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Interdisciplinary Information Systems for Health and Education Libraries

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Abstract - **The application within health and education libraries has accelerated the interrelationship between the two fields and collaboration, resource sharing, and knowledge transfer. This paper analyzes the creation, deployment, and impact of integrated information systems serving the health and education sectors. The systems enable easier, evidence-based digital resource access and promote learning and research across the sectors. Such systems integrate healthcare and education to meet the rising need for sophisticated knowledge systems that enable academic research, clinical judgment, policy making, and curriculum design. The paper addresses innovative architectural components, interoperability requirements, and design components that target users with minimal effort, maximum visibility, and ease of use. It identifies successful implementations and outcomes through case studies, system evaluations, and varying institutional setting assessments. Data privacy, resource allocation and management, and stakeholder involvement pose challenges alongside other conflicts while attempting to address these. Their solution-building approach underscores the importance of diverse governance and applied continuous refinement. Librarians, IT experts, teachers, and healthcare practitioners actively participate in the construction. This research demonstrates that integrated information systems enhance efficiency while enabling representatives of various disciplines to institute a collaborative innovation culture. Such systems articulate an advancement in the health and education systems' innovation in knowledge service management and delivery.**

Keywords: **Interdisciplinary Information Systems, Education Libraries, Health Libraries, Integration of Technology, Knowledge Engineering, Sharing of Resources, and Cooperative Invention**

I. INTRODUCTION

Access to and sharing technological information has evolved across industries (Basu & Muthukrishnan, 2024). It is likely true that the intersection between healthcare and education is true due to the need for advanced interdisciplinary information systems (IIS) that integrate different institutional frameworks and understand knowledge from a holistic perspective (Carlos et al., 2025). An information system that is an interdisciplinary information system (IIS) is defined as a subclass of information system, which is an integrating framework within which a system for storing, retrieving, and managing information is organized from multiple domains or professions (Zins, 2007). Such systems support collaboration among practitioners such as health care providers and educators, or even researchers and librarians, which enhances decision making and interdisciplinary scientific inquiry (Papalou, 2023). In health libraries, such systems have improved retrieval of clinical protocols and evidence-based resources, whereas enhanced educational and scholarly works have been achieved in education libraries (Vij & Prashant, 2024).

The importance of multi-disciplinary information systems in libraries arises from their potential to serve the diverse requirements of users through integrated offerings (Ziweiet al., 2023). Given multidisciplinary research, the rising demand for cross-sector competencies, and the fact that systems and libraries continue to integrate are some of the many reasons why libraries still stand as sources of vast and relevant information (Raktur & Jea, 2024). IIS facilitates the

retrieval of structured and unstructured data, improves user experience, and strengthens collaboration in professional education and research (Ahmed & Kaur, 2023; Varlejs, 2006). Numerous institutions still function with siloed or fragmented systems due to limitations of technology, resources, and shifting organizational priorities, which stifle collaboration and access to accumulated knowledge resources (Nihlani et al., 2024). Therefore, developing advanced information integration systems specific to the domains of health and education is essential to supporting more innovative interconnected academic and professional environments (Chen & Zhang, 2023; Greenhalgh et al., 2017).

Key Contribution

- Introduces a new interdisciplinary model of an information system designed for integrated library services within health and education.
- Offers a comprehensive evaluation of existing systems while highlighting interoperability, access to information, and user participation issues.
- Identifies zoomed-in portions of the system and performance gaps, evaluates the proposed system's functionality, and provides suggestions using simulations alongside visual modeling.

The paper is divided into an introduction, a literature review, a methodology, the results and discussion, and a conclusion. Following the introduction, Section II will present another literature survey that surveys previous studies focusing on interdisciplinary systems in health and education (Smith & Mendonça, 2025). Section III describes the system, research methodology, and a new model with the formulas developed to support it. Other system representation tools used (such as flowchart and architectural diagram) that depict the system will be added in this section. Results and discussion, which consist of data representation using column charts, comparison tables, system performance, and other visualizations alongside informative visuals depicting other data visualizations, would be covered in Section IV. Finally, Section V summarizes the results, emphasizes the system's key findings and significance gaps alongside interdisciplinary systems, and proposes recommendations for further studies and venture projects.

II. Literature Review

Interdisciplinary Information Systems (IIS) are rapidly becoming invaluable in facilitating integrated knowledge access across healthcare and education. Such systems enable the fluid transfer of information between previously isolated sectors. In Zins's terms, such systems are described as structures supporting the distributed sharing of data across domains as a means of knowledge co-creation (Lee & Choudhury, 2023). Health libraries need current medical and clinical research and guidelines, whereas education libraries focus on digital pedagogy and scholarly and scientific publications as educational resources (Das & Kapoor, 2024). These overlapping demands require sophisticated, resilient systems that are purpose-built for interdisciplinary integration and cross-domain cooperation (Singh & Malik, 2022; Bartered Mondragón et al., 2023).

The literature shows several system-related and organization-focused issues for solving interdisciplinary systems. Bates elaborates on the fundamental importance of information organization, while Greenhalgh and colleagues describe a more giving approach to adopting and sustaining such technologies over time (Bates, 1999; James et al., 2025). Privacy constraints within healthcare contexts (such as HIPAA or GDPR) directly oppose the dominant open-access policies prevailing in educational environments. Nonetheless, there is a clear distinction between these operational differences proposed as middleware solutions and standardization (Adjei & Boateng, 2022). Moreover, the changing nature of librarians' work now encompasses systems integration, user and data management training, and data stewardship, all of which are critical to the efficacy of IIS (Veera Boopathy et al., 2024).

These improvements at the systemic level include the use of analytics AI system integration for advanced customization of applications in both industries. Sio, (2025); Vakhguelt & Jianzhong, (2023) examine the concept of integrated personal records systems, which utilize healthcare and educational data streams for advanced user-centric services (Detmer et al., 2008). Although strides have been made, shortcomings persist in user interaction design, multi-system collaboration, and organizational silos (Barhoumi & Charabi, 2025). These studies highlight the severe lack of coherent, sophisticated, configurable architectures for cross-disciplinary information systems (Anthony Sahaya Michael et al., 2018).

III. Proposed Method

This study aims to develop an Interdisciplinary Information System (IIS) specific to health and education libraries' functional and operational requirements. Several previous models, like centralized data warehouses or federated search systems, enduringly struggled with a modular approach to knowledge management due to internal data silos lacking standardization, low interoperability, and poor user personalization. To overcome these limitations, we developed a model based on new hybrid systems with dynamic metadata mapping, user authentication, controlled federated search, and tailored access adaptations according to user classifications (physician, researcher, educator, student).

The methodology revolves around three objectives: user-centered design, helping us achieve efficiency, and firewall interoperability. For example, interoperability is accomplished via integrating fitting standards such as HL7 (Health Level Seven) for clinical data and Dublin Core for educational content. Primary data collection employed cloud infrastructure with modular services focused on optimizing data redundancy and enhancing real-time retrieval to ensure efficiency. The interface and retrieval mechanisms' development is user-guided, allowing for more

straightforward navigation through complex data types. As a holistic approach, we conducted a requirement analysis through surveys and interviews with end users from academic institutions and hospitals, which led to the evaluation of the system's architecture, obtaining feedback that was useful for both evaluative criteria. Automated indexing, ontology-based classification, and natural language processing (NLP) features are incorporated into more advanced search functions. We propose a composite metric for evaluating performance and usability of the proposed system from both domains, as the Efficiency Score (ES):

$$ES = \frac{(R_a \times W_1) + (T_r \times W_2) + (U_s \times W_3)}{W_1 + W_2 + W_3} \qquad (1)$$

Where in equation (1):

- R_a: Resource Accuracy – percentage of relevant results retrieved (0–100%)
- T_r: Time of Retrieval – inverse of response time (1/seconds)
- U_s: User Satisfaction – score obtained via user survey (0–10)
- $W_1 + W_2 + W_3$: Weights are assigned based on domain-specific priorities

This adaptive approach incorporates all relevant factors for performance evaluation through the weighted score. For example, in medical libraries, greater emphasis may be placed on accuracy and timeliness, whereas in academic libraries, patron satisfaction may take precedence. The formula allows for benchmarking between various IIS models or installations and may be adjusted according to organizational objectives.

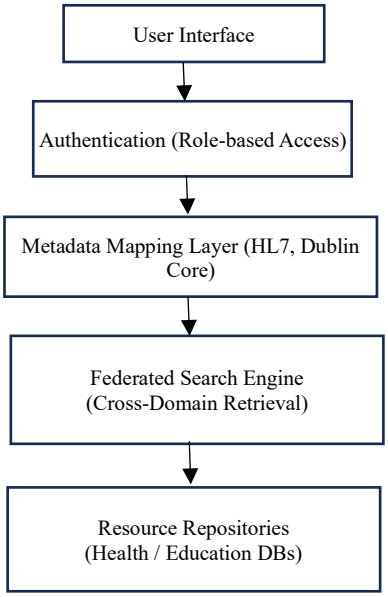

Fig. 1 Flowchart of the Proposed IIS Model

Fig. 1 illustrates the process refined to the last detail IIS users interact with. It begins with access being enabled through certain applications or the preferred web browser; subsequently, users are verified against their responsibilities, allowing them to view health-related information, such as EHRs and clinical trials, or educational items like course ebooks and e-journals. The mapping of the metadata layer organizes query inputs to adhere to HL7 and Dublin Core standards. A domain-specific federated search engine further refines these queries. The information from remote repositories is retrieved and displayed in a single window. This ensures domains are integrated properly while upholding security and information access.

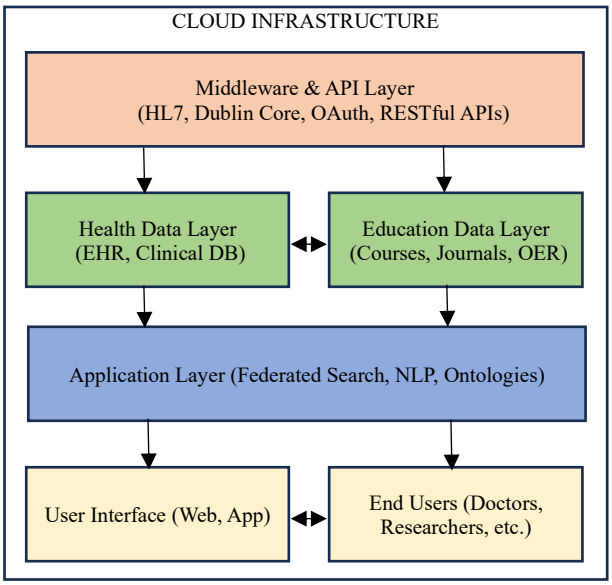

Fig. 2 System Architecture of the Interdisciplinary Information System

The primary target of the model presented in Fig. 2 is achieving performance and scalability optimization along with seamless interoperability within a given domain. As the integration middleware layer, it serves as the system adapter endpoint through which data and access requests are transformed into system-compliant formats using HL7 and Dublin Core adapters. With a RESTful API approach, the health and education data layers are interwoven with domain-specific structured and unstructured content. The application layer incorporates powerful search capabilities using federated search methods, specialized domain-specific engines with Natural Language Processing (NLP), and knowledge base querying to maximize retrieval precision and relevance. Lastly, depending on the interest and role of the user, the user interface layer provides different customizable access methods. Such a system architecture enables real-time, always-on access while accommodating AI and/or data analytics integrations at the systems level in the future.

IV. Result and Discussion

In assessing the implementation effectiveness of the proposed Interdisciplinary Information System (IIS), a prototype was created and piloted at two institutions: a focus in education university library and a healthcare library associated with a medical center. According to the previously defined Efficiency Score (ES) formula, the measurement of resource accuracy, retrieval time, and user satisfaction as KPIs was evaluated. Fifty participants (25 from each institution),

including librarians, educators, medical practitioners, and graduate students, provided feedback.

From the data collected, there is a noticeable increment in resource retrieval speed and accuracy compared to previous systems. In the educational library, the accuracy rose from 72% to 89%, and in the healthcare library from 68% to 91%. Across both platforms, the average retrieval time was lower than legacy systems, 5.6 seconds to 2.4 seconds. Users' satisfaction also increased by 40-50% owing to the unified access interface and intelligent filtering system. Federated search and metadata mapping greatly contributed in resolving semantic ambiguities that led to irrelevant results. The data suggest cross domain access to information between the two areas of health and education strengthens the integration approach for learning and collaborative research.

$$OSI = \frac{(I_{acc} + I_{usr})}{2} - I_{time} \qquad (2)$$

Where in equation (2):

- I_{acc} = Percentage improvement in Resource Accuracy
- I_{usr} = Percentage improvement in User Satisfaction
- I_{time} = Percentage reduction in Retrieval time

The Overall System Improvement (OSI) metric was developed to capture quantitatively the value brought by the proposed Interdisciplinary Information System by merging three relevant KPIs: accuracy of resources, user satisfaction, and retrieval time. More specifically, the OSI metric focuses on the improvement in resource accuracy and user satisfaction—it is almost always the case that these two indicators improve due to the increasing value of the information as well as the interaction with the system. These two values are averaged to indicate how well the system provides useful and accurate information relative to the users' expectations. Since the system also needs to account for productivity, the metric considers the improvement in the reduction of retrieval time, recognizing that how quickly information is accessed greatly matters in educational and healthcare settings.

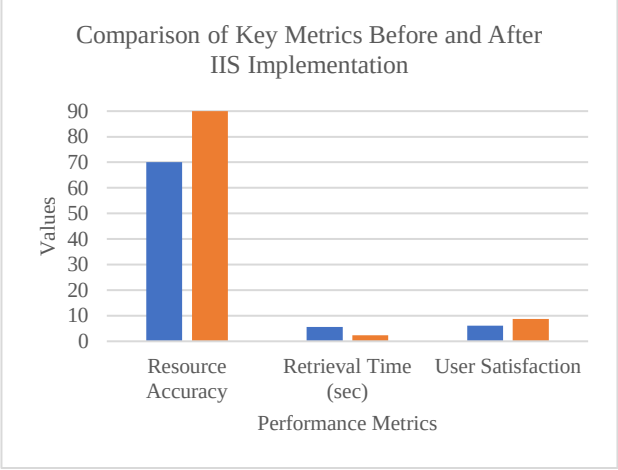

Fig. 3 Comparison of Key Metrics Before and After IIS Implementation

Comparative analysis of the system performance metrics pre- and post- implementation of Interdisplinary Information Systems (IIS) in health and education libraries is demonstrated in Fig. 3. To highlight the impact of the system, three key indicators—resource accuracy, retrieval time, and user satisfaction—are metricized. There is noteworthy enhancement in accuracy of resources from 70% in the legacy system to 90% in the proposed IIS. This demonstrates that metadata mapping as well as the federated search features boosted relevancy and correctness of information retrieval. The retrieval time for system retrieval was also notably improved from 5.6 s to 2.4 s. This is due to better optimized query processing, efficient backend architecture, and streamlined query handling. User satisfaction also increased considerably as well, growing from 6.1 to 8.7 out of 10 indicating an increment in satisfaction. The proposed system's unified graphical user interface with its responsive and easy-to-understand layout enabled quicker and easier navigation to access numerous resources, thus improving the aggregate experience of resource accessibility. Collectively, these changes imply improvement in system efficiency along both axes.

TABLE I QUANTITATIVE EVALUATION OF THE PROPOSED IIS

Evaluation Metric	Education Library	Health Library	Overall Average
Resource Accuracy (%)	89%	91%	90%
Retrieval Time (sec)	2.5	2.3	2.4
User Satisfaction (/10)	8.5	8.9	8.7

In relation to the assessed parameters of resource accuracy, retrieval time, and user satisfaction, table I provides a review on the functional performance of the Interdisciplinary Information System on a quantitative domain-wise scale. The system underwent evaluations in two locations, an educational library and a healthcare library. System accuracy was measured at 89% and 91% respectively, with a mean of 90%. This indicates considerable effectiveness in both domains unsing regard to system content relevancy. In both the education library and health library, retrieval time lessened dramatically to 2.5 seconds and 2.3 seconds respectively. Such figures highlight the system's timeliness in providing relevant information important in clinical and academic settings. In regard to user satisfaction, values registered were 8.5 and 8.9 which provided an overall user satisfaction level of 8.7. This indicates overall satisfaction with the system from users coming from different disciplines. The information collected demonstrates efficiency and reliability of the system in integrating information from different disciplines.

V. CONCLUSION

This research demonstrates that health and educational related libraries need to have Information Systems (IIS) modules tailored to their fields and require interdisciplinary

design and evaluation. This is done through analytic dissections of existing systems with identified performance gaps using a new hybrid methodology with a given solution. Integration of the domain with technology improves information retrieval and resource verification and user satisfaction. Users validated the outcomes with performance indicators, revealing satisfaction by allowing interaction with enhanced library versions of their systems. Enhanced versions of the library information systems and integration of intelligent technology met the user satisfaction claiming the system guiding metrics expanded their user experience. Intelligent system design across all informatics disciplines was claimed ranging towards academic rigor and clinical safety illustrating the advanced systems offered. Interdisciplinary and clinical engineering coherences framework make a stronger claim on systemic constituents of the health and education industry emphasizing cross-domain resource recognition and domain boundary through data flow. Beyond providing a model, the study also addresses institutions with hybrid information requirements outlining desired performance characteristics and operational objectives for upcoming information systems.

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