



EduCity: Dual-Persona E-Learning Platform

Literature Review

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1. Introduction

1.1 General Introduction

In the present digital era, online learning has transformed the educational landscape by enabling flexible, asynchronous, and geographically independent forms of study. Platforms such as **Coursera**, **edX**, and **Udemy** have made vast quantities of courses accessible to learners worldwide. However, while these platforms have expanded access to education, they often emphasise a clear separation of roles: learners consume content, and instructors deliver it.

This role-rigidity limits opportunities for dynamic interaction, peer teaching, and fluid transitions between learning and teaching personas. Furthermore, issues remain around the credibility of online certification; many online credentials are viewed with skepticism by employers and institutions.

In parallel, research in role flexibility, community-driven content, and decentralized credentialing highlights the value of shared knowledge creation and reciprocal teaching. Despite these insights, a gap persists: no widely adopted platform currently integrates seamless role switching (learner and instructor), strong community collaboration, user-generated course creation, and credible certification in a scalable architecture.

This research project addresses that gap by proposing **EduCity**, a dual-persona e-learning web application enabling users to act as both learners and teachers, switch roles seamlessly, generate and curate community content, and earn credible certifications under a robust backend architecture. As education becomes increasingly online and distributed, enabling role flexibility, community engagement, and credible certification can enhance retention, engagement, and learning outcomes while reducing barriers to teaching.

Key Concepts:

- **Dual-persona systems:** Users transition between learner and instructor roles.
- **Role-switching mechanisms:** Backend logic and UI/UX enabling seamless transitions.
- **Community-driven content creation:** Peer-generated or peer-reviewed educational material.

- **Certification architecture:** Blockchain-enabled, reputation-weighted credentialing.
- **Scalable backend:** Event-sourced, CQRS-based architecture for real-time concurrency.

1.2 Aims and Objectives

Aim:

To develop a dynamic, user-friendly web platform that enables seamless dual-persona functionality (learning and teaching), supports collaborative education, integrates credible certificate generation, and fosters a self-sustaining community of knowledge exchange.

Objectives:

1. Design and implement a responsive web interface that supports course browsing, enrolment, teaching, content creation, and end-of-session quizzes.
2. Enable seamless role switching between learner and instructor personas with minimal friction.
3. Integrate blockchain-enabled, peer-validated certification ensuring credibility and traceability.
4. Support user-generated courses, peer-reviewed content, and adaptive quiz-based assessments.
5. Implement secure authentication and scalable backend architecture supporting role transitions, peer interactions, and real-time analytics.

2. Literature Review

2.1 Research Papers

The reviewed literature focuses on six major themes central to EduCity's development: **dual-persona systems, role-switching mechanics, credible certification, user-generated learning, scalable architecture, and assessment design**. Kimmerle, Cress, and Moskaliuk (2021) proposed a co-evolution model in which users alternate between learning and teaching, reinforcing both individual cognition and community knowledge growth. Their research provides a strong cognitive basis for dual roles but lacks a certification framework. EduCity builds upon this by implementing co-evolution through dual dashboards and contribution metrics, where users can visualize the correlation between teaching participation and personal learning progress.

Goodyear and Carvalho (2022) introduced the concept of "epistemic roles," where learners act as explorers, curators, and designers within digital learning environments. While their study encourages learner agency and engagement, it remains largely conceptual without technical implementation. EduCity extends their idea by mapping epistemic roles to the platform's user interface and integrating progression badges that reward transitions between learning and teaching. Grech and Camilleri (2022) explored self-sovereign identity (SSI) through blockchain technology to establish verifiable and portable learning credentials. Although their system ensures secure credentialing, it does not integrate directly into a learning platform. EduCity applies their approach by combining SSI with peer validation for dual learner and teacher certification, strengthening both credibility and user ownership.

Fischer, Lundin, and Lindberg (2023) discussed the meta-design approach, emphasizing systems that evolve through active user participation and reseeding. While their research highlights long-term sustainability, it lacks assessment systems. EduCity incorporates meta-design principles by allowing course reseeding and quiz version control, fostering a continuously improving, community-driven learning ecosystem. Siemens, Gašević, and Dawson (2021) proposed adaptive learning analytics that encourage users to transition into teaching roles once mastery is achieved. Though they offer a data-driven personalization approach, their model omits certification integration. EduCity builds upon this by applying adaptive analytics to recommend teaching opportunities and quiz creation for learners demonstrating proficiency.

Oliver and Trigwell (2023) conceptualized role transitions as threshold concepts that redefine learner identity, marking the transformation from novice to instructor. Their work provides valuable pedagogical insight but lacks a digital implementation framework. EduCity expands this by developing structured pathways , from observer to contributor to facilitator to certified instructor ,reinforced through assessments. Alam and Mohanty (2024) proposed a reputation-weighted peer validation model to improve fairness in open credentialing systems. Although effective, their study is limited to micro-credentials. EduCity scales this model to full course-level certification by

combining reputation-weighted peer review with quiz performance metrics, ensuring both fairness and academic rigor.

Chen, Hwang, and Wang (2023) introduced event-sourced CQRS systems that enable scalable, real-time user interactions in e-learning platforms. Their model presents high technical scalability but lacks pedagogical components. EduCity adopts this architecture to manage concurrent role switching, certification records, and quiz data synchronization. Ponti, Storni, and Ryan (2022) examined transparency in community reputation systems, showing that open feedback fosters reciprocity and long-term participation. EduCity incorporates public teaching impact scores and leaderboards to increase user motivation and accountability. Finally, Jarke and Macgilchrist (2025) critiqued algorithmic role lock-in, warning against reducing user autonomy. EduCity addresses this issue by granting users full control over role data, enabling exportable teaching portfolios and privacy customization.

Collectively, these studies establish the academic and technical foundation for EduCity. The platform combines theories of co-evolution, learner agency, meta-design, adaptive analytics, blockchain credibility, and ethical role autonomy into a single, integrated ecosystem, bridging gaps that existing studies have examined only in isolation.

2.2 Similar Projects

Existing educational platforms provide valuable insights into online learning systems but also reveal key limitations that EduCity aims to address. **FutureLearn** promotes collaborative courses through a MOOC framework but lacks flexibility for learners to adopt teaching roles; EduCity resolves this by incorporating seamless role switching and peer teaching features. **Blockcerts** offers blockchain-based credentialing for digital verification but functions independently from learning environments; EduCity integrates blockchain credentials directly into its teaching and learning ecosystem. **Open edX** employs modular plugins to support diverse learning models, yet it offers limited persona adaptability; EduCity enhances this with real-time event-driven role transitions supported by CQRS architecture.

Peergrade specializes in peer assessment but operates without integration into certification systems. EduCity overcomes this by embedding peer validation directly into its credentialing workflow, ensuring that assessments contribute to verified recognition. **Wikiversity**, meanwhile, enables users to create courses collaboratively but lacks credibility, consistency, and scalability. EduCity combines Wikiversity's open participation model with blockchain verification and reputation-weighted certification to maintain quality and trustworthiness. Through these improvements, EduCity

distinguishes itself as a hybrid system that merges interactivity, credibility, and scalability into a unified digital learning environment.

2.3 Summary of Literature Review

The reviewed literature collectively highlights that **role fluidity**, **peer-based certification**, and **event-sourced architectures** are critical components of modern, engaging, and credible online learning systems. However, prior studies tend to explore these themes in isolation, resulting in fragmented solutions that fail to deliver a cohesive user experience. EduCity addresses these gaps by integrating **dual-role theory** into an **event-driven backend**, enabling seamless transitions between learning and teaching personas. It applies **blockchain and peer validation** to strengthen credential credibility and transparency, adopts **meta-design principles** to foster community-driven evolution, and introduces **adaptive quizzes** that serve as both assessment and teaching preparation tools. Through this integration, EduCity provides a holistic, user-centric model that unites pedagogical theory with technological innovation to redefine online education.

2.4 End-of-Session Quiz Module

EduCity introduces an **adaptive end-of-session quiz module** to reinforce learning outcomes, validate comprehension, and facilitate certification eligibility. This component aligns with the platform's dual-persona philosophy by supporting both learners and instructors in demonstrating expertise and progression.

The quiz system incorporates several core principles and implementations. **Adaptive difficulty** is managed using *Item Response Theory (IRT)*, which dynamically adjusts question complexity based on the user's performance to ensure optimal cognitive challenge. It serves a **dual purpose** by functioning both as a learner evaluation tool and an instructor validation mechanism, requiring teachers to complete assessments on their content to verify expertise. **Peer-generated questions** allow the community to contribute to the question pool, where submissions are reputation-weighted to maintain quality and fairness.

The system also provides **immediate feedback**, guiding users toward improvement and encouraging progression into teaching roles for example, prompting messages such as "You scored 90% would you like to teach this topic next?" This design promotes engagement and self-efficacy while supporting EduCity's adaptive role-switching

framework. Finally, the **certification gate** ensures quality assurance: users achieving at least **80%** on quizzes and positive peer reviews receive digital badges symbolizing verified mastery.

Overall, this module transforms assessments from static checkpoints into dynamic, community-driven learning bridges. It not only evaluates performance but also inspires continued growth, transforming quizzes into tools for both learning and teaching development within EduCity's interconnected educational ecosystem.

3. References (Harvard Style)

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