Micro-credentials in Higher Education: Challenges and Solutions for Lifelong Learning at the University of Maribor

Boštjan Vlaovič[1,*]

[1]*Faculty of Electrical Engineering and Computer Science, University of Maribor, Koroška cesta 46, Maribor, Slovenia*

Abstract

Technological change, demographic shifts, and the green transition are reshaping the labour market, making lifelong learning and flexible educational pathways essential. In Europe, the Council Recommendation on Micro-Credentials provides a framework for short, targeted learning experiences that complement formal qualifications. These micro-credentials certify specific competences and support reskilling and upskilling for a fast-changing environment.

Slovenia integrated micro-credentials into its Higher Education Act, defining them as public documents linked to 1–9 ECTS credits, with clear learning outcomes, assessment methods, and quality assurance procedures. Since 2022, universities have been piloting different approaches. At the University of Maribor (UM), 23 pilot projects have been launched, producing guidelines for the development of short courses. Short courses are categorised as non-accredited or accredited, with accredited ones leading to official micro-credentials published in the UM lifelong learning catalogue.

A central challenge is competence frameworks and classifications' diverse and fragmented nature. To address this, UM is developing a Curriculum Management System (CMS) and the UM Competencies Classification (UMCC), integrating international competency frameworks and classifications. This digital support enables structured descriptions, transparent quality assurance, and alignment between education, societal, and labour market demands.

Keywords

lifelong learning, short courses, quality assurance, micro-credentials, competence frameworks, competence classifications, curriculum management system, course catalog

CEUR-WS.org/Vol-4076/keynote1.pdf

1. Introduction

Technological progress, the green transition, and demographic shifts are reshaping the labour market, making lifelong learning essential. Higher education must adapt, as traditional occupation-based models no longer ensure resilience. Competencies are gaining prominence, and short courses tailored to societal and labour market needs are emerging as key tools.

Despite this, only 40% of European adults participate in lifelong learning [1], while 44% of the global workforce will require re-skilling by 2030 [2]. The EU adopted the 2022 Recommendation on a European Approach to Micro-Credentials to address these challenges, encouraging member states to build flexible, qualification-linked learning pathways.

In Slovenia, coordinated activities began in 2022. At the University of Maribor (UM), 23 pilot projects were launched under the Recovery and Resilience Plan, resulting in the first Guidelines for the Development of Micro-Credentials [3]. UM also contributed to the national Guide for the Development of a Micro-Credentials System [4] and the new Higher Education Act [5]. Additionaly, we participated in the policy lab coordination between Ministry of Higher Education, Science and Innovation, Ministry of Education, Ministry of Public Administration, National Quality Assurance Agency in Higher Education (NAKVIS), University of Ljubljana, University of Primorska, Institute of the republic of Slovenia for

NWISEd 2025, Workshop on Co-Creating New Ways of Information Systems Education, September 10–11, 2025, Maribor, Slovenia

*Corresponding author.

bostjan.vlaovic@um.si (B. Vlaovič)

0000-0002-8401-1465 (B. Vlaovič)

© 2025 Copyright for this paper by its authors. Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).

CEUR Workshop Proceedings ceur-ws.org ISSN 1613-0073

vocational education and training, Employment Service of Slovenia, Public Scholarship, Development, Disability and Maintenance Fund of the Republic of Slovenia and other interested parties.

UM sees micro-credentials as part of its lifelong learning strategy and a mechanism for closer collaboration with business and non-business sectors, enhancing research transfer and creating high-value jobs. Representatives from practice are involved in designing short courses, supported by a unified system of cooperation and external expertise.

The following sections present Policy and Regulatory Frameworks, the University of Maribor's approach to developing short courses, competency management, and the development of the Curriculum Management System, including lessons learned and proposed solutions.

2. Policy and Regulatory Frameworks

2.1. Europe

Within Europe, a growing number of people need to update and improve their knowledge, skills and competences to fill the gap between their formal education and training and the needs of a fast-changing society and labour market. One of the significant challenges facing European businesses and employers is an insufficient supply of relevant skills in the EU labour market. Simultaneously, workers are facing unprecedented changes in how work is organised. In addition, task profiles and skills requirements are changing fundamentally due to the digital and green transitions. There have been calls for education and training systems to become more flexible and to find solutions to deliver more learner-centred, accessible and inclusive learning to a broader range of profiles. An effective culture of lifelong learning is key to ensuring that everyone has the knowledge, skills and competences they need to thrive in society, the labour market, and their personal lives. Micro-credentials could help certify the outcomes of small, tailored learning experiences. They make possible the targeted, flexible acquisition of knowledge, skills, and competencies to meet new and emerging societal and labour market needs. They also allow individuals to fill the skill gaps they need to succeed in a fast-changing environment while not replacing traditional qualifications. They can, where appropriate, complement existing qualifications, providing added value while not undermining the core principle of full degree programmes. Micro-credentials could be designed and issued by various providers in different learning settings (formal, non-formal and informal). The European Skills Agenda [6] announced, among its 12 flagship actions, a new initiative on a European approach to micro-credentials published in Council Recommendation on a European approach to micro-credentials for lifelong learning and employability [7].

2.2. Slovenia

Slovenian Qualifications Framework (SQF) [8] and the Higher Education Act of the Republic of Slovenia [5] define tasks associated with the accreditation of study programmes and higher education institutions. The culture of quality and creation of regulatory frameworks are in line with European development guidelines.

The Higher Education Act defines a micro-credential as a public document certifying the completion of a short course or training. A micro-credential is a record of learning outcomes achieved by an individual through short education and training, expressed in terms of the European Credit Transfer and Accumulation System (ECTS)[9]. Higher education, delivered in the form of officially recognised short education and training programmes leading to micro-credentials by higher education institutions, is in the public interest. A micro-credential shall comprise a minimum of 1 and a maximum of 9 ECTS credits. Short education and training programmes leading to micro-credentials do not constitute the implementation of study programmes, nor the fulfilment of study obligations defined within such programmes. Notably, micro-credentials are not formally included in the Slovenian Qualifications Framework (SOK). Opinions are divided, and the discussion is still ongoing.

At universities, the university senate approves the micro-credentials on the proposal of the relevant faculty body. Each higher-education institution defines its own internal procedures for designing,

approving, and delivering micro-credentials, while aligning them with institutional and national quality assurance frameworks. Institutions must also maintain a self-evaluation system that regularly reviews the implementation, structure, content, revision, and discontinuation of micro-credentials as part of the overall self-evaluation of their educational activities. The procedures for implementing and evaluating short education and training programmes leading to micro-credentials are reviewed on a sample basis during the regular procedures for the renewal of institutional accreditation, carried out by NAKVIS [10].

The mandatory components of a short education and training programme leading to a micro-credential are:

1. the title of the short education and training programme,
2. the study field according to KLASIUS and classification within the SQF,
3. the definition of objectives, competencies, and learning outcomes,
4. credit-rated learning obligations in ECTS, with specified methods and forms of learning activities,
5. admission requirements,
6. methods of assessment,
7. conditions for the award of a micro-credential,
8. the quality assurance mechanism on which the micro-credential is based.

The mandatory components of the public document awarding a micro-credential are:

1. participant's personal details (name, surname, date, place, and country of birth),
2. the title of the short education and training programme leading to a micro-credential,
3. the issuing country,
4. the name of the higher education institution awarding the micro-credential,
5. the name, surname, and signature of the responsible person of the higher education institution,
6. the serial number of the micro-credential,
7. the date and place of issue,
8. the learning outcomes,
9. the workload required to achieve the learning outcomes (in ECTS),
10. the level (EQF, QF-EHEA, and SQF),
11. methods of assessment,
12. the quality assurance mechanism on which the short education and training programme leading to a micro-credential is based.

Officially recognised micro-credentials will be part of public evidence of the Ministry of Higher Education, Science, and Innovation. A record of awarded micro-credentials shall also be maintained.

2.3. University of Maribor

The educational activity currently carried out by the University of Maribor has its roots in higher vocational and higher education. The development of study programmes was initially guided by the local community's needs, gradually expanding to address broader economic and societal demands. The University of Maribor comprises seventeen members, offering 178 study programmes across all higher education levels in engineering, natural sciences, agriculture, medicine, social sciences, and the humanities [11].

Guidelines for developing Micro-Credentials at the University of Maribor [12] align with the Higher Education Act [5]. They constantly evolve and will be updated at the end of 2025 to reflect the latest developments. Within the Agile Development of Education and Micro-Credentials pilot project, we are developing university-wide support for all forms of education, backed by competency frameworks and classifications [3, 13].

Short courses are categorised as follows [14] :

1. Non-accredited short courses without assessment and evaluation of learning outcomes, resulting in a certificate of attendance.
2. Non-accredited short courses with assessment and evaluation of learning outcomes, resulting in a certificate of attendance.
3. Accredited short courses with assessment and evaluation of learning outcomes, resulting in a micro-credential.

Non-accredited short courses without assessment and evaluation of learning outcomes are part of regular staff training and various offerings based on individual employer agreements. These programs already have an established support environment, which will be upgraded to accommodate lifelong learning and the inclusion of external participants.

Non-accredited short courses with assessment and evaluation of learning outcomes, leading to a certificate of attendance, are implemented at UM member institutions. UM member institutions issue certificates in accordance with the standardised certificate template. UM micro-credentials will be issued exclusively for accredited short courses with assessment and evaluation of learning outcomes during the accreditation. All accredited short courses leading to the micro-credentials will be published in the UM lifelong learning catalogue. All participants will be enrolled in the Academic Information Subsystem (AIPS), where information will be managed by the same standards as those valid for the rest of the UM students. With the unique identifier, they will have access to the university infrastructure. Quality assurance and reporting will be carried out per legislation, sectoral regulations, and guidelines for developing micro-credentials at UM.

At the University of Maribor, the recommended minimum scope of a short training program for awarding a micro-credential is 1 ECTS. The number of work hours required by participants is determined by the program developer in accordance with the European Credit Transfer and Accumulation System (ECTS) [9], Criteria for Credit Evaluation of Study Programs under ECTS [10], and the Processes of Internal Management and Quality Monitoring of Study Programs at the University of Maribor [14].

The minimum level of short training programs for awarding a UM micro-credential is level 6 within the European Qualifications Framework (EQF). It is recommended that learning outcomes be defined between 1 and 8, depending on the scope of the short training program. The learning outcome description must include an appropriate verb based on the selected taxonomy (e.g., Bloom's taxonomy). It must be measurable, achievable, and assessable through evaluation and assessment processes.

Mandatory elements to describe micro-credential were extended with the member of the UM that provides the short course, participating institutions, acronym, course coordinator (habilitated teacher), brief description (maximum 1000 characters), link to the list of competencies based on the selected competency framework or competency classification, the language of instruction, level of qualification framework (SOK, EQF, EHEA – European Higher Education Area Framework), KLASIUS P-16 classification (defined at the third classification level, 4-digit code), ISCED-F classification (defined at the first classification level, 2-digit code), grade achieved, grading system, grading scale and unique identifier of the issued micro-credential.

The accreditation of a short course for awarding a micro-credential must reasonably follow the well-established procedures at member institutions of the University of Maribor. The accreditation process is initiated by the Application for Accreditation of a Short Course, along with the curriculum, a statement by the short course coordinator, a financial assessment, and confirmation from the Senate of the member institution.

2.4. Competences

For the successful completion of education, the learner must demonstrate that they have achieved all learning outcomes. Learning outcomes are therefore directly linked to assessment – we must know which learning outcome(s) we are evaluating for every assessment method. We must choose an assessment method that enables us to verify the achievement of learning outcomes, and thus the competences associated with each learning outcome. This also applies to teaching approaches, methods,

and the learning environment. These must be adapted to the target audience to enable the acquisition of the desired competencies. Everything starts with competences, followed by learning outcomes (descriptions of broader competences or several of them), selecting an appropriate learning environment and teaching approaches for the target audience (the same set of competences can be taught using different approaches for different audiences). Based on the learning environment and the learning outcomes, the most appropriate method for knowledge verification and assessment is then selected.

Recognition of prior and non-formal learning, as well as employer acceptance of micro-credentials, must be competency-based. However, competencies are described in highly diverse ways, requiring a coordinated international approach and a shift from occupation-based to competency-based learning. At the University of Maribor (UM), we distinguish between two key concepts: competence frameworks (CF) and competence classifications (CC). Ideally, a global classification would integrate all competencies and be regularly updated, while frameworks would specify required competencies and expertise levels for particular fields.

2.5. Definitions

Although sometimes used as synonyms, skill and competence can be distinguished according to their scope. The term skill typically refers to using methods or instruments in a particular setting and in relation to defined tasks. The term competence is broader and refers typically to the ability of a person to face new situations and unforeseen challenges, to use and apply knowledge and skills in an independent and self-directed way.

Learning and acquiring concepts, principles, theories, and practices results in knowledge. Knowledge is acquired in various environments: in the educational process, at work, and within the private and social life context.

Skills, within the national qualifications framework, refer to cognitive skills (e.g., the use of logical, intuitive, and creative thinking) and/or practical skills (e.g., the use of materials, tools, and instruments).

Competences refer to the ability to apply and combine knowledge and skills in educational, work-related, personal, and/or professional situations. Competences are graded according to the complexity, independence, and responsibility of action [15].

A learning outcome means a knowledge, skill, and competence standardised at a specific qualification level. It is a statement of what a candidate knows, is capable of doing, and is able to decide upon completion of a learning period at a certain qualification level. Learning outcomes may be formulated in relation to courses, programme units, modules, or programmes. In some contexts, learning outcomes can be aggregated into a qualification or level of education.

A qualification is the official result of an assessment and recognition process by a competent authority, which determines that an individual has achieved learning outcomes in accordance with defined standards. A qualification holds value on the labour market, in the formal education system, and in lifelong learning.

2.6. Competences Frameworks

We have identified several hundred competence frameworks across disciplines. Some originate from major professional associations (e.g., IEEE [16], ACM [17]), others from national or international projects. They vary in scope: some systematically map entire professions, others address training needs or specific fields (e.g., tourism). Certain frameworks, like DigComp, also define proficiency levels. Most, however, are not machine-readable and lack international standardisation, creating challenges for interoperability. While AI tools may support harmonisation, human expertise remains essential for developing robust frameworks.

2.7. Competences Classifications

European Commission, run by the Directorate General Employment, Social Affairs and Inclusion, developed European Skills, Competences, Qualifications and Occupations [18] classification. It provides

descriptions of 3,039 occupations and 13,939 skills linked to these occupations, translated into 28 languages (all official EU languages plus Icelandic, Norwegian, Ukrainian, and Arabic). ESCO aims to support job mobility across Europe and, therefore, a more integrated and efficient labour market by offering a "common language" on occupations and skills that different stakeholders in employment, education, and training topics can use. It is available in an online portal and can be consulted free of charge. Its first full version (ESCO v1) was published on 28 July 2017. The latest version of the classification can be downloaded or retrieved via the ESCO API. In the USA, Lightcast offers the Open Skills Library with over 32,000 skills derived from real-world labour market data. Its taxonomy, maintained by experts, provides commercially available skills, though its primary use remains outside Europe.

ESCO applies the same definition of "competence" as the European Qualification Framework (EQF). According to this, "competence means the proven ability to use knowledge, skills, and personal, social, and/or methodological abilities, in work or study situations and in professional and personal development." They are described in terms of responsibility and autonomy.

Our testing within the ATHENA European University project in 2022 revealed limitations: ESCO is incomplete for higher education, overly focused on lower-level skills, and lacks proficiency levels. An additional challenge is the diverse and fragmented nature of CF. To address this, we initiated the development of UM Competencies Classification (UMCC) based on all competencies linked to the learning outcomes of our educational offerings. Professors can select competencies from ESCO, Lightcast, and various competence frameworks from their specific field of work. Additionally, they will be able to propose new competencies based on their research and projects. We aim to use this information to address the detected competencies gap for higher education in the ESCO and actively contribute to its development. To support this significant undertaking, we are developing a Curriculum Management System (CMS) to map learning outcomes to multiple competence frameworks and classifications systematically.

3. Curriculum Management System

Curriculum Management System (CMS) supports agile development of education offerings at UM. Currently, we manage the development of all courses of the Faculty of Electrical Engineering and Computer Science, and all short courses developed at the UM within the project [3]. Description of the course is based on European and national quality standards (Figure 3). The user interface is professor-centred, it supports tracking changes, workflows required by [14], and structuring offerings based on the [5]. The goal is to gradually deploy its use to all members of the UM for all the educational offerings.

By leveraging artificial intelligence, our system enhances the efficiency and accuracy of competency alignment, ensuring better transparency, comparability, and recognition of acquired skills. The professor can link learning outcomes to competencies from selected CF and CC (Figure 3) [19]. All selected competences are linked to the UMCC in the background. We plan to develop a competency editor to support the review process for the proposals for the ESCO upgrades.

4. Conclusion

In Slovenia, every company must maintain a job classification system, which includes formal job descriptions for each position. These descriptions define the expected skills, knowledge, and competencies of employees. To support the identification of gaps between societal and labour market needs and the educational offerings of UM, we plan to develop a job description editor that will not only streamline the preparation and updating of job descriptions but also allow for integration with UMCC and ESCO. This ensures that acquired and required competencies can be described in a structured, comparable, and internationally recognisable way.

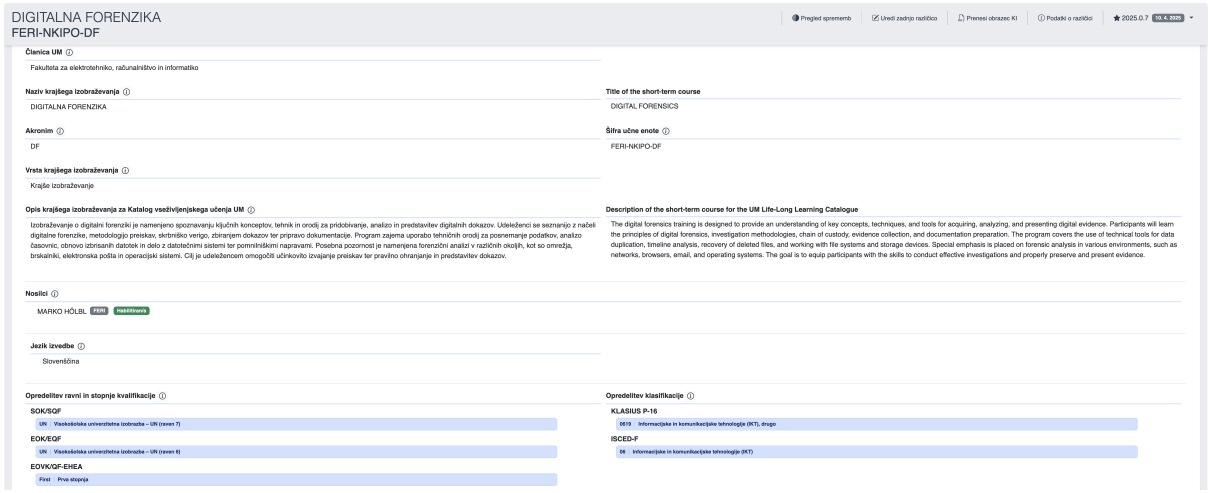

Figure 1: Curriculum Management System - The description of the short course.

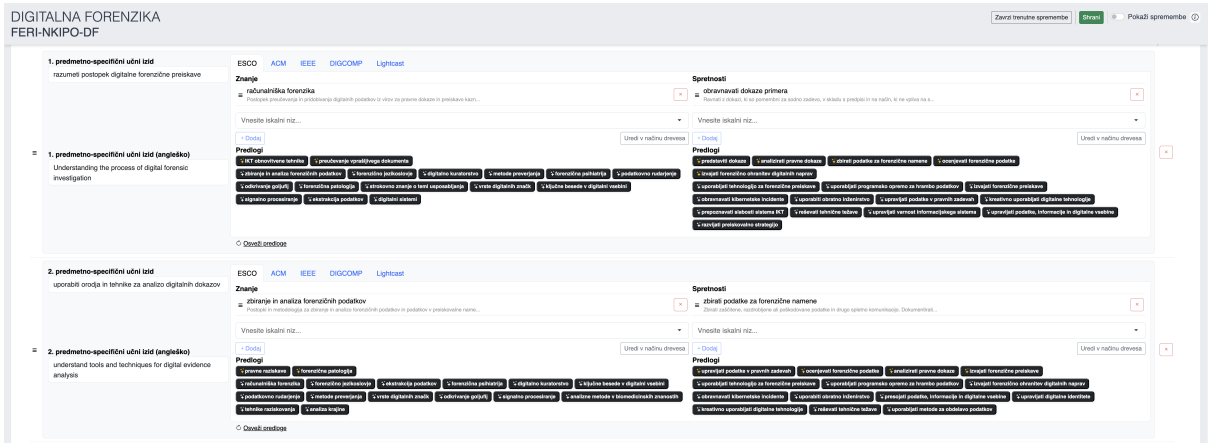

Figure 2: Curriculum Management System - Learning Outcomes and Competences.

We have recognised that digital support is crucial. UM is developing a university-wide platform that integrates competency frameworks, supports accreditation and quality assurance, and includes a catalogue of short courses (Figure 4). Best practices in higher education are followed, but with agile development allowing implementation within three months. Additional projects support micro-credential management through verifiable digital credentials. The success of micro-credentials depends on collaboration with stakeholders, ensuring quality, transparency, recognition, and comparability. Explicitly defined learning outcomes, competences, and shared tools are essential.

Acknowledgments

The Republic of Slovenia, the Ministry of Higher Education, Science and Innovation, and the European Union – NextGenerationEU co-financed the project under the Recovery and Resilience Plan, reference number C3330-22-953012 - NOO.

The author would like to thank all professional colleagues from the Centre for Lifelong Learning, especially the head, Anita Ješovnik. Appreciation is also extended to the head of the Department of Education and Study at the University of Maribor, Sebastijan Frumen. A special acknowledgement goes to the invaluable contributions of Faculty of Electrical Engineering and Computer Science (FERI) colleagues, particularly Miha Strah and Uroš Brglez, for their dedicated work on the Curriculum Management System (CMS).

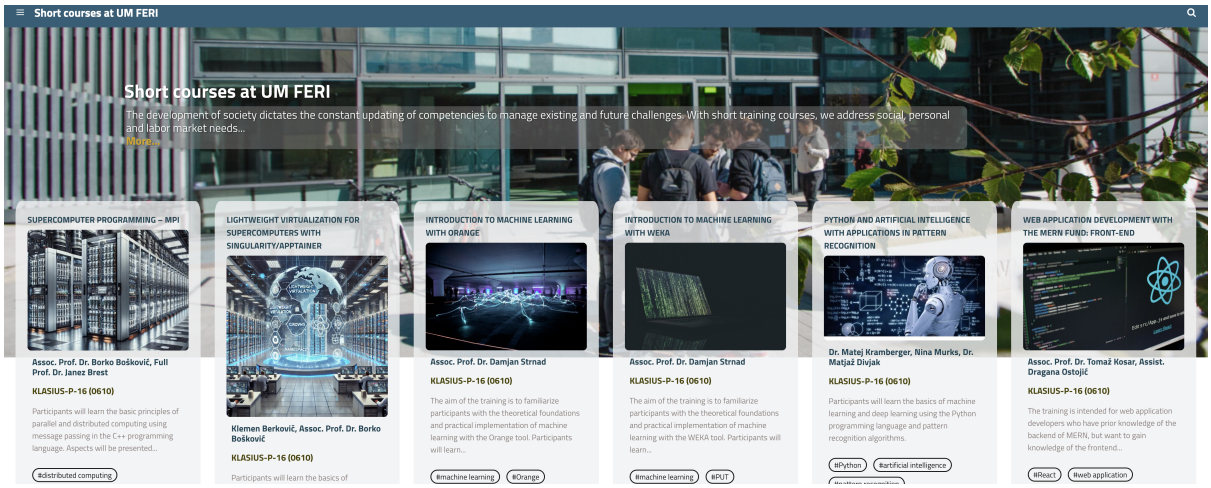

Figure 3: Curriculum Management System - The description of the short course.

Declaration on Generative AI

During the preparation of this work, the author used ChatGPT-5 to check grammar and spelling, translate, generate BibTeX records for some references from plain text, and prepare summaries of longer texts by the same author. After using these tool(s)/service(s), the author reviewed and edited the content as needed and takes full responsibility for the publication's content.

References

[1] Organisation for Economic Co-operation and Development, OECD Skills Outlook 2023: Skills for a Resilient Green and Digital Transition, OECD Publishing, Paris, 2023. URL: https://doi.org/10.1787/27452f29-en. doi:10.1787/27452f29-en.

[2] World Economic Forum, Future of Jobs Report 2025, World Economic Forum Publishing, Switzerland, 2025. URL: https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf.

[3] University of Maribor, Pilot Projects under the Recovery and Resilience Plan (NOO), 2025. URL: https://www.um.si/o-univerzi/pilotni-projekti-noo/.

[4] Ines Gergorić, Guide for the Development of a Micro-Credentials System in Slovenian Higher Education, 2025. URL: https://moja.um.si/vsezivljenjsko-ucenje/Documents/2024.12-Vodnik_za_razvoj_sistema_mikrodokazil_v_Slovenskem_visokem_solstvu.pdf, ministry of Higher Education, Science, and Innovation in collaboration with the National Agency of the Republic of Slovenia for Quality in Higher Education.

[5] Ministry of Higher Education, Science, and Innovation, Higher Education Act (ZViS-1), Official Gazette of the Republic of Slovenia, No. 56/2025 (2265/2025), p. 6520, 2025. URL: https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2025-01-2265, Adopted by the National Assembly on 15 July 2025; published on 25 July 2025; entry into force on 9 August 2025.

[6] European Commission, European Skills Agenda for sustainable competitiveness, social fairness and resilience, 2020. URL: https://employment-social-affairs.ec.europa.eu/policies-and-activities/skills-and-qualifications/european-skills-agenda_en, Communication COM(2020) 274, a five-year plan (2020–2025).

[7] Council of European Union, Council Recommendation on a European approach to micro-credentials for lifelong learning and employability 2022/C 243/02, 2022. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022H0627(02).

[8] Ministry of Higher Education, Science, and Innovation, Slovenian Qualifications Framework Act, Official Gazette of the Republic of Slovenia, No. 104/2015; available via PiSRS (id=ZAKO6958),

2015. URL: https://pisrs.si/Pis.web/pregledPredpisa?id=ZAKO6958, In force from 11 January 2016; effective from 11 July 2016.

[9] European Commission, European Credit Transfer and Accumulation System (ECTS), 2015. URL: https://education.ec.europa.eu/education-levels/higher-education/inclusive-and-connected-higher-education/european-credit-transfer-and-accumulation-system.

[10] National Agency for Quality Assurance in Higher Education (NAKVIS), Criteria for Credit Evaluation of Study Programs under ECTS, 2019. URL: https://www.nakvis.si/wp-content/uploads/2019/11/Merila-za-kreditno-vrednotenje-%C5%A1tudijskih-programov-po-ECTS.docx.

[11] Z. Kačič, D. Mongus, I. Golob, B. Vlaovič, S. Frumen, A. Ješovnik, Educational Activity at the University of Maribor, 50 Years of the University of Maribor: Half a Century of Knowledge and Research, University of Maribor, 2025, pp. 341–379. doi:10.18690/um.1.2025.11.

[12] University of Maribor (UM), Guidelines for the Development of Micro-Credentials, 2024. URL: https://moja.um.si/vsezivljenjsko-ucenje/Documents/2024.01.18-Smernice_za_razvoj_mikrodokazil_na_UM_2.0.pdf.

[13] Office of the Republic of Slovenia for Recovery and Resilience Plan, Ministry of Finance, Recovery and Resilience Plan, 2021. URL: https://www.gov.si/en/registries/projects/the-recovery-and-resilience-plan/about-the-recovery-and-resilience-plan/".

[14] University of Maribor (UM), Processes of Internal Management and Quality Monitoring of Study Programs at the University of Maribor, 2017. URL: https://www.um.si/wp-content/uploads/2022/03/Procesi-notranjega-upravljanja-in-spremljanja-kakovosti-studijskih-programov-na-Univerzi-v-Mariboru.pdf.

[15] Council of the European Union, Council Recommendation of 22 May 2017 on the European Qualifications Framework for lifelong learning (2017/C 189/03), Official Journal of the European Union, C 189, 15 June 2017, pp. 15–28, 2017. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017H0615(01).

[16] Institute of Electrical and Electronics Engineers (IEEE), January 2025 IEEE Thesaurus, 2025. URL: https://www.ieee.org/content/dam/ieee-org/ieee/web/org/pubs/ieee-thesaurus.pdf.

[17] Association for Computing Machinery, ACM Computing Classification System, 2012. URL: https://dl.acm.org/ccs.

[18] European Commission, European Skills, Competences, Qualifications and Occupations (ESCO), 2017. URL: https://esco.ec.europa.eu/.

[19] Vlaovič, Boštjan, Development of Micro-credentials Ecosystem at the University of Maribor, in: Elena Trepul0117 (Ed.), Shaping the Future of Education in the Age of AI: Empowering Inclusion, Innovation and Ethical Growth, EDEN Digital Learning Europe, Bologna, Italy, 2025. URL: https://eden-europe.eu/wp-content/uploads/2025/07/EDEN-2025-AC-Proceedings-2.pdf, EDEN 2025 Annual Conference, 15–17 June 2025.