



# Blockchain in E-Learning Platform to Enhance Trustworthy and Sharing of Micro-Credentials

International Workshop on Blockchain for Information Systems (BC4IS24) and Blockchain for Trusted Data Sharing (B4TDS) - International Conference on Advanced Information Systems Engineering (CAiSE) 2024

**Ph.D. Student Alessandro Bigiotti**

**Ph.D. Student Maria Paola Francesca Bottoni**

**Lecturer Giacomo Nalli**

Cyprus, Limassol, June 3rd-7th, 2024

This research was funded by Ministero dell'Università e della Ricerca (MUR), issue D.M. 351/2022 "Borse di Dottorato" - Dottorato di Ricerca di Interesse Nazionale in "Blockchain & Distributed Ledger Technology", under the National Recovery and Resilience Plan (NRRP).



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# E-Learning Platforms

E-Learning Platforms and Micro-Credentials

## E-Learning Platforms

An *e-learning platform* is a digital space designed for delivering educational content and resources over the internet. These platforms facilitate learning by providing a variety of tools and features.

**Course Material** : Access to lectures, readings, and multimedia resources;

**Interactive Tools** : Quizzes, assignments, discussion forums, and live classes;

**Tracking and Analytics** : Monitoring student progress, performance analytics, and feedback systems.



# Micro-Credentials

E-Learning Platforms and Micro-Credentials

## Micro-Credentials

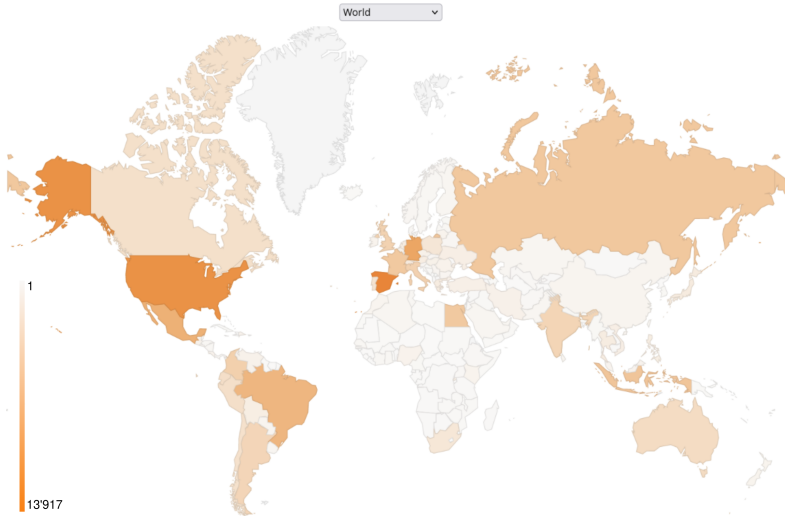
*Micro-credentials* certify the learning outcomes a learner achieves from a small volume of learning, assessed against transparent and clearly defined standards. These credentials equip learners with specific knowledge, skills, and competences tailored to societal, personal, cultural, or labor market needs. Owned by the learner, micro-credentials are shareable, portable, and can stand alone or combine into larger credentials. They are supported by quality assurance based on agreed standards in the relevant sector or area of activity.

**Flexibility** : Can be earned through short courses, workshops, or even on-the-job experience;

**Recognition** : Increasingly recognised by employers and institutions as evidence of specific expertise;

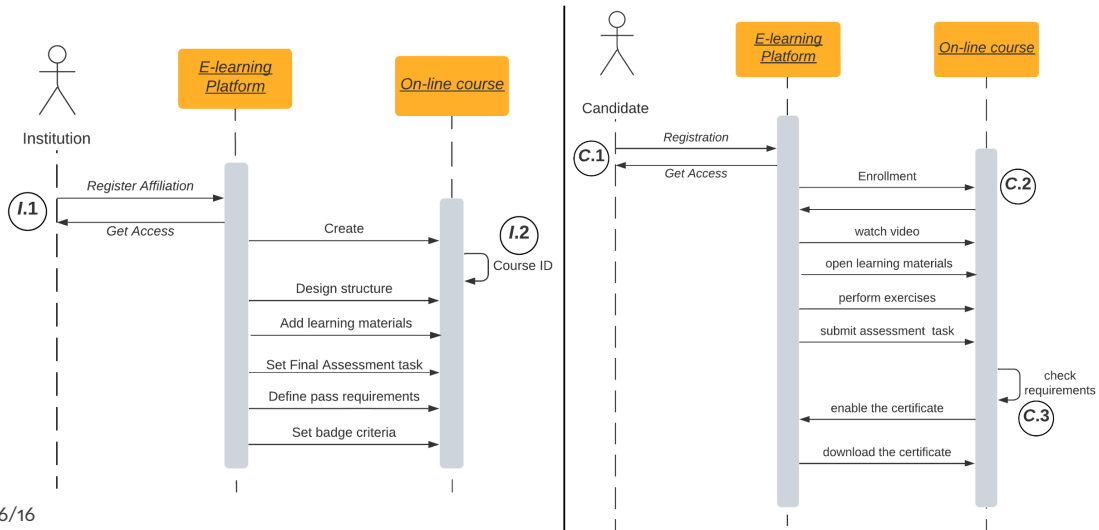
**Digital Badges** : Often issued as digital badges that can be shared on social media, resumes, and professional profiles.

### Moodle registration map



# E-Learning Platform: Use Case

## E-Learning Platforms and Micro-Credentials





# E-Learning Platforms: Limitations and Issues

## E-Learning Platforms and Micro-Credentials

**Fragmentation** : Micro-credentials are offered by a wide range of providers, including universities, online learning platforms, professional associations, and private companies;

**Difficulty in Verification** : Unlike traditional degrees, which have well-established verification processes, micro-credentials often lack standardised methods for authenticating the legitimacy of the credential.

**Counterfeiting** : The digital format of micro-credentials makes them relatively easy to copy or alter using basic graphic editing software.

*How can these issues be mitigated?*



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# Blockchain Technology

Integrating Blockchain Technology within E-Learning Platforms for Micro-Credentials

## Blockchain Technology

*Blockchain* is a decentralised, immutable ledger that securely records transactions across a network. Its key properties include decentralisation, cryptography, transparency, immutability, and trustlessness. Each transaction is grouped into blocks, linked via hash functions, forming a chain of blocks. This structure makes it nearly impossible to alter or tamper with past transactions. This distributed ledger eliminates the need for intermediaries, reduces the risk of fraud, ensures data integrity, and fosters transparency.



# Benefits of Blockchain Integration

Integrating Blockchain Technology within E-Learning Platforms for Micro-Credentials

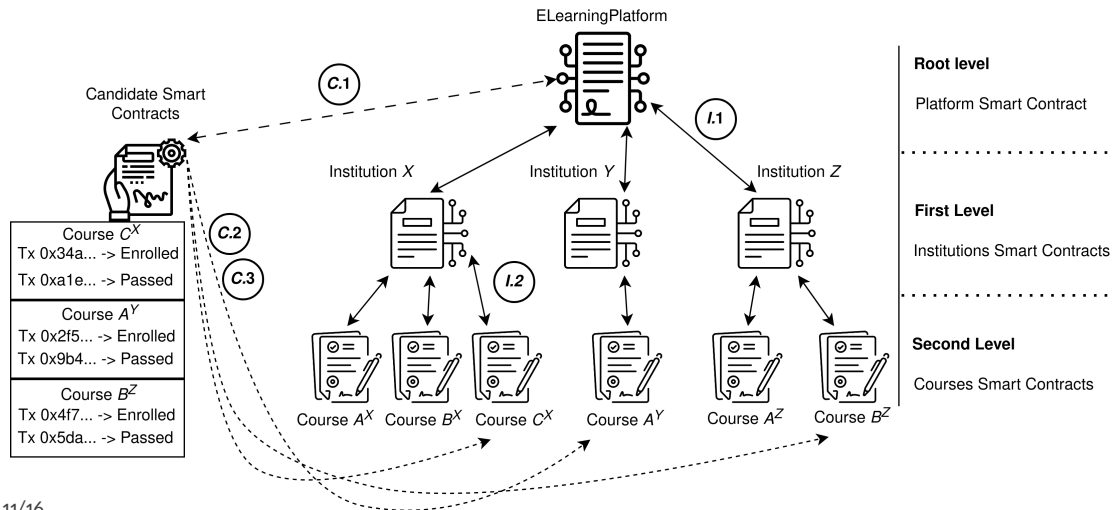
**Integration** : The micro-credentials are maintained in special smart contracts for each candidate;

**Easy Verification** : Blockchain allows for real-time verification of credentials. Employers and institutions can quickly and securely verify the authenticity of a credential without needing to contact the issuing body directly;

**Enhance Trust** : The secure, transparent, and immutable nature of blockchain builds trust among stakeholders. Employers and educational institutions can trust the validity and authenticity of credentials stored on the blockchain.

# A Smart Contract Driven Approach

Integrating Blockchain Technology within E-Learning Platforms for Micro-Credentials





## Approach' Key Points

Integrating Blockchain Technology within E-Learning Platforms for Micro-Credentials

**Silent and Invisible** : The involvement of trainees, educators, instructors and managers in the use of blockchain is not currently easy. This approach aims to enable users to interact with the blockchain indirectly with a silent integration into e-learning platforms;

**GDPR Compliant** : Sensitive candidate data is not stored within the blockchain, but is saved off-chain and managed directly by the platform. Candidates have a unique identifier that will be stored within the blockchain, creating a link to the user's sensitive data.

**Simplify Verification** : Blockchain acts as a validator for the certificates held by candidates. The e-learning platform must guarantee the reading access to the blockchain, linking sensitive data with the related smart contracts, allowing third parties to carry out checks on the status of the certificates held by the various candidates;

# Solidity Implementation

## Integrating Blockchain Technology within E-Learning Platforms for Micro-Credentials

```
// SPDX-License-Identifier: Apache 2.0
pragma solidity >=0.8.0 <0.9.0;
import "./Institution.sol";
import "./Candidate.sol";
import {InstitutionInfo, CourseInfo, CourseAttended} from "./DataStruct.sol";
import {ICandidateContract, IInstitution} from "./Interfaces.sol";
contract ELearningPlatform {

    event NewInstitution(string message,
        address indexed institutionAddress,
        string indexed institutionID);
    event NewCandidate(string message, string indexed candidateID);

    address public ownerPlatform;
    string public platformName;

    // Institution data
    address[] institutionsList;
    mapping(string => uint) institutionIndex;
    mapping(string => address) institutionKeys;
    mapping(string => bool) istiturionRegistered;

    // Candidate data
    address[] candidateList;
    mapping(string => uint) candidateIndex;
    mapping(string => bool) candidateRegistered;
```

```
// SPDX-License-Identifier: Apache
pragma solidity >=0.8.0 <0.9.0;
import {CourseAttended} from "./DataStruct.sol";
contract Candidate {

    event CourseSubscribed(string _candidateID, string _institutionID, string _courseID);
    event CourseCompleted(string _candidateID, string _institutionID, string _courseID);
    address platformAddress;
    string candidateID;
    mapping(string => mapping(string => CourseAttended)) courseAttended;
    CourseAttended[] courseCompleted;

    function courseSubscription( infinite gas ->
    ) public {--
    }

    function coursePassed( infinite gas ->
    ) public {--
    }
```

```
// SPDX-License-Identifier: Apache 2.0
pragma solidity >=0.8.0 <0.9.0;
import "./Course.sol";
import {InstitutionInfo, CourseInfo} from "./DataStruct.sol";
import {ICourse} from "./Interfaces.sol";
contract Institution {

    event NewCourseRegistered(string message, address indexed courseAddress);
    address platformAddress;
    address institutionAddress;
    string institutionID;
    string institutionName;
    string addressLine;
    string country;
    string postCode;
    address[] coursesContracts;
    mapping(string => uint) public courseContractIndexes;
    mapping(string => bool) public courseRegistered;

    function registerCourse( infinite gas ->
    ) public {--
    }

    function getInstitutionInfo() public view infinite gas ->
    {--
    }
```

```
// SPDX-License-Identifier: Apache 2.0
pragma solidity >=0.8.0 <0.9.0;
import {CourseInfo} from "./DataStruct.sol";
contract Course {

    address platformAddress;
    address institutionAddress;
    string institutionID;
    string courseID;
    string courseName;
    uint courseYear;

    function getCourseInfo() public view returns(CourseInfo memory) {
    }
```



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## 3 Future Directions

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**Real Implementation** : Integrate the proposed solution with real e-learning platforms supporting Micro-Credentials, such as Moodle;

**Massive Online Open Courses** : Extend the proposed solution to the MOOC platforms, like Coursera, as they share analogous issues;

**European Digital Credentials Infrastructure** : The European Commission is developing tools, software and services that will form part of the European Digital Credentials Infrastructure (EDCI) and the experimentation of the blockchain in the micro-credentials field can be a good way to implement the vocational training policy (IGG), combining credibility and agility in labour market.



*Thank you for the attention!*

*Any questions?*

Email: [alessandro.bigiotti@unicam.it](mailto:alessandro.bigiotti@unicam.it)

Linkedin: <https://www.linkedin.com/in/alessandro-bigiotti/>

Research Gate: <https://www.researchgate.net/profile/Alessandro-Bigiotti-3>