used as defined in Camilleri (2019)²

A micro-credential is a small volume of learning certified by a credential. It explicitly defines learning outcomes in terms of specific knowledge, skills or competences with an indication of the associated workload required to achieve such outcomes.

Micro-credentials can be generally defined as sub-unit of a credential or credentials that can be stacked into larger credentials. In terms of workload they can be ranged from 2-30 ECTS

This document reports on a MicroHE WP2 activity that aimed to conduct a future-foresight exercise using a raft of forecasting techniques to map the likely impacts of micro-credentials on HEIs, the sector and the wider society as a whole. The future-foresight exercise was accomplished in a delphi study that was modified to the activities of MicroHE project. The four stages of the delphi study included a group of experts from across Europe, engaging them in a series of exercises and activities in 2019 and 2020. The below section will expand on the process.

2. MicroHE Delphi study

The MicroHE partnership set out to conduct a future-foresight exercise that utilises a raft of forecasting techniques in a form of a Delphi methodology. The activity essentially aimed at scenario building to map the likely impacts of micro-credentials on Higher Education Institutions, the education sector and the wider society as a whole. The methodology for the MicroHE Delphi study was detailed in D2.1. The Delphi study consisted of 4 stages as shown in the Figure below.

² Camilleri, A. (2019). Micro Credentials 101: What are they and why should we care? MicroHE MasterClass, Bled Slovenia, October 2019: <https://microcredentials.eu/wp-content/uploads/sites/20/2019/10/20191021-Policy-Roadmaps-for-MicroCredentials.pdf>

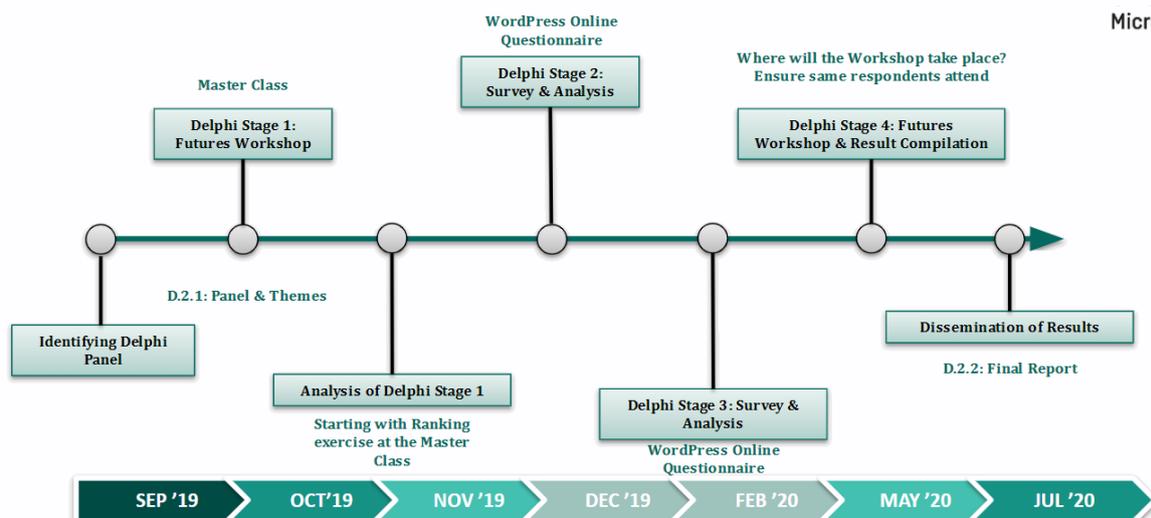


Figure 2. The original Delphi Timeline in MicroHE

The Delphi study conducted by the project intends to answer the research question of “How will further modularisation of education impact Higher Education Institutions in 5 to 10 years from now?”, by considering multiple perspectives (pedagogical, technological, organizational and learners benefits) through the analysis of four themes depicted in the next figure.

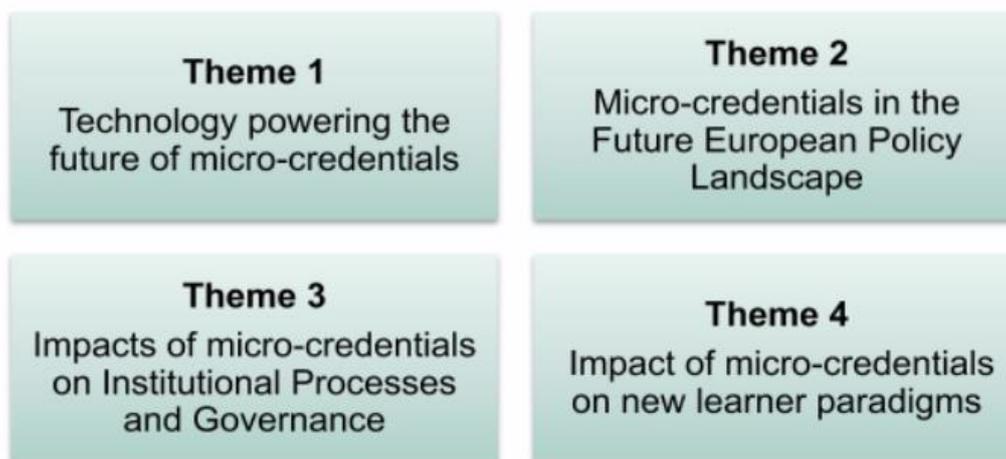


Figure 3. The four identified themes for analysis in the Delphi study

While the use of technology and European policy initiatives (current and future) were identified as the *drivers* that could facilitate the adoption of micro-credentials into the mainstream, it was also considered crucial to understand the *impact* that micro-credentials would have on the existing institutional processes, and on benefits for learners derived from changes of the Learner centred paradigm implementations by opening up the HE and breaking/blurring barriers between formal and non-formal learning.

The four stages of the Delphi study are described in the next sections by elaborating on both the methods and results of each stage. The stages included

1. Futures workshop as a part of Digital Credentials Masterclass in Bled, Slovenia
2. Survey and analysis
3. Second round of Survey and analysis
4. Futures workshop with emphasis on scenario building

2.1. Stage 1: Masterclass in Slovenia

The Bled Masterclass was a two day long landmark event conducted by the MicroHE consortium to enable a pivotal discussion among higher education experts³ from across Europe about the future of micro-credentials; their adoption as well as impact on the future of higher education landscape.

The guiding question was: *How will further modularisation of education impact Higher Education Institutions in five-ten years from now*

Before the masterclass, 4 themes were identified which were presented to the invited group of experts. While the use of **technology** and **European policy initiatives** (current and future) were identified as the drivers that could facilitate the adoption of micro-credentials into the mainstream, it was also considered crucial to understand the impact that micro-credentials would have on the **existing institutional processes** and the corresponding **impact on learners**. The themes were related to each other as the figure below depicts.

³ Selected from the stakeholder analysis conducted as part of the MicroHE activities

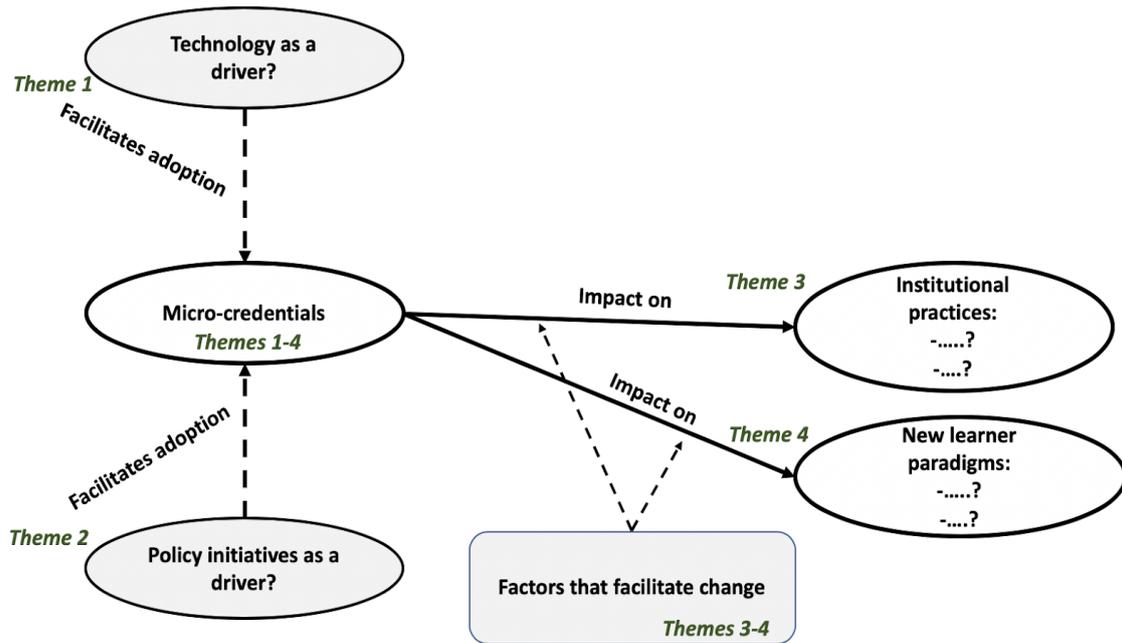


Figure 4. Overview of the four themes relationships

The masterclass commenced with a string of presentations from the invited experts, where all the four identified themes were highlighted from varying perspectives of national and international relevance. Those presentations are listed in the Annex 4.2. The event was conducted in a workshop format where each day was focussed on two of the identified themes. Each theme was highlighted and discuss in two keyways:

- Presentation session from expert speakers to set up the stage for the discussions that were pivotal for the beginning of the modified Delphi process (See Annex)
- Moderated small group workshop discussion session

Method: Altogether 29 experts participated in the masterclass. They were divided into four groups. Each group was accompanied by two consortium members serving as a moderator and an additional rapporteur in order to facilitate and document the discussion. The goal for each group was to firstly discuss the theme presented to them based on a guiding question. Based on the discussion, the participants came up with a number of impact statements that were consequently ranked by them in the order of priority and likelihood. The moderators then collected and aggregated these statements as part of the preparation for stage 2.

The following statements were used as Guiding questions per theme:

Theme 1: The discussion will focus on the principles that technology (such as Blockchain, open badges, artificial intelligence) can enable for micro-credentials

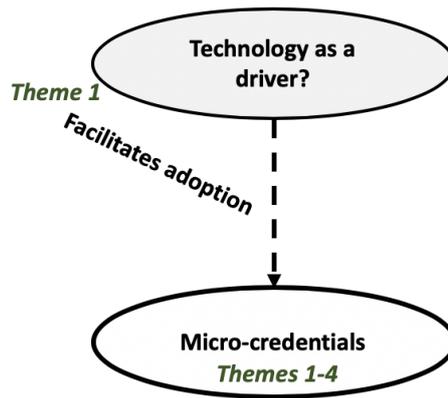


Figure 5. Theme 1. Technology as driver/enabler for Micro-credentials adoption.

Theme 2: The discussion will focus on the impact of European policy initiatives, such as Digital Education Plan, Bologna Digital, Single Labour Market on adoption of micro-credentials in higher education

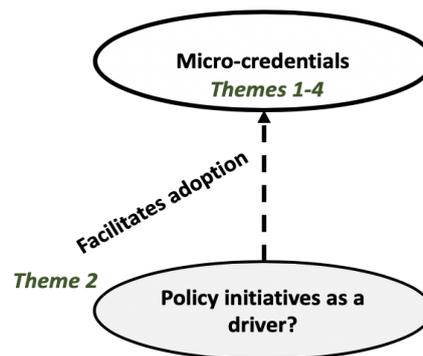


Figure 6. Theme 2. Policy initiatives as driver/enabler for Micro-credentials adoption.

Theme 3: The discussion will focus on 'The university of the future via micro-credentials'. Stackability of micro-credentials, unbundling, ultra-mobile digital students.

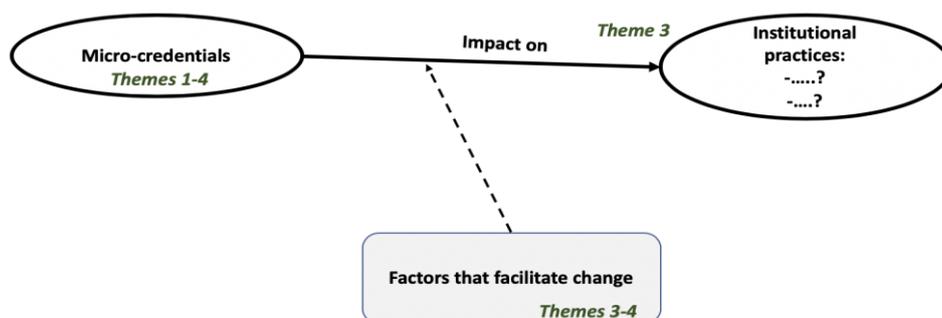


Figure 7. Theme 3. Institutional practices impacted by the Micro-credentials' adoption.

Theme 4: The discussion will focus on Lifelong Learning through Micro-credentials: impacts on learners, education funding, lifelong learning; Initiatives like Europass⁴ and LLL passports, skills matching for labour market.

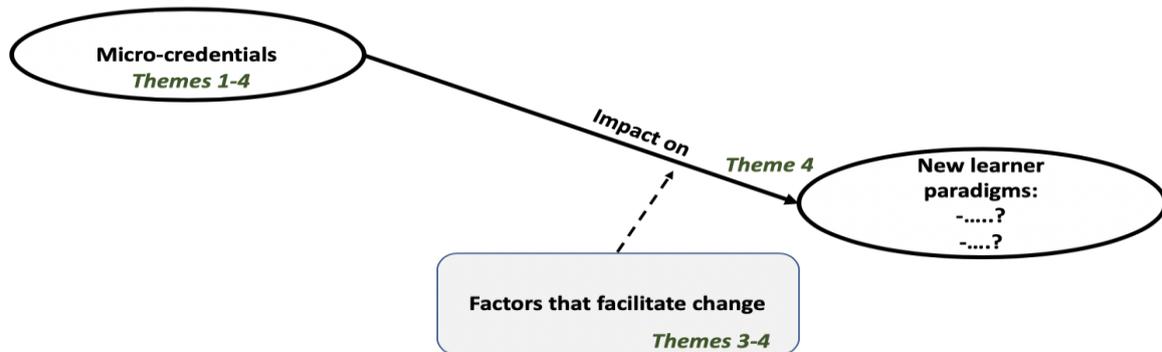


Figure 8. Theme 4. Learner practices impacted by the Micro-credentials' adoption.

Result of Stage 1: The main output of this stage was to generate a fixed number of futures statements resulting from group consensus that will be turned into future scenarios (Stages 2-4). To ensure an output consistency, the statements were formulated in a pre-decided format as discussed below:

For Themes 1-2 (Facilitating adoption of micro-credentials)

e.g.: _____ (policy initiative or technology) enables adoption of micro-credentials in HE via _____

Sample Statement: Blockchain technology enables adoption of micro-credentials in HE because it offers forge-proof credentials via immutability

For Themes 3-4 (Impact and impact enabler)

Should be a statement that addresses the question of 'what is the impact' and 'how' the impact is enabled

e.g.: _____ (facilitating condition) enables the impact of micro-credentials on _____

Sample Statement: Stackability of credentials enables the impact of micro-credentials on unbundling of a degree into smaller units

How Statements should not be Formulated

Statements should **not be conditional** (even expressed without the use of 'if', 'or')

⁴ <https://europa.eu/europass/en>

As a conclusion, 10-12 Statements were identified pertaining to each theme which were further consolidated into 8 to prepare for the next round of Delphi. Each of the statements are presented below.

Theme 1: Technology powering the future of micro-credentials

- Artificial Intelligence enables adoption of micro-credentials for higher education because it will substitute many elements of the teaching process and management (such as course personalization, course recommendation, course design, employability, career guidance and policy level decision making on international, national and regional levels) by using historical data at scale for analysis, prediction and prescription of the actions for the benefit of students.
- Blockchain can enable adoption of micro-credentials by allowing the persons' achievements to be linked to their identity across geographical, institutional and technical boundaries.
- Convergence of Blockchains and Artificial intelligence for the storage of all European credentials will provide an open platform for stakeholders enabling the creation of new educational business models and educational opportunities for micro-credentials.
- The semantic harmonization of educational standards and their alignment to employment enable the adoption of micro-credentials for higher education because it enables interoperability and automatic recognition for all the stakeholders.
- Any technology that is open source, based on commonly agreed European Standards, will facilitate the adoption of micro-credentials.
- Open badges and other credentialing technologies will enable transparency and recognition of micro-credentials irrespective of whether they are formal or non-formal by origin.
- A reliable technical platform, accompanied by secure certificates, can enable data portability, trust and healthy exchange, which can facilitate the adoption of micro-credentials.
- Building up on existing infrastructure instead of entirely reinventing tech systems will ensure trust in facilitating the adoption of micro-credentials

Theme 2: Micro-Credentials in the Future European Policy Landscape

- Effective national-level strategies specifically targeted at micro-credential coming jointly from ministries, world of work and higher education institutions will facilitate the adoption of micro-credentials.
- Including micro-credentials into Bologna process will provide a forum for agreeing about recognition and portability standards to invite countries to actions and stimulate national policies.
- Europass and EBSI⁵ will facilitate a European-wide trusted platform for all kinds of credentials capturing formal, non-formal and informal learning, in the process facilitating adoption of micro-credentials.

⁵ <https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/EBSI>

- Connecting commercial employment platforms to European educational institutions through micro-credentials will lead to industrially relevant courses (for the region) and enhance employability which will in turn make micro-credentials an attractive avenue.
- A clear definition of goal of policies i.e. profitability, appeal and access to education and re-scaling and upscaling of citizens will enable the adoption of micro-credentials.
- The extension of Enic-Naric policies for assessment of micro-learning will enable the adoption of micro-credentials in higher education.
- Link with the structures and principles EQF and ECTS enables the adoption of micro-credentials.
- Defining the levels of Micro-credentials according to the national qualification framework from the providers issuing the micro-credential (institutional or private providers) will enable the adoption of micro-credentials.

Theme 3: Impacts of Micro-Credentials on Institutional Processes and Governance

- Common standards will emerge to enable stackability of micro-credentials thus, enabling their impact.
- Educational ecosystems based on stackable micro-credentials involving universities, employers, MOOC providers will enhance educational offerings, workforce capability and create new markets.
- Stackable micro-credentials will facilitate new business models for existing universities, professional bodies (e.g., chambers of commerce), new entrants (e.g., google), tech-start-ups and associations.
- Adoption of Micro Credentials in formal education will impact how student success is measured and help institutions differentiate themselves from others.
- The granularity and focus on learning outcomes enable the impact of Micro-credentials on easier recognition of skills and competences of students and teachers.
- Institutional openness towards micro-credentials has the potential to reduce drop-out rates.
- Micro-credentials will have an impact on the overall institutional strategies for micro credentialing by offering new possibilities not just to inculcate trust into the inter-institutional processes but also to think in terms of defining the vision, mission and strategy of an institution.
- Micro-credentials can have an impact on the flexibility of Institutions by offering the possibility to meet students' needs of more flexible and personalized learning, in the process also enhancing mobility and employability.

Theme 4: Impact of micro-credentials on learners

- Micro-credentials will decrease skills mismatch and enhance employability and contribute to better career planning.
- Recognition of micro-credentials can enhance student motivation, responsibility and determination, enabling more effective learning.
- Micro-credentials provide a platform for fine-grained capturing of skills, which facilitates student privacy, transparency and better decision-making for employers.

- The underlying metadata on skills and competences contained in micro-credentials enables learners to express learning outcomes beyond simple participation certification
- Customization and better matching to vacancies will enable MCs in activating new funding schemes for students.
- Micro-credentials can have a positive impact on participation of disadvantaged people in the population through LLL, MCs and flexibilization of learning thus, contributing to the well-being of society.
- Micro-credentials could enable reorientation or re pivoting in terms of student studies and career e.g.: If people have gone too far off in a wrong direction could strategize again with lower barriers.
- Micro-credentials could have a big impact in helping student prepare for jobs that do not exist yet and help in anticipating future needs

2.2. Stage 2: 1st Online Survey

The 12 statements (per theme) obtained as a result of the masterclass workshop were further consolidated into 8 statements based on their relative relevance by the consortium panel. While the statements obtained from theme 3 (*Impact of micro-credentials on institutional processes and governance*) and 4 (*Impact of micro-credentials on learners*) were classified as impact statement the statements from theme 1 (*Technology serving as a driving force*) and 2 (*European policy initiatives serving as driving force*) were classified as drivers that would make those impacts possible. The statements were then turned into a survey to get further consensus from participants.

An online survey was set to gather experts' answers ranking statements per theme. The survey is available at <https://microcredentials.eu/outputs/microhe-outputs/wp2/delphi2/> (password: delphi2020). The same group of experts who participated in the previous stage, were also invited to complete that survey. The participants were asked to rank the statements based on how significantly they pertained to a particular theme. And a total ground of 20 inputs were collected at the end of the consulting period.

Result of Stage 2: At the end of stage 2, 5 statements per theme were obtained and ranked in the order of their significance by the participants.

Theme 1: Technology powering the future of micro-credentials

1. Artificial Intelligence enables adoption of micro-credentials for higher education because it will substitute many elements of the teaching process and management (such as course personalization, course recommendation, course design, employability, career guidance and policy level decision making on international, national and regional levels) by using historical data at scale for analysis, prediction and prescription of the actions for the benefit of students.
2. Any technology that is open source, based on commonly agreed European Standards, will facilitate the adoption of micro-credentials.

3. Open badges and other credentialing technologies will enable transparency and recognition of micro-credentials irrespective of whether they are formal or non-formal by origin as long as a clear classification is maintained.
4. A reliable technical platform, accompanied by secure certificates, can enable data portability, trust and healthy exchange, which can facilitate the adoption of micro-credentials.
5. Building up on existing infrastructure instead of entirely reinventing tech systems will ensure trust in facilitating the adoption of micro-credentials.

Theme 2: Micro-Credentials in the Future European Policy Landscape

1. Effective national-level strategies specifically targeted at micro-credential coming jointly from ministries, world of work and higher education institutions will facilitate the adoption of micro-credentials.
2. Including micro-credentials into Bologna process will provide a forum for agreeing about recognition and portability standards to invite countries to actions and stimulate national policies.
3. Europass and EBSI will facilitate a European-wide trusted platform for all kinds of credentials capturing formal, non-formal and informal learning, in the process facilitating adoption of micro-credentials.
4. Linking the structures and principles EQF and ECTS enables the adoption of micro-credentials.
5. Defining the levels of Micro-credentials according to the national qualification framework from the providers issuing the micro-credential (institutional or private providers) will enable the adoption of micro-credentials.

Theme 3: Impacts of Micro-Credentials on Institutional Processes and Governance

1. Micro-credentials can have an impact on the flexibility of Institutions by offering the possibility to meet students' needs of more flexible and personalized learning, in the process also enhancing mobility.
2. The granularity and focus on learning outcomes enable the impact of Micro-credentials on easier recognition of skills and competences of students and teachers.
3. Mainstream stackable micro-credentials will facilitate new business models for existing universities, professional bodies (e.g., chambers of commerce), new entrants (e.g., google), tech-start-ups and association
4. Educational ecosystems based on stackable micro-credentials involving universities, employers, MOOC providers will enhance educational offerings, workforce capability and create new markets.
5. Common standards will be needed to enable stackability of micro-credentials thus, enabling their impact.

Theme 4: Impact of micro-credentials on new learner paradigms

1. Micro-credentials will decrease skills mismatch and enhance employability and contribute to better career planning.

2. Recognition of micro-credentials can enhance student motivation, responsibility and determination, enabling more effective learning.
3. The underlying metadata on skills and competences contained in micro-credentials enables learners to express learning outcomes beyond simple participation certification.
4. Micro-credentials could enable reorientation or re pivoting in terms of student studies and career e.g.: If people have gone too far off in a wrong direction could strategize again with lower barriers.
5. Micro-credentials could have a big impact in helping students prepare for jobs that do not exist yet and help in anticipating future needs

2.3. Stage 3: 2nd Online Survey

The data obtained from the first survey was analysed by the consortium and based on the output of that analysis, the strategy for the 3rd stage was modified to obtain meaningful information for the definition of future scenarios in the 4th stage and driver statements were shortened to facilitate the statements layout in the online questionnaire design.

A new online questionnaire was designed to gather experts' feedback regarding the most important drivers (top 5 in the order of priority) pertaining to every impact statement that they identified as relevant in the previous stage. The survey is available at <https://microcredentials.eu/outputs/microhe-outputs/wp2/delphi-stage-3-survey-and-analysis/>

Password: delphi2020). The same group of experts who participated in the previous stage, and a total of 15 inputs were collected at the end of the consulting period.

Result of Stage 3: Top 5 drivers were obtained for every statement related to themes 3 and 4.

Statement 1: Micro-credentials can have an impact on the flexibility of Institutions by offering the possibility to meet students' needs of more flexible and personalized learning.

Top drivers:

- Including micro-credentials into Bologna process.
- A reliable, portable and secure technical platform for data exchange.
- European-wide trusted platform such as Europass, EBSI.
- Making use of Artificial Intelligence to personalize learning and teaching experience.
- Making use of blockchain to link learning to learner's identity.

Statement 2: The granularity and focus on learning outcomes enable the impact of Micro-credentials on easier recognition of skills and competences of students and teachers.

Top Drivers:

- Open Source tech based on commonly agreed upon European Standards.
- A reliable, portable and secure technical platform for data exchange.
- Defining levels of micro-credentials in accordance with NQFs.
- Open badges and other credentialing technologies that enable transparency and recognition.

- Including micro-credentials into Bologna process.

Statement 3: Mainstream stackable micro-credentials will facilitate new business models for existing universities, professional bodies (e.g., chambers of commerce), new entrants (e.g., google), tech-start-ups and association.

Top Drivers:

- A reliable, portable and secure technical platform for data exchange.
- Open badges and other credentialing technologies that enable transparency and recognition.
- Building up on existing infrastructure instead of reinventing the wheel.
- Connecting commercial employment platforms to European educational institutions.
- European-wide trusted platform such as Europass, EBSI.

Statement 4: Educational ecosystems based on stackable micro-credentials involving universities, employers, MOOC providers will enhance educational offerings and create new markets.

Top Drivers:

- National level strategies created in cooperation between ministries, HEIs and employers.
- A reliable, portable and secure technical platform for data exchange.
- Open badges and other credentialing technologies that enable transparency and recognition.
- European-wide trusted platform such as Europass, EBSI.
- Making use of Artificial Intelligence to personalize learning and teaching experience.

Statement 5: Institutional openness towards micro-credentials has the potential to reduce drop-out rates.

Top Drivers:

- Defining levels of micro-credentials in accordance with NQFs.
- National level strategies created in cooperation between ministries, HEIs and employers.
- Extension of Enic-Naric policies for assessment of micro-learning.
- Making use of Artificial Intelligence to personalize learning and teaching experience.
- European-wide trusted platform such as EuroPass, EBSI.

Statement 6. Micro-credentials will decrease skills mismatch and enhance employability

Top Drivers:

- National level strategies created in cooperation between ministries, HEIs and employers.
- European-wide trusted platform such as EuroPass, EBSI.
- Open badges and other credentialing technologies that enable transparency and recognition.
- Connecting commercial employment platforms to European educational institutions.
- Making use of Artificial Intelligence to personalize learning and teaching experience.

Statement 7. Recognition of micro-credentials can enhance student motivation, responsibility, and determination, enabling more effective learning.

Top Drivers:

- National level strategies created in cooperation between ministries, HEIs and employers.
- Including micro-credentials into Bologna process.
- Open badges and other credentialing technologies that enable transparency and recognition.
- Defining standard size for Europe wide micro credentials.
- Connecting commercial employment platforms to European educational institution.

Statement 8. The underlying metadata on skills and competences contained in micro-credentials enables learners to express learning outcomes beyond simple participation certification.

Top Drivers:

- Open badges and other credentialing technologies that enable transparency and recognition.
- Defining levels of micro credentials in accordance with NQFs.
- National level strategies created in cooperation between ministries, HEIs and employers.
- Extension of Enic-Naric policies for assessment of micro-learning.
- Making use of blockchain to link learning to learner's identity.

Statement 9. micro-credentials can have a positive impact on participation of disadvantaged people in the population through LLL and flexibilization of learning thus, contributing to the well-being of society.

Top Drivers:

- National level strategies created in cooperation between ministries, HEIs and employers.
- A reliable, portable and secure technical platform for data exchange.
- Open Source tech based on commonly agreed upon European Standards.
- Including Micro-credentials into Bologna process.
- Making use of Artificial Intelligence to personalize learning and teaching experience.

Statement 10. micro-credentials could have a big impact in helping students prepare for jobs that do not exist yet and help in anticipating future needs.

Top Drivers:

- National level strategies created in cooperation between ministries, HEIs and employers.
- Connecting commercial employment platforms to European educational institutions.
- Making use of Artificial Intelligence to personalize learning and teaching experience.
- Building up on existing infrastructure instead of reinventing the wheel.
- European-wide trusted platform such as EuroPass, EBSI.

Summary of Stage 1-3

The table below summarises the first three stages of the conducted Delphi study.

Table 1. Summary of stages 1-3

Stage 1: Masterclass held in Bled, Slovenia (October 2019)	
Method	Panel of experts with presentations linked to every theme that has been identified.
	Working sessions to collaboratively determine a set of statements related to drivers and impacts (Themes 1 till 4).
Results	12 Statements were identified pertaining to each of the four identified themes.
Stage 2: 1st Online Survey	
Method	Participants were asked to rank the statements based on how significantly they pertained to a particular theme. The initial 12 statements were consolidated to 8 statements based on relevance.
Result	5 statements per theme ranked in the order of their significance were identified. 5x2 impact statements and 5x2 drivers.
Stage 3: 2nd Online Survey	
Method	The numbers of identified drivers increased from 10 to 13 based on analysis of each statement associated with 5-8 drivers and proposals made by experts.
	Participants were asked to rank the top 5 drivers for each impact statement.
Result	Top 5 drivers obtained for every statement related to Themes 3 and 4.

2.4. Stage 4: Futures Workshop

Method: The final stage of the futures workshop was initially envisioned as a face to face meeting with the expert panel however, due to the ongoing pandemic situation, it was modified into a virtual event. Based on the feedback received in stages 1-3, several impacts that micro-credentials could have either on the institutional processes or on the learners were identified (In the next 5-10 years timeline). At the same time a number of enabling factors were identified,

divided into two categories, those driven by European policy initiatives and those driven by technological advancements. Based on the analysis of the previous stages results and the internal consortium discussions *three* likely scenarios that could possibly be realised in the next 5-10 years have been identified, depending on the degree/extent of the impacts being realised.

- I. Scenario 1: HEIs fully embrace micro-credentials (Wide Scale Adoption of Micro-credentials)
- II. Scenario 2: HEIs partially embrace micro-credentials (Partial adoption).
- III. Scenario 3: HEIs minimally embrace micro-credentials (Minimal adoption).

The goal of the final (4th) stage was the analysis and validation of these scenarios during the online workshop. The invited experts participated in discussions during the workshop, which helped us to further examine the initial research question: How will further modularisation of education impact Higher Education Institutions in 5 to 10 years from now?

The interactive virtual event was conducted over Zoom. Altogether 28 number of participants attended the event. Participants were familiarised with the three scenarios developed (explained in detail below) and then split into three groups, each group tackling one scenario. They were then sent into smaller breakout rooms to discuss and analyse each scenario presented in the tabular form as shown in tables 2, 3 and 4 for Scenario 1, 2 and 3 respectively. Once in the breakout room, they had to follow the following steps:

- Use the first ten minutes for self-reflection and personal notes, where they would take some time to familiarise themselves with the contents of the table.
- Participants were asked to parse through the table horizontally.
- Each table consisted of 10 impact statements from the previous stages which were categorised and enhanced with a few examples that offered an insight into how that particular impact could be realised in 5 to 10 years from now.
- The participants were asked to mark the likelihood of realisation of each impact. While in Scenario one, they were presented with a table that had marked all the impacts as realisable (being the ideal case), scenario 2 and 3 were presented with all the impacts as unrealisable to begin with. Participants were asked to analyse each impact for each scenario, discuss it within their groups and change its realizability (or not) based on the group consensus.
- The table also highlighted the key technological and policy driver that was responsible for a particular impact to materialise, as ranked in the previous stage. Participants were given an additional option to add to the list of drivers, if they so wished.
- Finally, the participants were asked to list the barriers that were either overcome or the ones that were not but could stand in the way of realisation of each impact.
- A few examples for possible barriers were provided in the initial impacts to guide the discussions.
- Each group then went on to discuss and draw conclusions along with a group moderator from the consortium.

Breaking down the three Scenarios

The proposed scenarios show a gradual transformation of HEIs in Europe regarding the adoption of micro-credentials at two levels: i.e. institution level and community level. The latter has taken into account the different customer segments in the adoption of innovations.

Scenario 1: HEIs fully embrace micro-credentials (Wide-scale adoption)

In this scenario we predict that HEIs fully adopt micro-credentials as a means for developing and demonstrating highly demanded skills and competences on a European Level for most study programs (But not for all). micro-credentials have been integrated into formal education in a large majority of programs within institutions in Europe with interoperability at the centre of the mechanism.

The main actors involved in this scenario are *innovators*, *early adopters* and *early majority*.

The scenario materialization is achieved by changes in the institutional policy 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) served as effective drivers for this goal.

The discussion section “Results of Stage 4” contains a full tabular description of this scenario. The table includes a scenario description considering the different impacts on institutional governance and policies, and learner benefits, which are presented in its different rows. Each of the impacts is described using examples of how the impact is realized (column C), whether the impact was realized, which are the policy and technological drivers which facilitate the impact in columns (A, B) and the those facts which act as barriers and were overcome to ensure the impact realization (column D).

Scenario 2: HEIs partially embrace micro-credentials (Partial adoption)

In this second scenario, HEIs adopt micro-credentials as a means for developing and demonstrating highly demanded skills and competence within small networks. For e.g. A few institutions within a network have mutually created and accepted micro-credentials. Micro-credential integration into formal education has taken place only in selective networks within institutions in Europe.

The main actors involved in this scenario are the *innovators* and the *early adopters*.

The scenario materialization is achieved by a few changes in the institutional policy 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) served as partially effective drivers for this goal. The discussion section contains a full tabular description of this scenario.

Scenario 3: HEIs don't embrace micro-credentials (Minimal adoption)

In the last scenario, only some HEIs adopt Micro-credentials as a means for developing and demonstrating highly demanded skills and competences on an institutional level. Micro-credential integration into formal education has not taken place within institutions in Europe.

Only the *innovators* have been the main actors in this scenario.

In this scenario minimal changes are done in the institutional policy and governance mechanisms of those HEIs (as described Theme 3). Such changes also led to a limited impact on learners who are beneficiaries of those HEI (as described Theme 4). Technology (as described Theme 1) and policy initiatives both regional and European (as described Theme 2) mostly failed to serve as effective drivers for the adoption of micro-credentials. In the next section a full description of this scenario is presented using the table elements previously explained.

Result of Stage 4:

The following tables represent the three scenarios for the micro-credential adoption. They reflect upon the impact statements and drivers from the previous round of the Delphi study, depicting whether for the particular scenario the impacts have been realized and what barriers obstructing the realization of the impact.

Scenario 1: HEIs fully embrace micro-credentials (Wide Scale Adoption)

Table 2. Scenario 1: HEIs fully embrace micro-credentials (Wide Scale Adoption)

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
1	Changes in curriculum designs	Institutions offer flexible and more personalized learning opportunities.	-Students have access to an extensive curriculum from outside their own university. - Content is aligned to long-term employability and oriented towards individual education goals, interests and needs.	<input checked="" type="checkbox"/>	Including Micro-credentials into Bologna process.	A reliable, portable and secure technical platform for data exchange. Robust built-in MC recognition mechanisms.	- Resistance towards Digitalisation - Lack of trust on Micro-credentials - Lack of a trusted list of Micro-credentials issuers

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
							<ul style="list-style-type: none"> - Lack of know-how, experience, knowledge, resources, examples causes lack of trust - Management skills and solutions, adoption readiness in handling these changes - Agencies lack of proper mechanisms in place to accredit smaller study modules/programs. -Lack of financial incentive for institutions
2	Quality frameworks to ensure recognition / validation of micro-credentials	Institutions utilize micro-credentials as a means to recognize the skills and competences of learners and teachers.	<ul style="list-style-type: none"> - Development of 21st century skills/ demanded skills in the job market has been supported by having proper recognition mechanisms in place. - Micro-credentials have been used by teachers to 	<input checked="" type="checkbox"/>	Defining levels of micro-credentials in accordance with NQFs.	Open Source tech based on commonly agreed upon European Standards.	<ul style="list-style-type: none"> - Lack of common recognition frameworks - Lack of common format for describing learning - Push towards innovation

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
			upgrade to new skills and for personal development.				<ul style="list-style-type: none"> - Lack of portability of credentials - Failure of Integration of micro-credentials into Bologna tools
3	Emergence of innovative business models and processes	Stackable micro-credentials have enabled the adoption of new business models for HEIs professional bodies (e.g., chambers of commerce), new entrants (e.g., Google, edX), tech-start-ups and associations.	<ul style="list-style-type: none"> - Micro-credentials have been provided for a specific job function for a unique group of learners in collaboration with a professional body leading to new revenue models. -Shift towards degree programmes done in conjunction with online content providers has been achieved. 	<input checked="" type="checkbox"/>	Building upon existing infrastructure instead of reinventing the wheel -Offering interoperable learning ecosystem (Formal education, non-formal education).	A reliable, portable and secure technical platform for data exchange.	<ul style="list-style-type: none"> - Lack of opportunities/will to collaborate without a common agenda for fear of own profit cannibalism - Lack of consensus among the traditional higher ed community - Lack of investment into human capital and competences - Preference to uptake of micro-credentials (quantitative) instead of qualitative unique institutional scenarios - Financing and funding mechanisms in national contexts for e.g. how many

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
							<p>students are enrolled in a degree prog as a factor</p> <p>- ignoring open source systems</p>
4	Mobilisation of increasingly collaborative educational ecosystems	New educational ecosystems have emerged consisting of universities, employers and educational content providers.	<p>-Real-world projects and engagements with employers and the world of work is commonplace</p> <p>-There is a proper process for providing academic credit for experience and learning at work.</p>	<input checked="" type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	A reliable, portable and secure technical platform for data exchange.	<p>- Cooperation in defining the skill requirement</p> <p>- Establish dialogue on an ongoing timeframe</p>

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
5	Mechanisms to retain students	Dropout rates are reduced.	- Necessary competence leading to focused and relevant job opportunities has been provided which in turn is effective in preventing dropouts -Learners are allowed to take breaks in their studies and collect credentials as they go	<input type="checkbox"/>	Defining levels of micro-credentials in accordance with NQFs.	Making use of Artificial Intelligence to personalize learning and teaching experience and European-wide trusted platform such as EuroPass ⁶ , European Blockchain Services Infrastructure (EBSI) ⁷ .	- <i>Bachelor's</i> and master's degree programmes are seen as the only measure of educational competence
6	New approach to enhance average employability	Skill mismatch is decreased, and employability is enhanced.	- Micro-credentials helped in responding to the need to be multi-skilled by being specifically tailored to the needs and requirements of businesses/companies.	<input checked="" type="checkbox"/>	National level strategies created in cooperation between	European-wide trusted platform such as EuroPass, European Blockchain Services Infrastructure (EBSI).	- Here apply those barriers listed for statements 1 and 2

⁶ <https://europa.eu/europass/en>

⁷ <https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/EBSI>

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
			-Micro-credentials have been used to provide a faster response to changing needs of employment.		ministries, HEIs and employers		
7	Mechanisms to improve learners' intrinsic motivation and responsibility	Student motivation, responsibility and determination were increased enabling effective learning.	-Micro-credentials have actively contributed by providing a system for constant, lifelong learning in all contexts. -Micro-credentials are used to respond to the need of flexible and personalised learning.	<input checked="" type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	Open badges and other credentialing technologies that enable transparency and recognition.	- We should not overestimate the importance of micro-credentials in learning and motivation
8	Transparency on actual competence achieved	The underlying metadata on skills and competences contained in Micro-credentials has enabled learners to	-Employers and other institutions have more visibility on a student's achieved competences beyond a simple view of grades with no information	<input checked="" type="checkbox"/>	Defining levels of micro credentials in accordance with NQFs.	Open badges and other credentialing technologies that enable transparency and recognition.	- Common understanding and usage of vocabulary for standardized metadata describing micro-credentials and learning management systems.

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
		express learning outcomes beyond simple participation certification.	on the mechanism underneath. -Mechanisms to easily share a student competence on various platforms are in place.				
9	Flexible learning opportunities to foster inclusivity	Participation of disadvantaged people is increased through LLL and flexibilization of learning thus, contributing to the well-being of society.	-People who are not in a position to enrol in full degree programmes, due to personal reasons such as work, finances, lack of access etc., are able to use micro-credentials to slowly acquire relevant competences and use them to avail themselves of various job opportunities	<input checked="" type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	A reliable, portable and secure technical platform for data exchange.	<i>No barriers were added.</i>
10	Opportunities to upskill and reskill	Students are more prepared for jobs	-The high availability of learning opportunities based	<input checked="" type="checkbox"/>	National level strategies	Connecting commercial employment platforms to	<i>No barriers were added.</i>

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Uncheck the box if you disagree)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
		that didn't exist and are able to anticipate future needs (10)	on micro-credentials offers possibilities to acquire new competences/skills considering the rapidly evolving skill demand		created in cooperation between ministries, HEIs and employers.	European educational institutions.	

Scenario 2 HEIs partially embrace micro-credentials (Partial Adoption)

Table 3. Scenario 2 HEIs partially embrace micro-credentials (Partial Adoption)

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
1	Changes in curriculum designs	Institutions offer flexible and more personalized learning opportunities.	-Students have access to an extensive curriculum from outside their own university. - Content is aligned to long-term employability and oriented towards individual education goals, interests and needs.	<input type="checkbox"/>	Including Micro-credentials into Bologna process.	A reliable, portable and secure technical platform for data exchange. Robust built-in MC recognition mechanisms.	<ul style="list-style-type: none"> - Strategies are missing to allow implementation - Resistance towards further digitalisation in terms of micro-credential adoption - Lack of trust on Micro-credentials - Lack of a trusted list of Micro-credentials issuers - Large HEIs are not flexible enough to adapt - Willingness of management to follow the good examples

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
2	Quality frameworks to ensure recognition / validation of micro-credentials	Institutions utilize micro-credentials as a means to recognize the skills and competences of learners and teachers.	<ul style="list-style-type: none"> - Development of 21st century skills/ demanded skills in the job market has been supported by having proper recognition mechanisms in place. - Micro-credentials have been used by teachers to upgrade to new skills and for personal development. 	<input checked="" type="checkbox"/>	Defining levels of micro-credentials in accordance with NQFs.	Open Source tech based on commonly agreed upon European Standards.	<ul style="list-style-type: none"> - Lack of common recognition frameworks - Lack of visible manifestation of learner benefit - Lack of reference framework to define high demanded skills/competences (expressed in machine readable format) but also mappable - Lack of Job market studies to determine which skills are industry demanded
3	Emergence of innovative business models and processes	Stackable micro-credentials have enabled the adoption of new business models for HEIs professional bodies	<ul style="list-style-type: none"> - Micro-credentials have been provided for a specific job function for a unique group of learners in collaboration with a professional body leading to 	<input checked="" type="checkbox"/>	Building upon existing infrastructure instead of reinventing the wheel	A reliable, portable and secure technical platform for data exchange.	"Lack of opportunities/will to collaborate without a common agenda for fear of own profit cannibalism

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
		(e.g., chambers of commerce), new entrants (e.g., Google, edX), tech-start-ups and associations.	new revenue models. -Shift towards degree programmes done in conjunction with online content providers has been achieved.		-Offering interoperable learning ecosystem (Formal education, non-formal education).		Lack of clear definition and agreements about the roles of the different institutions will play in the Micro-credentials value chain and which will be their revenue streams from the provision and recognition of micro-credentials
4	Mobilisation of increasingly collaborative educational ecosystems	New educational ecosystems have emerged consisting of universities, employers and educational content providers.	-Real-world projects and engagements with employers and the world of work is commonplace -There is a proper process for providing academic credit for experience and learning at work.	<input checked="" type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	A reliable, portable and secure technical platform for data exchange.	- Absence of means of direct collaboration between industry actors and HEIs

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
5	Mechanisms to retain students	Dropout rates are reduced.	- Necessary competence leading to focused and relevant job opportunities has been provided which in turn is effective in preventing dropouts -Learners are allowed to take breaks in their studies and collect credentials as they go	<input type="checkbox"/>	Defining levels of micro-credentials in accordance with NQFs.	Making use of Artificial Intelligence to personalize learning and teaching experience and European-wide trusted platform such as EuroPass, European Blockchain Services Infrastructure (EBSI).	-Nonflexible composition of study programs vs. flexible nature of micro-credentials
6	New approach to enhance average employability	Skill mismatch is decreased, and employability is enhanced.	- Micro-credentials helped in responding to the need to be multi-skilled by being specifically tailored to the needs and requirements of businesses/companies. -Micro-credentials have been used to provide a faster response to changing needs of employment.	<input type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers	European-wide trusted platform such as EuroPass, European Blockchain Services Infrastructure (EBSI).	-Industry Endorsement for skills and competence within the Reference framework (see barrier listed above)

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
7	Mechanisms to improve learners' intrinsic motivation and responsibility	Student motivation, responsibility and determination were increased enabling effective learning.	-Micro-credentials have actively contributed by providing a system for constant, lifelong learning in all contexts. -Micro-credentials are used to respond to the need of flexible and personalised learning.	<input type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	Open badges and other credentialing technologies that enable transparency and recognition.	<i>No barriers were added.</i>
8	Transparency on actual competence achieved	The underlying metadata on skills and competences contained in Micro-credentials has enabled learners to express learning outcomes beyond simple participation certification.	-Employers and other institutions have more visibility on a student's achieved competences beyond a simple view of grades with no information on the mechanisms underneath. -Mechanisms to easily share a student competences on	<input type="checkbox"/>	Defining levels of micro credentials in accordance with NQFs.	Open badges and other credentialing technologies that enable transparency and recognition.	<i>No barriers were added.</i>

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
			various platforms are in place.				
9	Flexible learning opportunities to foster inclusivity	Participation of disadvantaged people is increased through LLL and flexibilization of learning thus, contributing to the well-being of society.	-People who are not in a position to enrol in full degree programmes, due to personal reasons such as work, finances, lack of access etc., are able to use micro-credentials to slowly acquire relevant competences and use them to avail themselves of various job opportunities	<input type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	A reliable, portable and secure technical platform for data exchange.	- Differences in study benefits, costs of studying between countries; general goals of accessing any studies on a large-scale problematic - Differences in Learning Needs (as in Special Educational Needs)
10	Opportunities to upskill and reskill	Students are more prepared for jobs that didn't exist and are able to anticipate future needs (10)	-The high availability of learning opportunities based on micro-credentials offers possibilities to acquire new competences/skills	<input checked="" type="checkbox"/>	National level strategies created in cooperation between	Connecting commercial employment platforms to European educational institutions.	<i>No barriers were added.</i>

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
			considering the rapidly evolving skill demand		ministries, HEIs and employers.		

Scenario 3 HEIs minimally embrace micro-credentials (Minimal Adoption)

Table 4. Scenario 3 HEIs minimally embrace micro-credentials (Minimal Adoption)

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (if any)(Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
1	Changes in curriculum designs	Institutions offer flexible and more personalized learning opportunities.	-Students have access to an extensive curriculum from outside their own university. - Content is aligned to long-term employability and oriented towards individual education goals, interests and needs.	<input checked="" type="checkbox"/>	Including Micro-credentials into Bologna process.	A reliable, portable and secure technical platform for data exchange. Robust built-in MC recognition mechanisms.	<ul style="list-style-type: none"> - Resistance towards Digitalisation - Lack of trust on Micro-credentials - Lack of a trusted list of Micro-credentials issuers - Institutions do not see the benefit of opening up their curricula - Absence of mutual trust between HEIs, especially in an international level - Only few modules/ECTS in the curriculum are suitable for recognizing external learning

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (If any)(Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
2	Quality frameworks to ensure recognition / validation of micro-credentials	Institutions utilize micro-credentials as a means to recognize the skills and competences of learners and teachers.	<ul style="list-style-type: none"> - Development of 21st century skills/ demanded skills in the job market has been supported by having proper recognition mechanisms in place. - Micro-credentials have been used by teachers to upgrade to new skills and for personal development. 	<input type="checkbox"/>	Defining levels of micro-credentials in accordance with NQFs.	Open Source tech based on commonly agreed upon European Standards.	<ul style="list-style-type: none"> - 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 HEI's get involved - Lack of institutional/national approaches to map out the critical skills and competences and align with learning offerings and demands from the market"
3	Emergence of innovative business models and processes	Stackable micro-credentials have enabled the adoption of new business models for HEIs professional bodies (e.g., chambers of commerce),	<ul style="list-style-type: none"> - Micro-credentials have been provided for a specific job function for a unique group of learners in collaboration with a professional body leading to new revenue models. 	<input type="checkbox"/>	Building upon existing infrastructure instead of reinventing the wheel	A reliable, portable and secure technical platform for data exchange.	<ul style="list-style-type: none"> - Lack of opportunities/will to collaborate without a common agenda for fear of own profit cannibalism

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (If any)(Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
		new entrants (e.g., Google, edX), tech-start-ups and associations.	-Shift towards degree programmes done in conjunction with online content providers has been achieved.		-Offering interoperable learning ecosystem (Formal education, non-formal education).		- Reputation of issuing organisations will dominate the market / form monopolies
4	Mobilisation of increasingly collaborative educational ecosystems	New educational ecosystems have emerged consisting of universities, employers and educational content providers.	-Real-world projects and engagements with employers and the world of work is commonplace -There is a proper process for providing academic credit for experience and learning at work.	<input type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	A reliable, portable and secure technical platform for data exchange.	- Absence of means of direct collaboration between industry actors and HEIs - Setting up collaborative educational models requires sufficient members on the level playing field, which will not be the case in this scenario

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (If any)(Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
5	Mechanisms to retain students	Dropout rates are reduced.	<ul style="list-style-type: none"> - Necessary competence leading to focused and relevant job opportunities has been provided which in turn is effective in preventing dropouts -Learners are allowed to take breaks in their studies and collect credentials as they go 	<input checked="" type="checkbox"/>	Defining levels of micro-credentials in accordance with NQFs.	Making use of Artificial Intelligence to personalize learning and teaching experience and European-wide trusted platform such as EuroPass, European Blockchain Services Infrastructure (EBSI).	<ul style="list-style-type: none"> - Learners in the most disadvantaged circumstances will need local support (possibly from community organisations, charities, etc.) to develop the necessary digital literacies. - Strong partnerships will be needed between educational providers and such local organisations if drop-outs are to be prevented. - No single institution feels 'responsible' for retaining students, so students could disappear without being noticed.
6	New approach to enhance average employability	Skill mismatch is decreased, and employability is enhanced.	<ul style="list-style-type: none"> - Micro-credentials helped in responding to the need to be multi-skilled by being specifically tailored to the needs and requirements of businesses/companies. -Micro-credentials have been 	<input type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers	European-wide trusted platform such as EuroPass, European Blockchain Services Infrastructure (EBSI).	<ul style="list-style-type: none"> - Micro-credentials need to contain skill data that is up to date and can be "read" by other systems e.g. of employers - employer would need to understand how to submit skills for validation or request information on new skills

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (If any)(Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
			used to provide a faster response to changing needs of employment.				developed in a certain occupation - in order for employers to fully engage, you need a sufficient critical mass which is not the case in this scenario
7	Mechanisms to improve learners' intrinsic motivation and responsibility	Student motivation, responsibility and determination were increased enabling effective learning.	-Micro-credentials have actively contributed by providing a system for constant, lifelong learning in all contexts. -Micro-credentials are used to respond to the need of flexible and personalised learning.	<input checked="" type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	Open badges and other credentialing technologies that enable transparency and recognition.	- Various platforms to display and claim badges and credentials make it difficult to collect the various achievements into one place
8	Transparency on actual competence achieved	The underlying metadata on skills and competences contained in Micro-credentials has enabled learners to express learning	-Employers and other institutions have more visibility on a student's achieved competences beyond a simple view of grades with no information on the mechanism	<input checked="" type="checkbox"/>	Defining levels of micro credentials in accordance with NQFs.	Open badges and other credentialing technologies that enable transparency and recognition.	- The semantics and competence mappings are very different across organisations and complex systems such as ESCO are difficult to implement with a wide adoption; - open badges may not be viewed as

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (If any)(Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
		outcomes beyond simple participation certification.	underneath. -Mechanisms to easily share a student competence on various platforms are in place.				credible by some providers - Many HEIs were not able to offer robust enough assessment for their micro-credentials to be credible
9	Flexible learning opportunities to foster inclusivity	Participation of disadvantaged people is increased through LLL and flexibilization of learning thus, contributing to the well-being of society.	-People who are not in a position to enrol in full degree programmes, due to personal reasons such as work, finances, lack of access etc., are able to use micro-credentials to slowly acquire relevant competences and use them to avail themselves of various job opportunities	<input type="checkbox"/>	National level strategies created in cooperation between ministries, HEIs and employers.	A reliable, portable and secure technical platform for data exchange.	- Free learning opportunities don't contribute to inclusiveness per se, often the more expensive programs have better job placements available (still today), depending on the skills one wants to learn
10	Opportunities to upskill and reskill	Students are more prepared for jobs that didn't exist and are able	-The high availability of learning opportunities based on micro-credentials offers possibilities to acquire new competences/skills	<input type="checkbox"/>	National level strategies created in cooperation	Connecting commercial employment platforms to European educational institutions.	- High fees of some micro-credentials offers made them unaffordable or unattractive - Stackability doesn't work: HEIs and

#	Category	Impact	Examples of impact realisation (C)	The impact was realised (If any)(Select the ones that were realised)	What made the impact possible (Key drivers)? (Add more drivers if necessary)		What barriers stood in the way but were overcome? (D)
					Policy (A)	Technology (B)	
		to anticipate future needs (10)	considering the rapidly evolving skill demand		between ministries, HEIs and employers.		professional bodies are reluctant to recognize micro-credentials - information problem: learners find it difficult to identify suitable online courses/Micro-credentials

Discussion points for the future scenarios:

The 10 identified impacts were discussed in reference to each scenario in the three groups of experts (1, 2 and 3). Below are some conclusions based on the discussion conducted as part of the analysis of the workshop results:

1: Changes in curriculum design

Impact: Institutions offer flexible and more personalized learning opportunities

Examples of realisation:

- Students have access to an extensive curriculum from outside their own university.
- Content is aligned to long-term employability and oriented towards individual education goals, interests and needs.

Discussion:

A flexible and personalised learning offering using micro-credentials was considered a realisable impact in all the three scenarios, considering the following barriers are overcome:

- The most common barrier identified was a lack of trust within different systems, e.g. Lack of a trusted database of widely accepted micro-credentials, lack of trust between HEIs and an overall lack of trust on Micro-credentials.
- HEIs would need enough incentive (both financial and administrative) to open up their curricula.
- Institutional and regional strategies for implementation of such changes need to be put in place, for e.g. accreditation mechanisms, management and administrative strategy.

2: Quality frameworks to ensure recognition / validation of micro-credentials

Impact: Institutions utilize Micro-credentials to recognize the skills and competences of learners and teachers.

Examples of realisation:

- Development of 21st century skills/ demanded skills in the job market has been supported by having proper recognition mechanisms in place.
- Micro-credentials have been used by teachers to upgrade to new skills and for personal development.

Discussion:

While under scenario 1 and 2 the use of micro-credentials for recognition of skills of both teachers and students was declared as a realisable impact, it was thought to be not likely in the minimal adoption case. The reason the impact remains unrealisable in that scenario is because it requires a large scale collaboration between different stakeholders for an agreement on common frameworks, which is hardly possible in case there are very few

collaborators in the network to begin with (As is the case in scenario 3). Other barriers that were stated and needed to be overcome were:

- Micro-credentials need to be formally integrated into Bologna process.
- Common frameworks were adopted to describe learning outcomes, achievements, etc.
- Common framework to define highly demanded skills and competences (expressed in an interoperable machine-readable format) and recognized by the industry.
- A clear and visible communication mechanism to make learners aware of the benefits of the adoption of micro-credentials.
- HEIs chalk out strategies to map out the skills that are actually required in the market.

3: Emergence of innovative business models and processes

Impact: Stackable micro-credentials have enabled the adoption of new business models for HEIs professional bodies (e.g., chambers of commerce), new entrants (e.g., Google, edX), tech-start-ups and associations.

Examples of realisation:

- Micro-credentials have been provided for a specific job function for a unique group of learners in collaboration with a professional body leading to new revenue models.
- Shift towards degree programmes done in conjunction with online content providers has been achieved.

Discussion:

Participants in all the three scenarios considered this as not only a realisable impact but also as a cornerstone for micro-credential adoption and the overall unbundling process. Open source collaboration on technology and standards was considered as a key barrier that would need to be overcome to achieve this. It would be pivotal to have clear definitions and agreements about the roles different institutions will play in the micro-credentials value chain and the corresponding revenue streams from the provision and recognition of micro-credentials. A common framework and web of trust would be needed to combine micro-credentials from many different providers to create a learning offering (like the ECIU European University project⁸ is doing).

4: Mobilisation of increasingly collaborative educational ecosystems

Impact: New educational ecosystems have emerged consisting of universities, employers and educational content providers.

Examples of realisation:

- Real-world projects and engagements with employers and the world of work is commonplace.

⁸ More information about ECIU University at <https://www.eciu.org/>

- There is a proper process for providing academic credit for experience and on-the-job learning.

Discussion

While under scenario 1 and 2 the emergence of new educational ecosystems was declared as a realisable impact, it was thought to be not likely in the minimal adoption case. The underlying reasons for the latter appear to be the same as discussed in category 2 i.e. low possibility of large-scale collaboration in small networks.

It was unanimously stated that once there was an increased cooperation in areas such as defining the skill requirement in the industry through open dialogue between institutions, employers and Education Content Providers, this impact would be accomplished.

5: Mechanisms to retain students in the higher education ecosystem

Impact: Dropout rates are reduced

Examples of realisation:

- Necessary competence leading to focused and relevant job opportunities has been provided which in turn is effective in preventing dropouts.
- Learners are allowed to take breaks in their studies and collect credentials as they go.
- Learners can enhance their skills profile with new ones obtained through micro-credentials.

Discussion:

This was a realisable impact which could be effective in stopping the devaluation of partial studies and thus, provide students an improved set of options. The non-flexible composition of study programs in most HEIs vs the inherent flexible nature of micro-credentials was considered as one of the key barriers that needed to be overcome in all scenarios. However, allowing students to take breaks in their studies would also require meddling with national legislations related to study time limitations, and will need legislative changes in several participating countries. For the impact to be likely in smaller networks, i.e. scenario 3, it would require strong collaboration between local organisations and HEIs as well as HEIs will be required to take added responsibility for students. Additionally, institutional culture regarding the attention to vulnerable students also needs to be improved to ensure the realization of this impact.

6: New approach to enhance average employability

Impact: Skill mismatch is decreased, and employability is enhanced.

Examples of realisation:

- Micro-credentials helped in responding to the need to be multi-skilled by being specifically tailored to the needs and requirements of businesses/companies.

- Micro-credentials have been used to provide a faster response to changing needs of employment.

Discussion: For scenarios 1 and 2, participants identified a strong correlation between implementation of recommended changes in curriculum design (Category 1) and reduction of skill mismatch. Hence, they suggested the same barriers need to be overcome for the realisation of this impact; overcoming the lack of trust, having proper incentives systems in place and institutional as well as regional strategies to facilitate the process.

It was considered as an unrealisable impact under the minimal adoption scenario due to the lack of sufficient critical mass for employers to engage within a smaller community. The barriers needed to overcome were:

- Employers would need to understand how to submit skills for validation or request information on new skills developed in a certain occupation. Hence, a lack of commonly understood procedures to validate skills or to add new required skills for specific occupation/profession or knowledge domain.
- Micro-credentials need to contain skill data which is up to date and can be read outside of the system they were created in. Hence, a lack of interoperable implementations of reference framework used to define highly demanded skills and competences (expressed in machine readable format) and recognized by the industry.

7: Mechanisms to improve learners' intrinsic motivation and responsibility

Impact: Student motivation, responsibility and determination were increased enabling effective learning.

Examples of realisation:

- Micro-credentials have actively contributed by providing a system for constant, lifelong learning in all contexts.
- Micro-credentials are used to respond to the need of flexible and personalised learning.

Discussion: The participants had a collective opinion that although this could be a realisable impact, future predictions should not overestimate the role of micro-credentials in dealing with learner's intrinsic motivation to learn. It is crucial to take into account a related set of factors required for that to happen such as technological mechanisms and Learning Analytics infrastructure to properly assess levels of learners' motivation.

Other key barriers that would be needed to overcome would be the integration of AI tools with national and institutional systems to guide students towards a pathway suited to them. Such a tool will be reflective of real-life scenarios and hence, will keep students motivated towards the right learning path.

8: Transparency on actual competence achieved

Impact: The underlying metadata on skills and competences contained in micro-credentials has enabled learners to express learning outcomes beyond simple participation certification.

Examples of realisation:

- Employers and other institutions have more visibility on a student's achieved competences beyond a simple view of grades with no information on the mechanisms underneath.
- Mechanisms to easily share a student's competences on various platforms are in place.

Discussion: The participants across all three scenarios considered the use of micro-credentials as a competence transparency instrument provided the following barriers were overcome:

- Different systems being able to 'speak the same language' thus, ensuring interoperability.
- Universal standardisation achieved in metadata.
- Technological infrastructure and procedures to centrally collect and process micro-credentials at HEIs is made available.
- Robust assessment mechanism for micro-credentials to be viewed as credible.

9: Flexible learning opportunities to foster inclusivity

Impact: Participation of disadvantaged people is increased through LLL and flexibilization of learning thus, contributing to the well-being of society.

Examples of realisation:

People who are not in a position to enrol in full degree programmes due to personal reasons such as work, finances, lack of access etc. are able to use micro-credentials to slowly accumulate relevant competences and use them to avail themselves of various job opportunities.

Discussion: Participants agreed that the use of micro-credentials to foster inclusivity is not a realisable impact because of the many barriers that stand in its way irrespective of the scenarios:

- Differences in Learners needs (as in Special Educational Needs) have to be considered on a micro and macro level.
- Technical interoperable infrastructure to support special Educational needs are to be fully developed and implemented.
- The skills and competences developed via micro-credentials are not considered as prerequisites to access HE degrees.
- Improved learning opportunities (via micro-credentials) don't *always* equate to inclusiveness per se. Attitude shifts need to take place on a more holistic scale. Special learning needs require consideration towards a lot of other factors such as equal

opportunity access, an institutional push towards diversity, establishing course content that recognizes diversity and acknowledges barriers to inclusion among others.

10: Opportunities to upskill and reskill

Impact: Students are more prepared for jobs that didn't exist and were able to anticipate future needs

Examples of realisation:

The smaller composition and dynamic nature of micro-credentials has offered the possibility to support new skills/competences according to the rapidly evolving skill demand.

Discussion: Participants considered the use of micro-credentials as a means to improve access to upskilling/reskilling opportunities only when they are widely or at least partially adopted (Scenario 1 and 2). In the case of minimal adoption (Scenario 3) it is only likely in the case of some pioneers within certain departments who volunteer and take responsibility, provided the following barriers are overcome:

- Holistic systems to identify suitable online courses/ Micro-credentials opportunities and then make them visible to learners.
- Guidelines for recognition of micro-credentials and assessment practices.

3. Conclusions

This deliverable reports on a MicroHE WP2 activity that aimed to conduct a future-foresight exercise using a raft of forecasting techniques to map the likely impacts of micro-credentials on HEIs. The future-foresight exercise was done through a Delphi study, which was adapted to the conditions of MicroHE project. The four stages of the Delphi study included a group of experts from across Europe, engaging them in a series of exercises and activities in 2019 and 2020. The findings of the Delphi study were distilled into three potential scenarios of micro-credential adoption in HEIs, illustrating the major impacts and drivers of each potential scenario and the problematics that are likely faced given the scenario becomes a reality. As stated, the likelihood for a certain scenario to become reality depends on a variety of drivers and the completion of actions to overcome barriers hindering the realization of defined impacts.

Micro-credentials have become a pivotal aspect of the conversation surrounding the digital transformation movement targeted towards continuous and lifelong learning⁹. This was also a prevailing theme in the expert discussions throughout the four stages of the Delphi, While experts acknowledge the potential of micro-credentials in supplementing a future landscape

⁹ Resei, C., Friedl, C., Staubitz, T., & Rohloff, T. (2019). Micro-credentials in EU and global.

for higher education that puts learners at its centre, there are certain barriers that would need to be tackled to get there. Some of these barriers can be summarised as follows:

- There is a need for a **common understanding** as well as **awareness** regarding the definition and impact of micro-credentials among different networks involving all kinds of stakeholders from educators and institution management to policy makers and industrial representatives. A general lack of trust between HEIs as they differ on a regional and national basis and an overall lack of trust in micro-credentials needs to be overcome.
- Understanding the role of micro-credentials in the system as it currently is and as it will evolve in the next decade is the first step in this process. It is essential to **identify** where do micro-credentials fit in and convey the results to the intended channels. Hence, **effective strategies** need to be put in place both for understanding the requirement and ways to fulfil them.
- Need for **standardization** has been identified as one of the principal requirements when it comes to accreditation practices and **formalisation** of micro-credentials. Commonly accepted **frameworks** need to be defined and followed such as those linked to defining metadata, learning outcomes, assessment practices, size and workload.
- Enabling **stackability** in micro-credentials might ultimately lead to their acceptance in the formal and traditional higher educational community.
- **Collaboration** is key when it comes to a micro-credential powered future of HEIs. Open dialogue between HEIs, industry actors (Such as future employers and content providers) and government stakeholders regarding issues like defining market skill requirement and providing quality assurance could make a difference
- **Portability** in terms of technology ad recognition practices is what will take a micro-credential strategy across the finish line. There is a need for a technology powered system that is capable of handling, storing, verifying and assessing the data related to micro-credentials in an **interoperable** format. However, a technological breakthrough is only the first step. Its wide scale adoption, technical standardization based on open source principles, implementation and acceptance is also critical.
- Lastly, **an attitude shift** towards understanding the ephemeral nature of skills needed in a continuously metamorphosing world of work characterised by rapid technological advancement is required in the inherently cautious education sector.

Future works include the dissemination of these results and further discussions with different actors related to HEIs and micro-credentials. In addition to this deliverable, the results of the four stages of the Delphi will be compiled into a written report on the future impacts of micro-credentials in Higher Education that will aim at being published in a relevant media for the academic community in the last period of the MicroHE project lifetime.

4. Annex

4.1 Panel of experts

The MicroHE consortium thanks to the following experts for their contribution to the previous stages of the Delphi study.

Expert	Affiliation
Colin Tück	European Quality Assurance Register for Higher Education (EQAR)
Janina van Hees	SURF, Netherlands
Sandra Kucina Softic	The European Distance and E-Learning Network (EDEN)
Rolf Reinhardt	LinkedIn
Chiara Carlino	Cineca
Frederik De Decker	Ghent University
George Ubachs	European Association of Distance Teaching Universities (EADTU)
Airina Volungeviciene	Vytautas Magnus University
Andrea Mangiatordi	University of Milano-Bicocca
Gabi Whitthaus	Lancaster University
Nora Skaburskiene	VGTU, Vilnius Gediminas Technical University
Mykole Lukosiene	Vytautas Magnus University
Kristina Sutkutė	National Quality Assurance Agency for Higher Education in Lithuania
Markus Deimann	FernUniversität in Hagen

Mark Brown	Dublin City University Ireland
Claudio Dondi	independent expert
Aldo Torrebruno	Lab Hoc Politecnico di Milano
Ruben Alves	Reitoria da Universidade de Aveiro
Jari-Pekka Kanniainen	Tampere University
Margarita Tereseviciene	Vytautas Magnus University

4.2 Expert Presentations during the Masterclass held in Bled

Theme 1: Technology powering the future of micro-credentials

[National approach to open badges in higher education](#)

Janina van Hees, Project manager educational innovation with ICT, SURF

[Technology powering the future of micro-credentials: a view on Blockchain and Open Badges for Higher Education](#)

Chiara Carlino, Consultant for Universities, CINECA

[A European Infrastructure for Technology Collaboration](#)

Lluís Alfons Ariño Martín, Universitat Rovira i Virgili, Tarragona, IT Director – CIO & co-Convenor European Blockchain Partnership' Diplomas & Credentials use case

[Artificial intelligence, Blockchain & Analytics](#)

John Domingue, Director of the Knowledge Media Institute at The Open University

[Blockchain for Micro-Credentials](#)

Urban Osvald – 0xcert

Theme 2: Micro-Credentials in the Future European Policy Landscape

[Micro-Credentials for EU Skills and Employment Policies](#)

William O'Keeffe – DG Employment European Commission

[Enabling Collaboration between Universities for Digital Mobility](#)

Joao Bacelar – European University Foundation

[Micro-credentials' contribution to the future labour market](#)

Rolf Reinhardt – LinkedIn Learning

[Open Access through Unbundling](#)

Zeynep Varoglu, Programme Specialist, ICT in Education Knowledge Societies Division Communication and Information Sector, UNESCO

Theme 3: Impacts of Micro-Credentials on Institutional Processes

[Short-Learning Programmes of Common Micro-credential Framework](#)

Piet Henderikx, Senior Executive Advisor at EADTU

[Short-Learning Programmes and their Impacts on the quality system of micro-credentials](#)

Denes Zarka, Director of MTI at Budapest University of Technology and Economics

[Institutional Openness to Micro-Credentialling](#)

Henri Pirkkalainen, MicroHE Project & Tampere University

[Institutional Strategies for Micro-Credentialling](#)

Sandra Kučina Softić, Assistant Director for Education and User Support, University Computing Centre University of Zagreb SRCE, President of Eden

[Supporting Lifelong Pathways through a Credential Infrastructure](#)

Ildiko Mazar, Knowledge Innovation Centre

Theme 4: Impact of micro-credentials on new learner paradigms

[Didactical Innovation through Micro-Credentials](#)

Elena Caldirola, Head of Innovation in Didactics and Digital Communication Unit, University of Pavia

[Quality Assuring Micro-Credentials: A Student Centred Approach](#)

Colin Tück, European Quality Assurance Register

[Stackability for Student-Centred Learning](#)

Maria Sticchi Damiani, Lead Author of the ECTS Users Guide

[Recognising Micro-Credentials](#)

Yasmine Wauthier, NVAO

[Towards Flexible Work-Study Experiences](#)

Jasmina Policnik, Skupnost VSS

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