Societal Impact of Digital Credentials on Vocational Training in Latin America

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Abstract. This paper presents initial results of a pilot project that aims to introduce and sustain the use of digital credentials in Latin America. Digital credentials represent a major innovation, supporting the modular and flexible learning paths necessary for continuous reskilling in today's fast-changing labor market. Latin America can even more benefit from digital credentials, as a vulnerable youth exists that faces heightened barriers to education, employment, and training. However, there are severe challenges to introducing digital credentials in vocational training especially in Latin America, due to legal uncertainties, lack of standardization, limited interoperability, a weak digital culture in institutions, and a fragmented situation of educational institutions. As a solution approach, we have set up a training and awareness programme that introduces key concepts to all relevant stakeholders in the vocational training area in Guatemala, accompanied by pilot implementation for institutional demonstrations. In a survey, young people in Guatemala reacted very positively to this aim of introducing digital credentials and an expert group outlined opportunities and pitfalls.

1 Introduction

In Europe, there is a growing trend towards the adoption of digital credentials (electronic certificates that verify an individual's acquisition of skills or knowledge), serving as digital equivalents of traditional paper-based credentials. While digital credentials require a technological infrastructure for issuance, storage, and verification, they offer clear advantages: enhanced portability, richer documentation of the learning process, and greater trust from employers through reliable, verifiable information (Grech et al., 2021).

Digital credentials represent a major innovation, supporting the modular and flexible learning paths necessary for continuous reskilling in today's fast-changing labor market. Several key European initiatives exemplify this shift, including the European Digital Credentials for Learning (EDC)[25], the European Blockchain Services Infrastructure (EBSI)[26], and the CertiDigital project in Spain[27]. The EU Digital Education Action Plan 2021-2027[28] has also played a vital role in addressing the challenges and opportunities of digital education in Europe. It promotes the development of digitally certified qualifications frameworks, such as the European Qualifications Framework (EQF) and the European Skills, Competences, Qualifications and Occupations (ESCO) framework. The Europass platform, which is compatible with EDC, allows for the issuance and exchange of multilingual, verifiable digital credentials across borders.

In Latin America, while some higher education and vocational institutions have begun experimenting with digital credentials, there is still no unified ecosystem, nor shared standards or legal frameworks to ensure data security, privacy, and interoperability. The lack of government commitment further highlights the need for awareness-building and capacity development within Vocational Education and Training (VET) institutions. To keep pace with global trends, VET institutions must establish robust digital credential ecosystems. Such systems would allow:

- Citizens to build online learning portfolios, apply for jobs or training opportunities using verified credentials, and retain lifelong control over their learning data.
- Training providers to issue standardized digital credentials at lower cost, ensure quality, and improve institutional mobility and credit recognition.
- Employers to quickly authenticate credentials, better understand applicants' competencies, and detect fraudulent or tampered documentation.

Digital credentials can carry rich metadata, including learner identity, training details, learning objectives, theoretical and practical workload, assessment methods, qualification level, and quality assurance procedures (Kemcha et al., 2024). These features enhance the credibility, transparency, and comparability of educational offerings across institutions and countries. Despite these benefits, early implementations in Europe have revealed challenges, including legal uncertainty, lack of standardization, limited interoperability, and a weak digital culture in institutions. Most VET centers

[25] https://europass.europa.eu/en/stakeholders/european-digital-credentials

[26] https://ec.europa.eu/digital-building-blocks/sites/display/EBSI

[27] https://certidigital.uc3m.es

[28] https://education.ec.europa.eu/focus-topics/digital-education/action-plan

currently lack the expertise and internal capacity to design and implement digital credential systems.

These challenges are even more pronounced in Latin America, where educational systems are more fragmented. For this reason, initiatives are critical for laying the foundation for regional digital credential ecosystems, promoting adoption, trust, and collaboration among key stakeholders. This paper reports a pilot project that aims to research and establish a concept, how digital credentials can be introduced in Latin America. After discussing related work on vocational training and digital credentials in the next section, the concept and plan of the pilot project is presented in Section 3. In Section 4 the feedback from different stakeholder groups are presented, which outlines the needs, opportunities, and challenges of introducing digital credentials in Latin America.

2 Related Work and Background

2.1 Vocational Training

In today's world of rapid digitalization, globalization, and climate-related transformation, economies increasingly require adaptable, skilled workers. Traditional education models alone are no longer sufficient to meet these shifting demands (Maclean & Lai, 2011). As a result, vocational education and training (VET) has gained global relevance. These programs promote lifelong learning and equip individuals with practical, occupation-specific competencies often in collaboration with industries (Todd & Dunbar, 2018). While once limited to manual trades and often undervalued, vocational education now spans diverse sectors and contributes significantly to employability (Miller, 2024). Around 80% of jobs worldwide require vocational skills, prompting many countries to invest in VET as a way to facilitate economic growth by strengthening employability, especially for marginalized groups (Maclean & Lai, 2011).

Depending on the geographical location, VET slightly differs in terms of its realization, and therefore the terminology also varies by region. For example, in Europe we speak of vocational education and training (VET), while in the USA career and technical education (CTE) has become established. However, all these expressions refer to the same field. VET can therefore be defined as 'education and training which aims to equip young people and adults with knowledge, skills and competences required in particular occupations or more broadly on the labour market' (Erasmus+ Programme Guide, n.d.)

Many national vocational training authorities (VTAs) aim to strengthen ties between training providers and industries, enhancing economic impact (Angélica Ducci, 1997). Because informal training is the most established form of vocational education, many

Latin American nations aim to recognize informal apprenticeships to improve certification accessibility (Suescún Barón et al., 2024).

In the Latin American context, the COVID-19 pandemic amplified pre-existing disparities, particularly among vulnerable youth who face heightened barriers to education, employment, and training. Although Technical and Vocational Education and Training (TVET) systems across the region have made efforts to integrate digital skills into their curricula, a significant mismatch persists between the availability of digital training and the inclusion of marginalized populations. Recent studies by the International Labour Organization (ILO) highlight that, while enrolment of vulnerable youth has increased, their sustained participation and success are often hindered by recruitment challenges, entry barriers, and insufficient institutional support (Morales et al., 2022). Countries across the region are implementing policies to modernize vocational training systems, strengthen quality assurance mechanisms, and incorporate digital and green skills aligned with future labor demands (Prada & Rucci, 2023; Hirsch 2025).

Guatemala provides a valuable case study in this regard. The Instituto Técnico de Capacitación y Productividad (INTECAP) stands out as a national institution that has modernized its vocational training model by incorporating digital competencies, industry-aligned certifications, and decentralized strategies to improve access across diverse territories. INTECAP's approach reflects a comprehensive model that combines technical excellence with responsiveness to labor market trends (Cinterfor/ILO, 2001). Nonetheless, the challenge of reaching Guatemala's most vulnerable youth—particularly those in rural and indigenous communities—remains significant and requires deliberate strategies and targeted support systems.

In parallel, Fundación Kinal exemplifies how non-governmental organizations can complement national efforts by offering vocational training rooted in ethical values, personal development, and social responsibility. Kinal's programs focus on youth from low-income backgrounds, providing technical training and job readiness skills in partnership with private sector stakeholders. Such institutions play a key role in filling gaps left by formal education systems, not only by promoting employability but also fostering social inclusion and upward mobility.

Across the region, the successful integration of vulnerable youth into digital and vocational education systems requires inclusive institutional mandates, the incorporation of 21st-century competencies into curricula, stronger teacher training initiatives, and enhanced inter-institutional coordination. As the ILO emphasizes, policy frameworks must evolve from broad-based access to more targeted interventions that reflect the lived realities of young people navigating economic precarity, informal labor markets, and limited digital access (Morales et al., 2022). The evolving nature of work in Latin America calls for integrating soft skills, digital literacy, and environmental awareness into vocational curricula (Salazar-Xirinachs & Vargas, 2017; Amado-Salvatierra, Morales-

Chan, Hernández-Rizzardini, 2024). As such, vocational education in the region is increasingly viewed not only as a means of immediate job placement, but as a cornerstone of lifelong learning and sustainable development.

2.2 Digital Credentials

Digital credentials are electronic representations of learning outcomes and achievements, encompassing a broad spectrum such as digital certificates, badges, micro-credentials, macro-credentials, and verifiable credentials (Kato et al., 2020; AACRAO, 2022). Despite ongoing inconsistencies in terminology and overlaps between related concepts (Brown et al., 2021; Keevy & Chakroun, 2015), the shared characteristic of digital credentials is their digital format, which allows for secure storage, efficient transmission, and automated verification (Brands, 2002). At their core, digital credentials represent a shift away from traditional paper-based documentation towards systems that promote trust, portability, and authenticity through digital technologies (Foshay & Hale, 2017). They mark an evolution in how qualifications, competencies, and skills are recorded and shared, offering interoperable and secure solutions that are increasingly applied across various sectors, including education and training (Quigley, 2023; UNESCO, 2022).

The technical ecosystem of digital credentials involves several key roles: issuers (such as universities or certification bodies), holders (individuals who receive and store credentials), and verifiers (institutions or employers who check their validity) (World Wide Web Consortium, 2024). A credential typically goes through a lifecycle starting with issuance, followed by storage, sharing, verification, and potentially revocation (Gräther et al., 2018; Sedlmeir et al., 2021). This process is underpinned by a set of technological foundations that make digital credentials reliable and secure (Mühle et al., 2023). At the heart of the digital credential infrastructure are cryptographic technologies. Digital signatures ensure that a credential has not been tampered with and confirm its origin (Katz & Lindell, 2007). Public Key Infrastructure (PKI) and asymmetric encryption allow secure communication and authentication of identity (European Union Agency for Cybersecurity, n.d.). Additionally, emerging technologies such as Zero-Knowledge Proofs enable privacy-preserving verification by allowing credential holders to prove claims without revealing all underlying data (Goldreich et al., 1986). Another critical concept is Self-Sovereign Identity (SSI), which enables individuals to control their own digital identities and manage their credentials independently, often using Decentralized Identifiers (DIDs) (Preukschat & Reed, 2021; World Wide Web Consortium, 2022a). Moreover, blockchain and other distributed ledger technologies (DLTs) play a central role in making credentials tamper-evident and publicly verifiable without relying on a central authority (Narayanan et al., 2016; Yli-Huumo et al., 2016; Grech & Camilleri, 2017).

Two major international standards structure the implementation of digital credentials: The Open Badges standard, developed initially by Mozilla in 2012 and now maintained by

1EdTech, and the W3C Verifiable Credentials (VC) standard, maintained by the World Wide Web Consortium (W3C). Open Badges define a portable digital credential, originally designed exclusively as a visual badge embedded with metadata about the issuer, recipient, learning outcomes, criteria, and evidence. These badges are used across various sectors for both formal and informal learning. Until version 2.1, Open Badges were typically encoded in JSON and often embedded in PNG image files for easy sharing and display on digital portfolios or social media. Over 40 million Open Badges have been issued globally, providing a standard way to represent and communicate skills and achievements (1EdTech, 2024; UNESCO, 2018). In contrast, the W3C Verifiable Credentials standard offers a more technical and decentralized model focused on secure, privacy-respecting credential exchange. A Verifiable Credential (VC) enables cryptographic proof of authenticity and integrity and supports Self-Sovereign Identity (SSI) frameworks. It allows for selective disclosure, giving the holder control over which parts of the credential are shared with a verifier. Each VC involves three roles: issuer, holder, and verifier, with verification performed through cryptographic proofs without requiring a central authority. While the use of blockchain is optional, it can support functions such as credential revocation and timestamping, therefore enhancing transparency (W3C, 2022b; 2024). VCs are increasingly adopted in high-stakes domains such as academic qualifications, identity verification, and professional certifications.

Originally, these two standards had different technical architectures and goals: Open Badges focused on motivating learners and recognizing achievements in accessible and visual formats, while Verifiable Credentials emphasized security, privacy, and interoperability for scalable digital trust ecosystems (Lemoie, 2024, 2025). However, with the release of Open Badges 3.0, this gap has been closed. Open Badges 3.0 is now fully compatible with the W3C Verifiable Credentials Data Model v2.0 and the previous version v1.1 (IMS Global, 2025). It retains the core structure and use cases of Open Badges (e.g., skills recognition, portable evidence of learning) but is implemented as a Verifiable Credential using JSON-LD, Decentralized Identifiers (DIDs), and cryptographic proofs (IMS Global, 2025; Lemoie, 2024, 2025).The VC Data Model thereby provides the structure for every process in the lifespan of a VC, whereas credential-type-specific schemas function as standardized templates that define how particular types of achievements are represented and understood within that structure (IMS Global, 2025). Therefore, the convergence of both standards makes it possible to have a unified, open, and trustworthy digital credentialing ecosystem, where the respective advantages are combined.

The development and implementation of digital credentials are advancing rapidly worldwide. In Europe, several strategic frameworks and infrastructures have been established. Notable among them is the European Digital Credentials for Learning (EDC) system, which builds on the Europass initiative to create interoperable and trusted formats for issuing and verifying digital diplomas and certificates across borders

(European Commission, 2020, 2023). The European Blockchain Services Infrastructure (EBSI) provides a decentralized framework for secure credential exchange, while legislation like the GDPR and the eIDAS Regulation ensures data protection and legal validity for digital signatures and trust services (EUR-Lex, 2016; European Commission, 2024).

In Latin America, developments are more decentralized but show strong momentum. Universities in countries like Mexico, Chile, Argentina, and Peru are issuing digital credentials for academic and extracurricular achievements (Tecnológico de Monterrey, 2023; Universidad de Chile, n.d.; Pontificia Universidad Católica del Perú, 2024). Additionally, national vocational training institutions in countries such as Brazil and Colombia have implemented blockchain-based credentialing systems (SENAI, Confederação Nacional da Indústria, n.d.; SENA, 100.000 Strong in the Americas, 2024). The Inter-American Development Bank (IDB) is also a key driver in the region, promoting digital badges and micro-credentials for upskilling and regional mobility (Porto & Presant, 2023).

Despite the rapid progress and the many opportunities digital credentials offer, several challenges remain. Privacy and data security must be carefully managed, particularly when sensitive personal data is involved. Moreover, broad adoption across sectors and regions will require trust in the issuing authorities, the technical systems used, and the long-term viability of the infrastructures (Mühle et al., 2023). Digital credentials represent a transformative development in how learning, skills, and qualifications are documented, recognized, and exchanged. The combination of technological innovation, legal frameworks, and institutional collaboration is paving the way for more equitable, efficient, and learner-centered education and employment systems worldwide.

2.3 Role of AI in the Context of Learning Content and Digital Credentials

Generative Artificial intelligence is impacting all aspects of our life and work. Does it also play a role in the context of microcredential courses and digital credentials? Let us define a framework for the design and deployment of microcredentials covering from specification to learning opportunity and to certification (see Fig. 1).

Figure 1: Microcredential Framework with one learning opportunity and certification

The specification describes the knowledge and skills that are going to be transmitted in the course, together with a description of activities and assessment formats. The specification is useful for course catalogues. A learning opportunity is a concrete

instantiation of this specification that takes place at a particular time and place with concrete teachers, students, and learning material, activities, and assessments. The certification is a claim of the achievements of one particular learner in one opportunity. There is one-to-many relationship among these concepts: the same specification can be used for several learning opportunities, and one opportunity implies the issuing of several certificates, one for each learner describing their achievements (see Fig. 2).

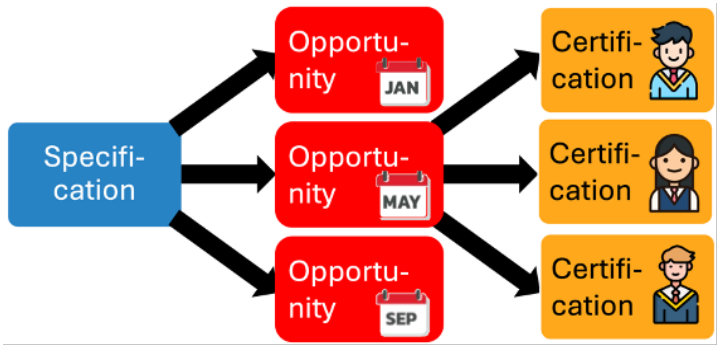

Figure 2: Microcredential Framework with multiple learning opportunities and certifications

Let's dive into the details of the opportunity. The educational material has to be prepared following the specification. This might include the preparation of text documents, videos, podcasts, pictograms, mind-maps, exams, and more. Then, the enactment comes with the teacher teaching the class and the learner following the class (which could be in presence or online). Finally, the learner must do some work, individually or in groups, to assimilate the content and do the assessments.

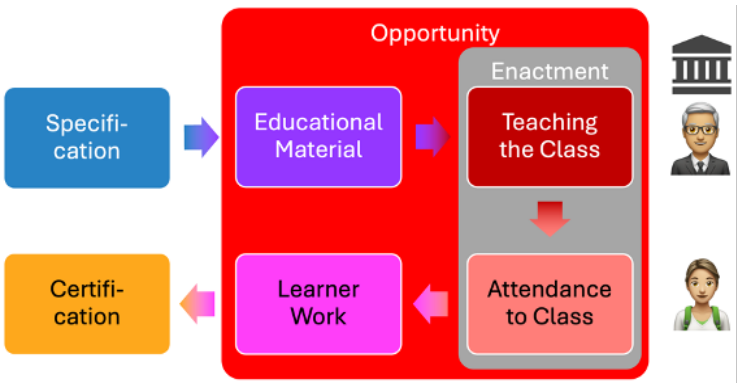

Fig.3: The learning opportunity process in detail

Once this framework is defined, the question is where can we apply Artificial Intelligence? The short answer is everywhere. Let's give some examples of the role AI can play in each of these 6 boxes. More information can be found in Delgado Kloos et al. (2025).

Specification. There are several classifications for defining skills and competences. For example, ESCO (esco.ec.europa.eu) defines close to 14,000 skills. Lightcast

(lightcast.io/open-skills) has also a rich taxonomy with more than 33,000 skills. AI can help in providing its first proposal for filling out a specification.

Educational Material. It is well-known that AI can help to prepare material in all formats: text, images, audio, video, etc. The technology has advanced so much that it is even possible to create videos with an avatar of teachers or translate their audio to other languages with voice cloning and lip synchronization. See for instance the MOOC 'Insegnare con l'AI: Strumenti'[29], which was recorded in Spanish but is shown in Italian (Fig. 4).

Fig.4: MOOC 'Insegnare con l'AI: Strumenti' that has been translated to Italian language.

Teaching the Class. When teaching a class, it is necessary to orchestrate activities to achieve maximum engagement of the students. AI tools can give useful recommendations building upon the rich literature in education and pedagogy.

Attendance in Class. Specific applications like StudyFetch (studyfetch.com) can help in transcribing the live lecture of the teacher so that the learner can later ask specific questions for clarification or even request quizzes on the material explained.

Learner Work. Multiple bots have been developed that help tutor learners on specific courses, such as Khamigo (khanmigo.ai), Duolingo Max (en.duolingo.com/help/what-is-duolingo-max), or CharlieBot at UC3M (uc3m.es/sdic/en/servicios/charliebot). But without going so far with specific developments that use RAG (Retrieval-Augmented Generation), it is possible to use general-purpose AI tools such as NotebookLM (notebooklm.google) and upload the educational material (PDFs, websites, Youtube videos, etc.) to specialize the responses to this material. Student forums such as David Malan's AI Duck (Liu et al. 2025) help students by adding an AI to the participants of the forum.

Certification. Certification or credentialing is closely related to specification. Both describe the learning opportunity in an abstract way, the specification focusing on the

[29] http://federica.eu/esplorare-ia

overall learning goals (or intended learning outcomes) for all and the certification on the concrete learning outcomes achieved by each learner. To achieve interoperability across systems, digital credentials are coded into particular formats, such as EDC (European Digital Credentials) in the context of ELM (European Learning Model) defined by the European Commission[30] or OpenBadges as maintained by 1EdTech (1EdTech, 2024). We know that AI is becoming increasingly better at coding. Therefore, the role of AI in digital credentialing is not only in helping fill out the necessary fields, but also in presenting them neatly in tabular form for human inspection or in one of the digital formats for interoperability (Delgado Kloos et al., 2025).

We have seen that there are multiple places in the context of microcredentials where AI can play a supporting role. However, one should use AI thoughtfully. There are many dangers and issues which are still unresolved.

3 Erasmus+ Project EcoCredGT

Digital Credentials are increasingly viewed as valuable tools for recognizing learning and competencies in formal and non-formal education contexts. From the perspective of educational researchers, digital credentials are seen as mechanisms to help learners evidence specific skills, reflect on personal development, and gain a competitive advantage in the labor market (Miller et al., 2017). This section presents the Erasmus+ project EcoCredGT (ecocredgt.org) that aims to set up a training and awareness programme introducing key concepts to all relevant stakeholders in the vocational training area in Guatemala, accompanied by pilot implementation for institutional demonstrations. The training concept and pilot implementation includes the whole cycle of creating learning content that is deployed as training units, followed by issuing digital credentials for mastering the units. Details on digital credentials, creation of training units, and vocational training as explained in the last section serve as foundation for this course. Before describing the training concept, the overall aim of the project is presented in the next subsection.

3.1 Project Goals

The project aims to build capacity in Vocational Education and Training (VET) institutions by fostering a digital credentials ecosystem that positively impacts employability. This ambitious global goal is broken down into five specific objectives:

1. To strengthen the capacities of VET institutions in driving digital transformation.

[30] http://europass.europa.eu/en/stakeholders/european-digital-credentials

2. To develop a replicable model for a digital credential issuance center that can be adopted by other VET institutions.
3. To implement pilot projects for vocational and professional training micro-courses that enhance employability, issuing the corresponding digital credentials for those learners who complete these courses.
4. To create a stronger connection between VET institutions and society by raising awareness of the value of digital credentials and updating training programs to meet the challenges of the Fourth Industrial Revolution.
5. To establish an observatory of digital credential issuance centers that fosters a community for sharing best practices, success stories, and training across the region.

The Erasmus+ project is implemented in Guatemala, with the leadership of two educational institutions: Fundación Kinal and Universidad Galileo. The project also includes two European partners with strong research experience in the field of educational technology: Universidad Carlos III de Madrid (Spain) and Graz University of Technology (Austria). The model for a digital credential issuance center is expected to be replicated in other countries in the Latin American region and to raise awareness of the need for the adoption of digital credentials in the region through the observatory.

3.2 Project Implementation

Based on the goals listed above and aligned with the overarching vision, the project conducted a comprehensive exploration of the global landscape of the digital credential scene and has carried out a detailed self-diagnostic analysis within its partner institutions in Guatemala. This study has not only mapped international best practices but has also identified institutional strengths and capacity gaps among the participating VET institutions.

These efforts have been fundamental in defining the roadmap for the design and implementation of a comprehensive Multilevel Training Plan, carefully tailored to the specific profiles and needs of the diverse actors involved in the digital credential ecosystem. The program targets four primary groups: (a) administrative and technical staff, who are central the operational deployment of credentialing platforms and require training in standards such as Open Badges and digital issuance tools; (b) educators, who must master the design of learning outcomes, assessment criteria, and credential metadata to ensure meaningful certification of competencies; (c) students, as the primary beneficiaries, who will engage with courses that certify transversal and technical skills enhancing their employability; and employers, whose awareness and endorsement are critical for the labor market acceptance of credentials, and who are invited to integrate them into hiring processes. By identifying institutional needs, contextual constraints, and

global benchmarks, the project has developed a differentiated training strategy that ensures relevance, accessibility, and scalability for each stakeholder group.

The Multilevel Training Plan is structured in three main modalities: (a) Webinars, (b) Massive Open Online Course (MOOC), and Hybrid workshops. This level approach (see figure 1) ensures that participants not only acquire theoretical knowledge but also develop the practical competencies necessary for implementing and sustaining digital credentialing processes within their respective institutions and professional environments.

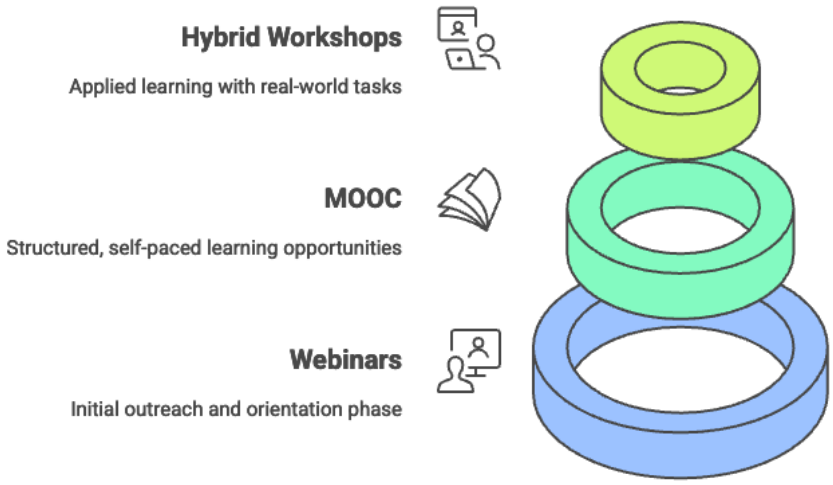

Fig.5: Multilevel Training Plan targeting four primary groups

(a) The Webinar series: composed of four executive format sessions serves as the initial outreach and orientation phase. These two-hour events are strategically designed for high accessibility and minimal time commitment, allowing a broad audience to quickly engage with core ideas. Each session targets a distinct stakeholder group: educators, technical and administrative staff, and employers. The first webinar provides from the introduction to digital credentials, covering key topics such as the evolution from badges to certificates, the transition from OpenBadges to the European Learning Model, the fundamentals of micro-credentials, and examples from global implementations. This second webinar will continue the work started in the State of the Art analysis. We will explain the technical ideas behind digital credentials in a simple way. The session will also show how credentials are created and shared, using real examples to help participants understand their practical use. In this third webinar, we will explore two main approaches to implementing credentialing systems: in-house implementation, where institutions use their own infrastructure to manage the process; and the use of external service providers, which offers benefits such as interoperability, scalability, and alignment with international standards. In the last webinar, we will discuss employers' perspectives on digital credentials, the potential benefits they see in adopting these systems, and what

this means for job seekers and students. The session will highlight how digital credentials can enhance employability, improve talent matching, and support lifelong learning.

(b) The MOOC: expands on these foundations, offering structured, self-paced learning opportunities designed to deepen and consolidate the knowledge introduced in the webinar series. Our MOOC will follow a modular structure, with weekly units composed of short instructional videos, learning activities, and formative assessments. Each unit will include clearly defined learning objectives and culminate in the production of applied learning activities and a final integrative project, aligned with internationally recognized credentialing standards.

Considering that the success of a MOOC is largely dependent on the level of student engagement and sustained participation (Hernandez et al., 2014), we have integrated the use of artificial intelligence tools to enhance the instructional design and foster a more meaningful learning experience. These kinds of technologies will support the creation of high-quality and adaptive educational resources, helping participants remain motivated and actively involved throughout the course. Specifically, AI tools will be employed to generate multimedia content tailored to diverse learners profiles, provide real-time feedback on assessment and learning activities through conversational agents capable of guiding participants through complex topics and answering frequently asked questions. In addition, reflective learning prompts, automatically generated by AI, will encourage students to connect course content with their own professional goals and real-word contexts. These strategies aim to create a more interactive and responsive learning environment, aligned with the pedagogical principles of engagement, relevance, and autonomy.

(c) The hybrid workshops: combining face to face sessions with online components. These workshops serve as applied learning spaces where participants engage in real-world tasks, including the technical issuance of credentials, integration into LMSs, and adaptation to institutional processes. In collaboration with international experts from UC3M and TU Graz, as well as local specialists, these workshops will address both global best practices and contextual challenges in Guatemala. Through case studies, demonstrations, and hands-on exercises, participants gain practical experience with digital credential systems, reinforcing their confidence and competence.

The implementation strategy also includes targeted outreach to employers, highlighting how digital credentials can enhance recruitment processes, improve talent matching, and contribute to a culture of lifelong learning.

4 Stakeholder Perspectives

The last section describes the training and implementation concept of how to introduce digital credentials in Guatemala. Though they become more and more integrated into formal and informal learning environments in some parts of the world, it is important to understand how various stakeholders perceive their value, utility, and limitations in the regional setting of Latin America. This section investigates distinct perspectives shaped by practical experience and expectations of students and experts that also need to be considered for the implementation of a digital credentialing ecosystem.

4.1 Students´ Perspective

Previous research has shown that students value opportunities to demonstrate their skills and achievements and to distinguish themselves from other candidates in competitive educational or employment contexts (Miller et al., 2017; Kiiskilä et al., 2023). Digital credentials, by making learning outcomes visible, verifiable, and portable, appear to align well with students' growing interest in flexible, skill-based recognition systems. For learners navigating increasingly complex educational and labor market environments, digital credentials offer a chance to document not only formal qualifications but also informal and non-formal competencies, thereby expanding their ability to signal expertise and readiness to employers.

To better understand students' acceptance of digital credentials in practice, we conducted a survey among students from Kinal, a vocational training institution that is a partner in the EcoCredGT project. An online questionnaire was administered to 113 male students that enrolled in five different vocational programs at Kinal. The students' ages ranged from 17 to 20 years with a mean of 17.9 years (SD = 0.57). The questions measured their perceptions of digital credentials, focusing on their intention to adopt them, the perceived utility for their careers, and any associated concerns.

The majority of students (81%) expressed a willingness to accept both paper-based and digital credentials, while only 5% preferred exclusively paper certificates and 13% would only opt for the digital credential. Students reported high confidence in their ability to effectively use new technologies and to handle digital credentials well in the future. Moreover, high ratings were given for the interest in receiving digital credentials to document their skills and achievements, to apply for jobs, and to support their career in general (see Table 1).

Factor	M	SD
Perceived ability to use new technologies effectively	4.38	0.70
Perceived ability to handle DCs well in the future	4.35	0.73
Interest in receiving DCs to document skills and achievements	4.47	0.78
Interest in DCs to use them for job applications	4.47	0.76
Perceived overall usefulness for career	4.53	0.70
Perceived cost (e.g. time, effort, resources)	4.35	1.00

Tab. 1: Mean rating scores (n=113). Note. For each factor the degree of agreement was measured on a Likert scale from 1 (not at all) to 5 (very).

Despite this overall positive reception, some students acknowledged potential challenges. The average perceived cost that needs to be invested to make digital credentials useful for oneself - defined in terms of time, effort, and resources - was moderate (see Table 1). A minority of students (12%) expressed specific concerns. On a personal level, these included confusion about the concept and functionality of digital credentials in general, or future disadvantages if people chose not to adopt them. At the institutional or systemic level, students raised issues related to data security, the recognition of previously earned certificates, and uncertainty about whether educational institutions or employers would value digital credentials. Additionally, concerns were voiced about the comparability and standardization of digital credentials across different settings, highlighting the need for clearer communication and institutional support to build trust in digital certification systems. Additionally, cost - both financial and in terms of effort - was perceived as a potential barrier by some respondents.

4.2 Experts´ Perspective

A panel discussion with four experts from different academic and professional backgrounds - STS, computer science and education - was conducted to gain broader insights into the potential and limitations of digital credentials. In detail, the involved people are affiliated with the Science, Technology and Society Unit at TU Graz (male), the Interdisciplinary Research Center for Technology, Work, and Culture (IFZ) in Graz (female), the Galileo University in Guatemala City (male) and the Universidad Carlos III de Madrid.

The panel highlighted the potential of digital credentials to expand access to education by recognizing smaller learning units and informal learning experiences. This modular

approach was described as an alternative to traditional, long-term educational programs and may facilitate participation among groups who are typically underserved by formal education systems. Digital credentials were seen as means to validate vocational and skill-based learning, particularly in contexts where such competencies often remain uncertified. The flexibility and portability of digital credentials were emphasized as key features that can support learner mobility and lifelong learning across institutional and national boundaries. Additionally, digital credentials were discussed as part of broader socio-technical transformations in education. Their implementation requires not only technological infrastructure but also alignment with institutional practices, cultural norms, and learner expectations. Overall, a great potential was seen for microcredentials in and for developing countries to support and train underprivileged groups.

Despite their potential, a number of critical challenges were raised. The importance of incorporating more diverse perspectives was emphasized as a key area for further attention. Furthermore, holders of digital credentials often wish to display their achievements publicly - such as on social media or professional networking platforms - to demonstrate their achievements. However, the visibility of such credentials may be influenced by the business models of these platforms, which often prioritize content from users who pay for premium features. This raises concerns about digital exclusion, as not all users can afford or access such visibility-enhancing options. Consequently, digital credential ecosystems must be designed to be open, fair, and resilient, avoiding over-reliance on a few commercial platforms that may amplify inequalities rather than reduce them. Other concerns included the recognition of digital credentials by institutions and employers, the comparability of credentials across systems and regions, and issues related to data privacy and digital security. Additionally, while digital credentials may reduce certain barriers to participation, the initial implementation of such systems could unintentionally exclude some groups, if they don't have access to the required digital technology. This tension between the goal of inclusivity and the realities of staged implementation was acknowledged as a challenge requiring ongoing reflection and adjustment.

Looking ahead, the experts agreed that the development and adoption of digital credentials must be approached as a dynamic and iterative process. Future efforts should prioritize broader inclusion by engaging underrepresented groups, addressing access and usability issues, and fostering trust through transparency and institutional support. This includes the incorporation of clear standards for credential recognition, user-friendly platforms, and supportive policies that encourage uptake among learners and employers. Moreover, the panelists emphasized that digital credentials should not be viewed solely as technical solutions but as components of a broader educational and social ecosystem. Their success will depend on continuous dialogue between educators, technologists, learners, and policymakers and on a shared commitment to ensuring that digital innovation supports equity, accessibility, and meaningful learning.

5 Discussion and Limitations

The last section provided an impact analysis from the perspectives of students and experts. The findings from the Kinal student survey indicate strong interest and acceptance of digital credentials, particularly with regard to their potential to support career development. Also the experts highlighted the potential of digital credentials for supporting learner mobility and lifelong learning across institutional and national boundaries.

However, both students and experts also raised some concerns. First, students and experts had some doubts regarding data privacy and digital security. In fact, as described in Section 2.1 digital credentials are designed in a way that they provide high security standards, independent if implemented centralised or decentralised. The training units created for students, educators, and administration and technical staff also include information about digital security to clarify issues on data protection.

Second, students and experts questioned the sustainability of digital credentials, as they were not sure if they are recognised by institutions and employers across systems and regions. Again, Section 2.1 presents various frameworks and standards related to digital credentials, which is also included in the training units for operators and administrative staff. This is an attempt to raise awareness for the importance of standards to ensure interoperability and sustainability of credentials. However, it is out of scope of our project to guarantee that obtained digital credentials are accepted always and everywhere.

Third, similar to the recognition issues, the experts also raised concerns that the visibility and accessibility of digital credentials on platforms depends on the platform where they are stored. Although our project does not have influence on digital credential platforms and their business models, there is still the opportunity to make students and also institutions aware of the importance of visibility and accessibility. Furthermore, digital credentials can also be stored on a decentralised block-chain, which provides equal and fair conditions for everybody, and removes dependency on platform providers and their business models.

Finally, the danger of unintentionally excluding learner groups due to a lack of access to the required digital technology in the transition phase when introducing digital credentials. This certainly requires careful planning of the initial implementation phase that monitors difficulties, obstacles, and fails when dealing with digital credentials. In our project, the Fundación Kinal is experienced in managing the access to learning content to diverse social groups, which also is also beneficial for organising fair access to digital credentials. Furthermore, in Latin America most people have at least access to a Smart Phone that can be used for receiving and managing digital credentials, if planned in advance.

6 Conclusion and Outlook

Digital credentials are increasingly recognized by both learners and experts as valuable instruments for the flexible and transparent recognition of skills and achievements. This article presents the initiative of the Erasmus+ project EcoCredGT that aims to implement digital credentials in Guatemala. This pilot project seeks to demonstrate how digital credentials can be established in Latin America. Therefore, a holistic training concept and course has been elaborated that addresses the whole development cycle including the creation of learning content, its deployment, and the issuance of digital credentials. Furthermore, the deployment of this course is presented consisting of a webinar, a Moodle course, and online workshops. The target audience is three-fold by addressing students, teachers, and administrative staff, which ensures that all stakeholders are made aware of a proper deployment of digital credentials. In an analysis, students and experts reacted very positively on this approach. However, some concerns raised - ranging from conceptual understanding and perceived costs to questions of recognition and institutional support - underscore that enthusiasm alone is insufficient for widespread adoption.

As a next step a digital credentialing system will be set up that complements the theoretical knowledge of the training course with practical experience of issuing and receiving digital credentials. Bridging the gap between the theoretical promise and practical implementation of digital credentials will require targeted and coordinated efforts across multiple levels. Effective communication, educational outreach, and policy development are essential to building awareness, trust, and usability. Ultimately, the success of digital credentialing systems will rely on inclusive and collaborative strategies that ensure these tools are not only technically robust, but also socially equitable and pedagogically meaningful.

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