

A THEORETICAL FRAMEWORK FOR DEVELOPING AN ELECTRONIC CUMULATIVE RECORD SYSTEM: ENHANCING SCHOOL COUNSELLING IN KWARA STATE, NIGERIA

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Abstract

This paper presents a theoretical framework for the development of an Electronic Cumulative Record System (E CRS) tailored to the needs of school counsellors in Kwara State, Nigeria. Recognising the limitations of traditional paper-based record management, such as data loss, inefficiency, and restricted accessibility, this study integrates established theories, including User-Centred Design (UCD), the Technology Acceptance Model (TAM), and Agile software development methodologies to guide the creation of a context-sensitive digital solution. Through iterative engagement with end-users and incorporation of socio-technical considerations like infrastructural constraints, digital literacy, and data privacy, the framework prioritises usability, security, and adoption potential. The resulting conceptual model offers a structured approach to designing scalable, secure, and user-friendly electronic record systems that address unique challenges in low- and middle-income educational environments. By bridging theoretical constructs with pragmatic development processes, this work contributes a replicable roadmap for advancing digital transformations in educational counselling. Future research directions include empirical evaluation to assess usability and impact on counselling effectiveness, thereby supporting broader implementation and policy development in resource-constrained settings.

Keywords: Electronic Cumulative Record System; School Counselling; User-Centred Design; Technology Acceptance Model; Educational Technology in LMICs

Introduction

Effective student support services are crucial for educational success, and school counsellors play an essential role in recording and managing student information to aid in their guidance activities. Traditionally, these records have been paper-based, a method fraught with challenges such as data loss, inaccuracies, and inefficiency in retrieval and update. These issues are especially pronounced in low-resource settings like Kwara State, Nigeria, where infrastructural constraints and limited technological adoption hinder modernisation. The growing digital transformation in education presents a valuable opportunity to improve the quality and accessibility of counselling records through electronic solutions. An Electronic Cumulative Record System (ECRS) can facilitate accurate, secure, and easily accessible storage and retrieval of student counselling data, thereby empowering counsellors to deliver more effective support.

Despite the evident advantages, existing digital records systems are often inadequately adapted to local contexts, with gaps in usability, scalability, and user engagement. Within the Nigerian educational ecosystem, there remains a scarcity of digital systems designed with the specific challenges of school counsellors in mind, highlighting the urgent need for contextually relevant solutions.

Rationale for the Study

This paper presents a theoretical examination of the development process for an ECRS tailored to the needs of school counsellors in Kwara State. Drawing from established software development methodologies and relevant theoretical frameworks, such as User-Centred Design principles and the Technology Acceptance Model (TAM), this study examines how these can guide the creation of a system that addresses local infrastructural, usability, and privacy concerns. Focusing on the development process rather than empirical evaluation, this work contributes a conceptual model and development roadmap that can support effective digital record keeping within similar low- and middle-income educational contexts.

Research Problem

Existing electronic record-keeping solutions often lack contextual adaptation, leading to low adoption rates among school counsellors in Nigeria. Challenges such as limited digital literacy, infrastructure inadequacies, and privacy concerns further impede the deployment and sustained use of such systems. There is limited theoretical work documenting how to systematically approach the development of electronic cumulative record systems that are both functional and aligned with users' real-world needs in Nigeria.

Objectives

The primary objectives of this theoretical study are to:

- a. Develop a comprehensive theoretical framework for the design and development of an Electronic Cumulative Record System tailored for school counselling in Kwara State.
- b. Articulate the guiding principles, development methodologies, and design choices needed to address contextual challenges.
- c. Provide a foundational conceptual model to inform future practical implementations and empirical evaluations.
- d. Bridge the gap between theory and practice in the digital transformation of educational counselling record management within low-resource settings.

Literature Review

The use of electronic cumulative record systems (ECRS) in educational contexts has steadily gained attention as a means to enhance the efficiency and accuracy of student data management. Rose and Thomas (2020) emphasise the critical role of user-centred design in ensuring that educational technologies meet the diverse needs of school staff, noting that usability and accessibility directly impact adoption rates among educators. Their findings highlight that systems which fail to account for varying levels of digital literacy may face resistance and underutilization.

In the context of low- and middle-income countries (LMICs) like Nigeria, infrastructural and contextual challenges further complicate the deployment of digital counselling tools. A recent study by Popoola, Kareem, and Oduola (2025) investigating Nigerian counsellors' awareness and readiness to use social media platforms for counselling services found that while counsellors are generally familiar with these digital tools, several barriers hinder their effective utilisation. Key challenges include poor internet connectivity, insufficient training and support, and cultural and religious constraints. These findings provide essential, context-specific design imperatives for an Electronic Cumulative Record System (ECRS) in Kwara State: the system must be engineered for resilience against poor connectivity, its rollout must be inseparable from sustained training, and its features must be aligned with local socio-cultural norms to ensure adoption and utility. Despite these obstacles, the study highlights the considerable potential of social media to enhance counselling service delivery in Nigeria by fostering greater collaboration among counsellors and improving access to support, particularly in remote and underserved areas. This underscores the importance of designing digital solutions that are both accessible and contextually relevant.

Digital counselling interventions have shown promise for improving mental health outcomes among students when carefully implemented. Calear et al. (2015) conducted a randomised controlled trial of the "Bite Back" positive psychology program in Australian schools, illustrating that web-based interventions can boost life satisfaction but require strategic implementation to maximise engagement. Similarly, Anttila et al. (2019) demonstrated the acceptability of web-based mental health programs in Thailand, underscoring that cultural and contextual tailoring is paramount for success.

From a theoretical standpoint, established models like the Technology Acceptance Model (TAM) provide useful frameworks for understanding factors that influence the adoption of new technologies by school counsellors (Davis, 1989). TAM underscores perceived usefulness and ease of use as core determinants shaping intention to use digital tools, making it particularly relevant in guiding the conceptualisation and design phases of ECRS development.

Collectively, this literature affirms the importance of combining robust theoretical frameworks with contextually sensitive design and development approaches to create effective electronic record systems that are feasible and sustainable in resource-constrained educational settings.

Development Process and Theoretical Framework

The development of the Electronic Cumulative Record System (ECRS) for school counsellors in Kwara State followed a structured, theory-driven approach. This process integrated established behavioural theories with iterative software development methodologies to ensure the system's contextual fit, usability, and user acceptance. The following sections detail the theoretical foundations, methodological steps, and resulting design models.

Theoretical Foundations

The system design was guided by three interconnected theoretical pillars:

User-Centred Design (UCD): UCD principles (Norman, 2013) mandated the active involvement of school counsellors at every development stage. This focus on continuous feedback and iterative refinement was critical for addressing varied digital literacy levels and tailoring the system to actual user workflows and cognitive models in Kwara State.

Technology Acceptance Model (TAM): TAM (Davis, 1989) informed design priorities by highlighting perceived usefulness and ease of use as core determinants of adoption. This guided decisions to simplify interfaces, ensure efficient data retrieval, and reinforce system reliability, directly addressing counsellors' attitudes and behavioural intentions toward the new technology.

Ethical Framework for Sensitive Data: Informed by principles for managing behavioural data (e.g., Zhao et al., 2024), the design process prioritized data security, confidentiality, and trust. This involved classifying data sensitivity, minimizing data collection, and implementing robust protection measures critical for safeguarding student counselling records and ensuring ethical compliance.

2. Development Methodology: Agile Phases

An Agile software development framework (Beck et al., 2001) was adopted to accommodate dynamic user needs and facilitate iterative progress. The process consisted of five key phases, each explicitly tied to the theoretical foundations: Requirements Elicitation and Analysis: Semi-structured interviews and focus group discussions with school counsellors identified functional requirements (e.g., appointment scheduling, secure record access) and non-functional requirements (e.g., usability under low bandwidth). UCD principles ensured stakeholder feedback directly prioritized these needs.

Conceptual Design and Modeling: Gathered requirements and TAM constructs were synthesized to create a high-level conceptual model of the development process (see Figure 1) and initial data models. This phase translated theoretical insights into a blueprint for development.

Iterative Development and Prototyping: Development proceeded in Agile sprints, producing functional increments of the ECRS. After each sprint, prototypes were reviewed by domain experts and a subset of end-users, applying UCD feedback loops to refine usability and address contextual technical constraints.

Technology Selection and Implementation: A technology stack (Laravel/PHP, JavaScript, HTML5, CSS) was selected based on scalability, security, and maintainability factors influencing TAM's perceived usefulness and ease of use. The MVC architecture supported modular development aligned with Agile iterations.

Integration of Ethical and Privacy Safeguards: Informed by the ethical framework, technical features like encrypted data storage, role-based access controls, and secure authentication were implemented as core system components, not as add-ons.

Conceptual Model of Development

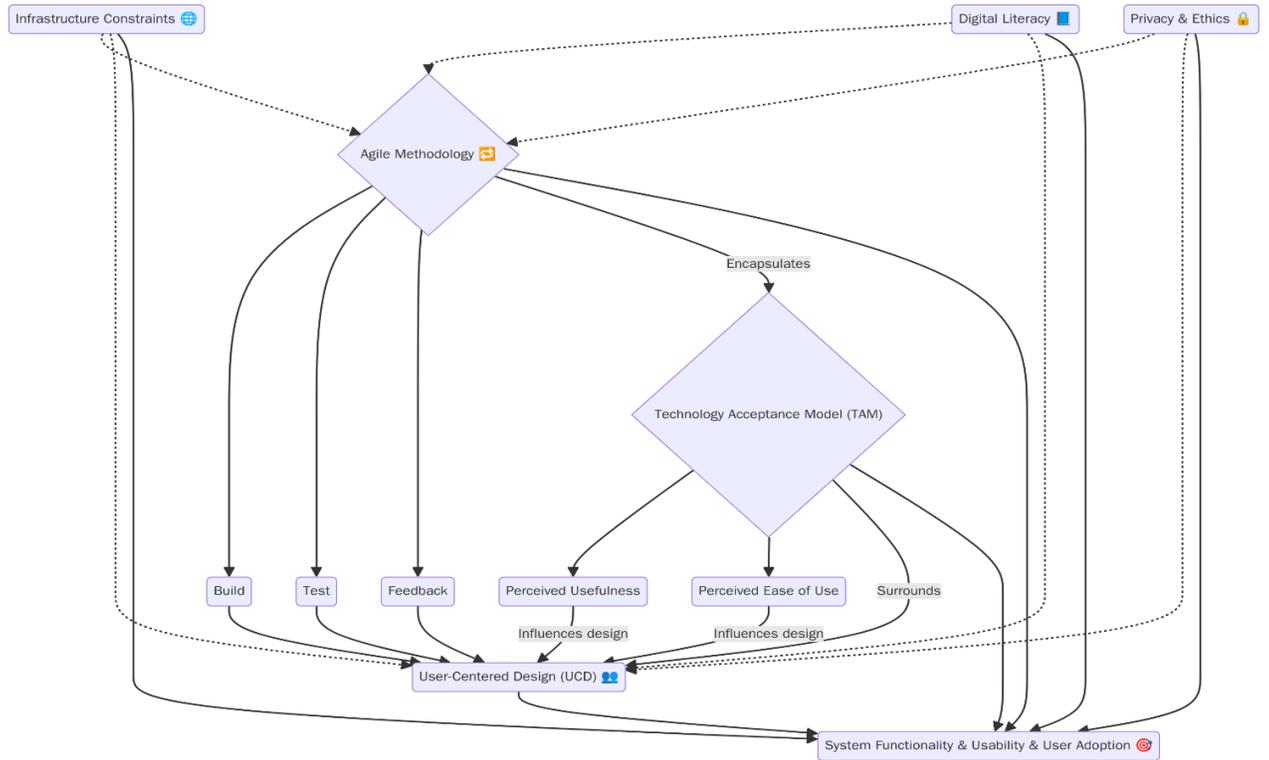


Figure 1: Conceptual Model of Development

Conceptual model illustrating the iterative development process, showing the interplay between User Needs (UCD), Acceptance Factors (TAM), Agile Sprints, and Contextual/Ethical Adaptation.

3. System Architecture & Design

The finalized design is manifested in the system architecture and data models, which operationalize the theoretical and methodological decisions.

3.1. System Architecture

The ECRS employs a three-tier client-server architecture to ensure separation of concerns, security, and scalability: *Presentation Layer (Front-End)*: Built with HTML5,

CSS, and JavaScript, this responsive interface adheres to UCD guidelines for intuitive interaction and supports devices commonly available in Kwara State schools.

Application Layer (Back-End): Developed using the Laravel PHP framework, this layer manages business logic, session handling, and all core functionalities (e.g., appointment scheduling, report generation). Its MVC structure facilitated the Agile, modular build.

Database Layer: A relational database management system (RDBMS) stores all encrypted data. Its design enforces strict access controls and referential integrity, complying with the mandated ethical privacy standards.

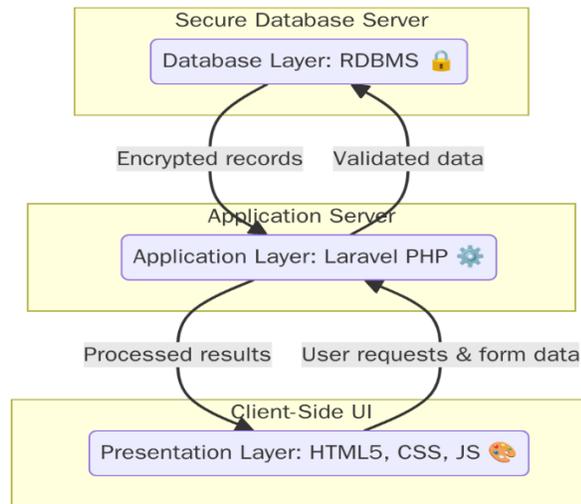


Figure 2: *System Architecture Diagram*

(Three-tier system architecture of the ECRS, detailing the Presentation, Application, and Database layers).

3.2. *User Workflow Design*

The user workflow was designed for task efficiency, aligning with TAM's perceived ease of use. Key streamlined activities include secure authentication, record management, appointment scheduling, access to self-help resources, and report generation.

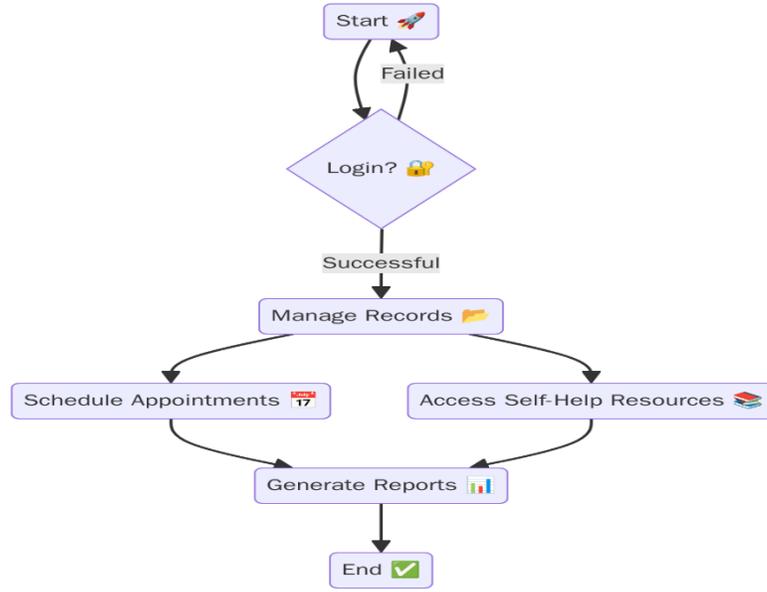


Figure 3: *User Workflow Diagram*

(User workflow diagram illustrating the key steps for counsellors within the ECRS, from login to report generation).

Data Models

3.3. Data Model: Entity-Relationship Diagram

The relational data model defines the core entities and their relationships, ensuring structured and secure data management. The main entities are: Student, Counsellor, Cumulative Record, Appointment, and Resource. The diagram specifies primary keys, foreign keys, and cardinalities (e.g., one Counsellor manages many Cumulative Records).

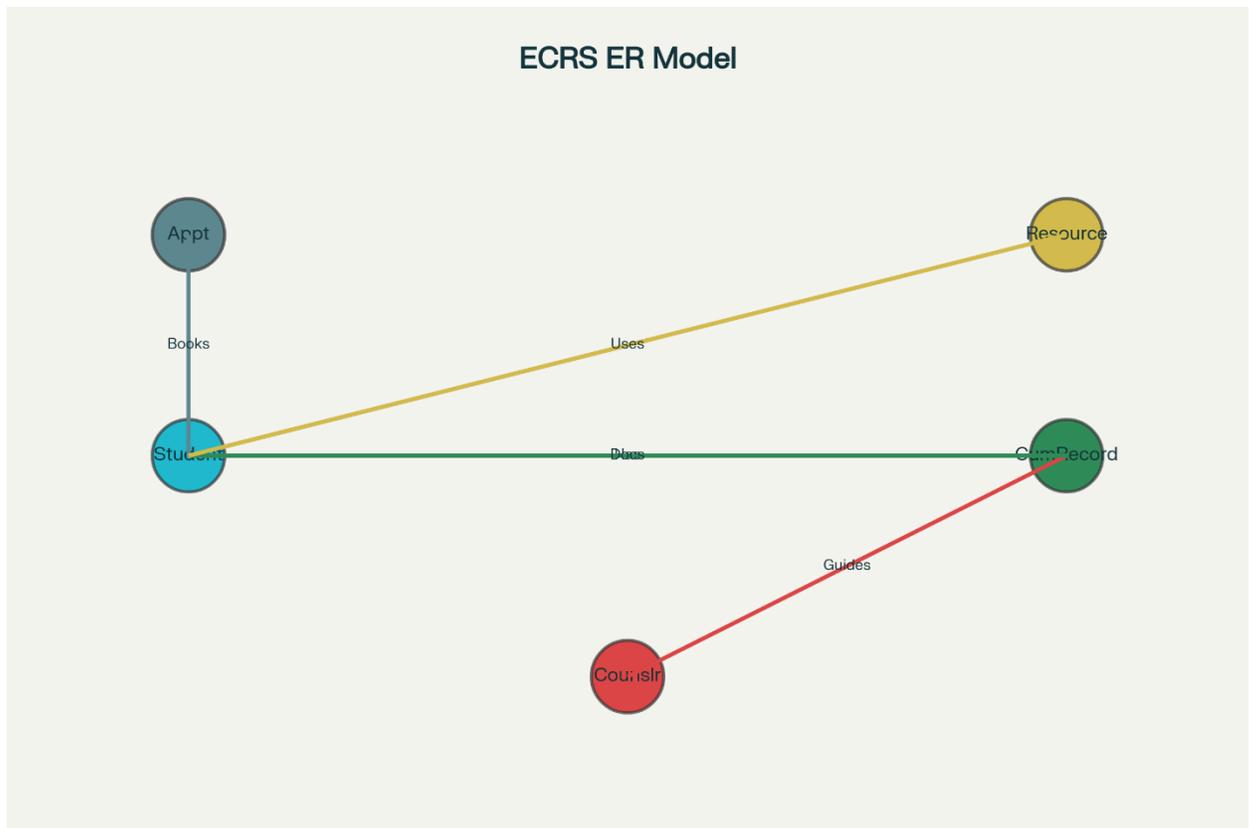


Figure 4: Entity-Relationship (ER) Diagram

(Entity-Relationship (ER) diagram for the ECRS database, showing entities, their attributes, and relationships with cardinality notation (e.g., 1 to).

Entities:

[Student]

- StudentID (PK)
- Name
- DateOfBirth
- Gender
- AcademicYear
- Other demographic/academic attributes

[Counsellor]

- CounsellorID (PK)

- Name
- ContactInfo
- AccessLevel
- [CumulativeRecord]
- RecordID (PK)
- StudentID (FK)
- CounsellorID (FK)
- SessionDate
- IssuesAddressed
- Recommendations
- Notes
- [Appointment]
- AppointmentID (PK)
- StudentID (FK)
- CounsellorID (FK)
- AppointmentDate
- AppointmentTime
- Status
- [Resource]
- ResourceID (PK)
- Title
- Description
- URL/Location
- ResourceType
- Relationships:
- Counsellor 1 --- CumulativeRecord
(A counsellor manages multiple cumulative records)
- Student 1 --- Appointment
(A student can have multiple appointments scheduled)
- Counsellor 1 --- Appointment
(A counsellor manages multiple appointments)

Student 1 --- CumulativeRecord

(A student may have multiple counselling records)

(Note: Referential integrity constraints enforce that CumulativeRecord.StudentID and CumulativeRecord.CounsellorID reference valid Student and Counsellor entries, respectively; likewise for Appointment.)

Summary:

- Primary Keys (PK) uniquely identify each entity's records.
- Foreign Keys (FK) establish links between entities per relationships.
- Cardinalities shown indicate one-to-many relationships.

Discussion

The development of the Electronic Cumulative Record System (ECRS) was fundamentally shaped by the integration of established theoretical frameworks namely the User-Centred Design (UCD) approach and the Technology Acceptance Model (TAM) combined with the Agile software development methodology. These frameworks collectively ensured that development decisions were not only technically sound but also deeply responsive to user needs, contextual limitations, and adoption factors specific to low- and middle-income country (LMIC) educational settings.

The UCD framework was instrumental in centring the perspectives, workflows, and usability challenges of school counsellors in Kwara State throughout the system's design and iterative refinement. By actively involving end-users via interviews, focus groups, and prototype feedback sessions, development efforts were consistently aligned with the real-world tasks and cognitive models of counsellors. This approach mitigated the risks typically associated with digital tool rejection due to complexity or mismatch with user capabilities, which are prevalent barriers in LMIC contexts where digital literacy may vary widely.

TAM provided a conceptual lens to foreground critical determinants of technology acceptance perceived usefulness and perceived ease of use. These constructs informed key design priorities such as simplifying interfaces, ensuring rapid data access, and embedding robust security features. This theoretical sensitivity helped preempt common adoption obstacles such as concerns over data privacy, system reliability, and procedural

complexity, which have posed challenges in prior attempts to digitalise educational counselling systems in similar resource-constrained settings.

The Agile methodology complemented these behavioural and design frameworks by enabling a flexible, iterative development process. This allowed the development team to incorporate timely user feedback and adapt to infrastructural constraints unique to the local environment such as intermittent internet connectivity and varied hardware availability. Agile's incremental delivery ensured that each module was tested against theoretical usability and acceptance benchmarks before progressing, enhancing system stability and relevance.

Theoretically, this development process contributes a holistic framework combining behavioural theories and technical methodologies tailored to LMIC educational technology projects. It underscores the importance of embedding sociotechnical perspectives, considering human factors, contextual realities, and infrastructural limitations within software development cycles for digital health and educational tools.

By explicitly documenting the integration of UCD, TAM, and Agile within a pragmatic development roadmap, this study fills a notable gap in the literature where electronic cumulative record systems often lack contextual adaptation and theoretical grounding. It offers a replicable model for practitioners and researchers seeking to design educational technologies that are usable, accepted, and sustainable in similar LMIC environments.

Furthermore, this work highlights critical insights into balancing theoretical rigour with practical constraints, such as privacy concerns and digital literacy variability, emphasising that successful digital transformations in education demand more than technology deployment they require comprehensive, theory-informed development strategies sensitive to local realities. This has broad implications for advancing educational technology implementation frameworks that can contribute to equitable, data-driven student support services globally.

Conclusion

This paper has presented a theoretical framework and detailed development process for an Electronic Cumulative Record System (ECRS) tailored to school counselling services in Kwara State, Nigeria. Grounded in the User-Centred Design (UCD) approach, the Technology Acceptance Model (TAM), and Agile software development principles, the system was conceptualised and built to address the unique infrastructural, digital literacy, and privacy challenges prevalent in low- and middle-income country (LMIC) educational settings.

The development methodology emphasised iterative engagement with end-users, ensuring the system's design met real-world needs while promoting ease of use, perceived usefulness, and data security, key factors influencing technology acceptance. By integrating behavioural theories with flexible development practices, this work bridges a significant gap between theoretical models and pragmatic system design adapted for resource-constrained environments.

Importantly, the theoretical model and development roadmap outlined here provide a replicable blueprint for similar educational technology initiatives aiming to improve data-driven counselling and student support services in LMICs. This study also foregrounds the necessity of considering socio-technical and ethical dimensions, including confidentiality and infrastructural constraints, when designing digital health and education tools.

While this paper focuses on the theoretical development process, future research should empirically evaluate the system's usability, effectiveness, and impact on counselling outcomes. Such evaluation will be critical for validating the framework's goals and informing larger-scale implementation.

Ultimately, this work contributes to advancing digital transformations in education by demonstrating how rigorous, theory-informed development processes can foster sustainable, contextually relevant solutions that empower school counsellors to better support student success through enhanced data management.

Final Note

This paper is theoretical and development-focused; it is appropriate to clearly state that system evaluation is beyond this manuscript's scope, but remains a vital future step. This clarifies your paper's contribution while managing reader expectations.

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