

# DESIGN AND ARCHITECTURE FRAMEWORK FOR EDUCATION ECOSYSTEM REGISTRY

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**Abstract** - This project is aimed at developing a Web Portal to reduce the count of illiteracy. The Portal can be accessed by Municipal Corporation (MNC), Hospitals, Schools and all NGO's working to find the children who are not taking Primary education. For all the stakeholder's proper login is provided. The people who face financial crises force their children to work and earn money, in the age when they should actually go to school and study. Because of such reasons the count of illiteracy is increasing, hence to reduce this count and convince the parents and for raising the awareness regarding education this portal is helpful. This portal can be used by Schools to maintain all admission records of student instead maintaining them manually and make that records accessible to Municipal Corporation. Also, hospital would able to maintain all birth records on portal instead of maintaining them manually and access them whenever needed. NGOs would able to maintain all children's birth record with the help of portal and will able to stay connected with them in coming days for their school admission. All birth entries made by Hospital and NGO's will be centralized in Birth certification Module (BCM) for make these records accessible to Municipal Corporation. For finding non-admitted children Municipal Corporation would consider the records from Birth certification Module for particular year and after 5 years Municipal Corporation would consider the records from School and compares both of these records and filter them according to area and send it to respective school and NGO's and school/NGO's informs the parents of those students who are not admitted.

**Key Words:** NGO (non-governmental organization), MNC (Municipal Corporation), BCM (Birth certification Module)

## 1. INTRODUCTION

This project is aimed at developing a Web Portal to reduce the count of illiteracy. The Portal can be accessed by Municipal Corporation (MNC), Hospitals, Schools and all NGO's working for finding the children who are not taking Primary education. For all the stakeholder's proper login is provided. The people who face financial crises force their children to work and earn money, in the age when they

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In the current digital landscape, educational web platforms have revolutionized the way information is accessed and disseminated, opening up new avenues for enhancing early childhood education and parental support. Although there is a growing recognition of the vital importance of early childhood development for lifelong learning and health, dependable and accessible resources for parents are still scarce, particularly in underprivileged areas. The Edu-India: A Child Birth Education Track Web Portal seeks to fill this gap by offering parents and caregivers a comprehensive, culturally sensitive, and user-friendly resource tailored to assist in a child's development from birth. This platform will provide research-based information on crucial subjects such as prenatal care, infant health, developmental milestones, early learning strategies, and health and safety guidelines, ensuring that parents receive timely and practical advice to help them make informed decisions throughout their child's growth stages. The mission of Eduindia transcends mere content delivery; it aims to offer an engaging and inclusive experience tailored specifically for Indian parents and caregivers. Built with user-friendly HTML and CSS, the platform prioritizes accessibility and versatility across a range of devices, making it beneficial for both tech-savvy individuals and beginners. By incorporating milestone tracking features, expert advice sections, and community discussion forums, Eduindia cultivates a supportive environment for learning and informed parenting. Ultimately, Eduindia seeks to

empower families with easily accessible resources, align with broader public health initiatives for early childhood, and address educational disparities by ensuring that all parents have access to dependable information that supports their child's growth and overall well-being.

## 2. RELATED WORK

The design and architecture of an Education Ecosystem Registry (EER) draw upon interdisciplinary research and existing implementations across digital identity management, interoperable data systems, enterprise architecture, and education technology platforms. This section reviews relevant frameworks, standards, and systems that inform the proposed registry model.

### 2.1 Digital Identity and Trust Frameworks

Digital identity systems provide foundational concepts for secure, verifiable, and federated access across distributed ecosystems.

- Self-Sovereign Identity (SSI) models emphasize decentralized identity control, enabling learners and institutions to manage verifiable credentials independently.
- The World Wide Web Consortium (W3C) Verifiable Credentials (VC) standard enables tamper-proof digital credentials.
- The OpenID Foundation developed OpenID Connect (OIDC), widely adopted for authentication and federation.
- The International Organization for Standardization (ISO/IEC 24760) defines frameworks for identity management.

These models contribute to authentication, authorization, and trust verification mechanisms within an education registry.

### 2.2 Education Data Interoperability Standards

Interoperability is central to ecosystem-based education systems.

- IMS Global Learning Consortium (now 1EdTech) developed Learning Tools Interoperability (LTI), OneRoster, and Common Cartridge standards.
- The Ed-Fi Alliance provides a standardized data model for K-12 educational systems.

- The Schools Interoperability Framework Association (SIF) supports data exchange among school systems.
- The IEEE Learning Object Metadata (LOM) standard defines metadata schemas for learning resources.

These standards inform the registry's metadata structure, API specifications, and semantic alignment.

### 2.3 Enterprise and System Architecture Frameworks

Architectural design principles for large-scale registries are influenced by established enterprise frameworks.

- The The Open Group Architecture Framework (TOGAF) provides methodology for enterprise architecture development.
- The Object Management Group (OMG) Model-Driven Architecture (MDA) supports modular, platform-independent system design.
- Microservices architecture and Service-Oriented Architecture (SOA) principles guide scalable registry development.
- Cloud-native patterns (containerization, API gateways, orchestration) enable distributed ecosystem integration.

These frameworks support modularity, scalability, governance, and lifecycle management within the registry architecture.

### 2.4 Digital Credentialing and Learning Record Systems

Several platforms demonstrate practical implementations of educational registries and credential repositories.

- MIT Media Lab developed the Blockcerts open standard for blockchain-based academic credentials.
- The European Commission introduced Europass Digital Credentials for interoperable qualification records.
- The Learning Economy Foundation supports decentralized learning record infrastructures.
- The Parchment provides transcript and credential exchange services globally.

These systems highlight approaches to credential verification, learner-owned records, and cross-border recognition.

## 2.5 Government and National Education Registries

National-level education registries provide insights into governance, compliance, and scalability.

- The National Student Clearinghouse maintains enrollment and degree verification records in the United States.
- GovTech Singapore supports digital identity integration (Singpass) across education and public services.
- The Ministry of Education of India promotes digital infrastructure initiatives such as Academic Bank of Credits (ABC).

These initiatives demonstrate large-scale registry governance models, regulatory integration, and public-private collaboration.

## 2.6 Distributed Ledger and Blockchain-Based Registries

Blockchain technologies have been explored to enhance immutability and trust in educational ecosystems.

- Platforms such as Ethereum support smart contract-based credential verification.
- The Hyperledger Foundation enables permission blockchain infrastructures suitable for regulated education environments.

While blockchain enhances transparency and tamper resistance, scalability, privacy, and governance trade-offs must be carefully evaluated.

## 2.7 Knowledge Graphs and Semantic Web Technologies

Education registries increasingly leverage semantic technologies for interoperability and intelligent discovery.

- RDF and OWL standards developed by the World Wide Web Consortium support linked data models.
- Knowledge graph architectures enable mapping between institutions, programs, competencies, credentials, and learners.

Semantic frameworks enhance discoverability, analytics, and cross-platform integration.

## 2.8 Synthesis and Research Gap

Existing systems provide strong foundations in:

- Identity management
- Credential verification
- Data interoperability
- Enterprise architecture
- Blockchain-enabled trust

However, most implementations operate in silos—focusing either on credentialing, identity, or institutional data management. There is limited research on a holistic, modular, and interoperable Education Ecosystem Registry that integrates:

- Multi-stakeholder governance
- Federated identity and trust models
- Cross-platform interoperability standards
- Credential lifecycle management
- Real-time analytics and ecosystem intelligence

The proposed framework aims to bridge these gaps by synthesizing identity standards, interoperability protocols, enterprise architecture principles, and decentralized trust mechanisms into a unified registry architecture.

## 3. TYPICAL ARCHITECTURE AND MAIN FEATURES OF SYSEM

This picture outlines a complex information stream and interaction demonstrated among different substances included in birth record enrollment, issuance of birth certificates, and following of non-admitted children for potential school confirmations. Each component within the chart speaks to an organization or database collaboration to guarantee that each child's birth record is precisely enlisted, a special recognizable proof number is issued, and upgrades approximately the child's status are communicated to significant parties.

Main Entities and Their Interactions:

### 1. Parents:

Parents are at the center of the system as they are notified about their child's records and receive information such as the unique ID generated by the system. Parents are notified about various updates from the municipal corporation and may receive important information regarding their child's birth certificate and vaccination schedules.

### 2. School:

Schools are responsible for registering admitted students and sending student records to the School Database (School

DB).The school also communicates with the Municipal Corporation to register students and provides a list of non-admitted children, which is a list of children who are not yet in school but need monitoring.

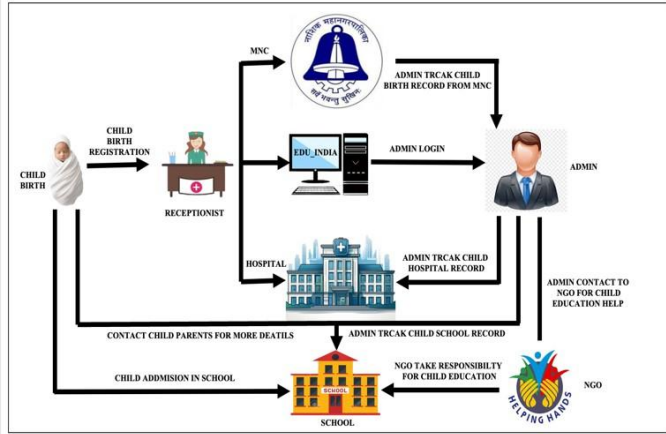


Fig- 1 System Architecture

### 3. Non-Governmental Organization (NGO):

NGOs are involved in monitoring children who may not have access to formal education or whose admission status needs tracking. NGOs receive notifications and lists of non-admitted children from the Municipal Corporation, which helps them in outreach and ensuring that children in need receive support. NGOs also store information in the NGO Database (NGO DB) and provide birth records back to the Municipal Corporation for centralized tracking.

### 4. Municipal Corporation:

This is the central entity that manages interactions and data exchange between different organizations. The Municipal Corporation registers birth records, monitors non-admitted children, and sends vaccination notifications to parents. It also manages admission entries from schools, updates the list of non-admitted children based on school data, and shares this information with NGOs for follow-up actions. The Municipal Corporation Database (Municipal Corporation DB) stores all records related to registered children, including birth records from hospitals and updates from the Birth Certificate Module.

### 5. Hospital:

Hospitals register birth records and send them to the Hospital Database (Hospital DB), which in turn shares these records with the Municipal Corporation DB. This data is crucial for initial birth registration and verification, which is subsequently used in the Birth Certificate Module.

### 6. Birth Certificate Module (BCM):

This module is responsible for generating birth certificates for registered children based on birth records obtained from hospitals. The BCM Database (BCM DB) stores all birth records and generates a unique ID for each child, which is then sent to the parents. The BCM DB coordinates with the Municipal Corporation DB and sends birth record data back to ensure records are up-to-date across systems. Data Flow and Communication: Birth Record Creation and Unique ID Generation: When a child is born, the hospital records the birth information in the Hospital DB. This data is then sent to the Municipal Corporation DB. The Birth Certificate Module retrieves birth records from the Municipal Corporation and BCM DB to issue a unique ID and generate the birth certificate for each child. This unique ID and birth record are then communicated back to parents, completing the initial registration process.

### 7. Tracking Non-Admitted Children:

The Municipal Corporation uses school and NGO records to identify children who have not yet been admitted to school. Schools send admission entries and lists of non-admitted children to the Municipal Corporation. NGOs receive similar lists to perform outreach and ensure that these children are not left out of educational opportunities.

### 8. Vaccination Notification:

The Municipal Corporation DB has a role in notifying parents about vaccinations. This ensures that registered children receive timely vaccinations based on their birth records. This flowchart shows an integrated data management system where multiple organizations work together to track, update, and manage each child's records from birth through early education. The system ensures that all relevant data is centralized in the Municipal Corporation DB, allowing for efficient tracking, communication, and record management for children across the network. This model also highlights how NGOs and schools contribute to the education tracking process, assisting the government in monitoring and supporting non-admitted children and improving educational outreach.

## 4. CONCLUSIONS

The problem stated was many children are deprived of primary education. As per our proposed solution, the system efficiently finds out the students who are not admitted in any of the school, taking into consideration the birth records and school records. Notifies their parents for admission. This would bring awareness among parents regarding their child's education and therefore play a great role in solving the problem.

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