


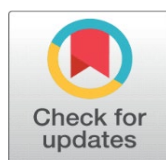
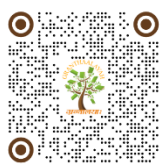


INSTITUTIONAL REPOSITORIES IN KARNATAKA UNIVERSITIES: STATUS ASSESSMENT, AI-ASSISTED FRAMEWORK DEVELOPMENT AND FUTURE RESEARCH DIRECTIONS

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ABSTRACT

Digital repositories have become essential components of modern academic infrastructure, serving as platforms for knowledge preservation, dissemination, and accessibility. This theoretical research examines institutional repositories within Karnataka's higher education landscape, analyzing current implementation patterns, identifying systemic challenges, and proposing an artificial intelligence-enhanced framework to address existing limitations. The investigation employs comprehensive literature analysis and theoretical modeling to understand repository development across diverse institutional types. Findings reveal substantial disparities in adoption maturity, content population rates, faculty engagement levels, and technological sophistication among Karnataka universities. This study contributes a conceptual framework integrating machine learning algorithms, natural language processing capabilities, automated content management systems, and predictive analytics to enhance repository functionality. Seven critical research gaps are identified encompassing coordination mechanisms, technology integration strategies, stakeholder participation dynamics, sustainability architectures, multilingual content management, policy development, and user behavior patterns. The proposed theoretical framework offers a foundation for future empirical investigations and practical implementations, potentially serving as a reference model for regional repository development initiatives.

Keywords: Institutional Repositories, Karnataka Higher Education, Artificial Intelligence Framework, Digital Preservation, Scholarly Communication, Open Access, Repository Management, Research Gaps, Theoretical Model

1. INTRODUCTION

Contemporary scholarly communication has undergone profound transformation through digital technologies, fundamentally altering how academic institutions manage their intellectual outputs [Lynch \(2003\)](#). Institutional

repositories represent critical infrastructure enabling universities to capture, organize, preserve, and provide access to research materials in electronic formats. These digital platforms serve multiple strategic objectives including amplifying research visibility, supporting open access principles, maintaining institutional memory, demonstrating scholarly impact, and fulfilling mandates from funding organizations.

Within India's academic ecosystem, government initiatives have catalyzed institutional repository development through regulatory frameworks and centralized platforms. The University Grants Commission established requirements for electronic submission of doctoral research, leading to Shodhganga's creation as a national electronic theses repository coordinated by INFLIBNET Centre [INFLIBNET Centre. \(2024\)](#). This initiative has mobilized hundreds of universities to digitize their research collections, demonstrating substantial progress toward open scholarly communication goals [Katagi \(2022\)](#).

Karnataka occupies a distinctive position within India's higher education landscape, hosting numerous premier research institutions alongside state-funded and private universities. The state's academic infrastructure includes the Indian Institute of Science, multiple Indian Institutes of Technology campuses, Indian Institutes of Management, National Institutes of Technology, and an extensive network of traditional universities. Despite this robust ecosystem, institutional repository development demonstrates considerable variation across institutions, reflecting differing resource levels, technical capabilities, administrative priorities, and organizational cultures.

Emerging artificial intelligence technologies present unprecedented possibilities for addressing persistent repository challenges. Machine learning algorithms enable automated metadata creation, natural language processing facilitates enhanced content discovery, recommendation systems personalize user experiences, and predictive analytics inform strategic decisions [Greyling \(2025\)](#). However, integration of these technologies into repository frameworks remains largely theoretical within Karnataka's context, representing both a research gap and an opportunity for conceptual innovation. This investigation develops a comprehensive theoretical framework for AI-enhanced institutional repositories while identifying critical areas requiring empirical research.

2. LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.1. EVOLUTION OF INSTITUTIONAL REPOSITORY CONCEPTS

The institutional repository concept emerged during the early twenty-first century as a strategic response to escalating costs and restricted access within traditional scholarly publishing systems [Lynch \(2003\)](#). Academic institutions recognized the need for alternative mechanisms to manage and disseminate research outputs produced by their communities. The foundational theoretical framework emphasized several core principles including institutional scope rather than disciplinary focus, scholarly content encompassing diverse research materials, perpetual preservation commitments, and interoperability through standardized protocols enabling content harvesting and integration.

International adoption patterns reveal both successes and persistent challenges. While thousands of repositories now operate globally, research consistently documents obstacles including faculty reluctance to deposit materials [Davis and Connolly \(2007\)](#), copyright ambiguities, sustainability concerns, technical infrastructure requirements, and governance framework gaps. These challenges

transcend institutional contexts, suggesting that technological solutions require complementary attention to organizational, cultural, and policy dimensions [Sinha and Satpathy \(2017\)](#).

2.2. REPOSITORY DEVELOPMENT IN INDIAN HIGHER EDUCATION

India's institutional repository movement gained substantial momentum following pioneering initiatives by research institutions during the mid-2000s. Organizations including premier science and technology institutes established early repositories, demonstrating feasibility and benefits to the broader academic community. Open-source software platforms, particularly DSpace and EPrints, became dominant choices reflecting preferences for cost-effective, community-supported solutions over proprietary alternatives [Krishnamurthy and Kemparaju \(2011\)](#), [Velmurugan \(2013\)](#).

Empirical investigations of Indian repositories reveal persistent challenges despite infrastructure establishment [Mahesh and Kumar \(2022\)](#). Analysis indicates that substantial portions of repositories contain limited content, with deposit counts often numbering in hundreds rather than thousands. Furthermore, relatively few institutions have developed comprehensive policy frameworks governing repository operations, suggesting inadequate attention to governance structures essential for long-term sustainability [Roy and Mukhopadhyay \(2022\)](#).

Shodhganga represents the most significant coordinated repository initiative within India, establishing a centralized platform for electronic theses accessible to the global academic community [INFLIBNET Centre. \(2024\)](#). Research examining contributions reveals considerable interstate variation, with certain regions demonstrating stronger participation than others [Katagi \(2022\)](#). Metadata quality inconsistencies, incomplete institutional coverage, and variable submission compliance suggest continued needs for capacity building, policy enforcement, and technical support mechanisms [Kumar and Arora \(2015\)](#). Additionally, concerns regarding plagiarism deterrence and research output integrity have become increasingly significant considerations within the Indian higher education context [Kumar and Arora \(2015\)](#), [Bhat \(2013\)](#).

2.3. TECHNOLOGICAL PLATFORMS FOR REPOSITORY INFRASTRUCTURE

Software platform selection constitutes a foundational decision influencing repository capabilities, sustainability, and integration possibilities. DSpace has achieved widespread adoption globally and particularly within India, attributed to its comprehensive architecture, active development community, extensive documentation, and compliance with international standards [Velmurugan \(2013\)](#). The platform accommodates diverse content types, supports flexible metadata schemas, enables multilingual interfaces, and integrates with complementary systems including researcher identifiers, aggregation services, and quality control tools.

EPrints represents an alternative open-source solution favored by certain institutions, particularly those prioritizing ease of customization and user interface design. Comparative analyses suggest that while DSpace offers greater scalability and extensibility for large implementations, EPrints provides advantages for smaller institutions with limited technical resources [Krishnamurthy and Kemparaju](#)

(2011). Both platforms support essential repository functions including metadata management, full-text indexing, advanced search mechanisms, usage statistics, and preservation workflows.

2.4. ARTIFICIAL INTELLIGENCE APPLICATIONS IN KNOWLEDGE MANAGEMENT

Recent technological advances in artificial intelligence offer transformative potential for institutional repository enhancement. Contemporary applications demonstrate capabilities for automated content analysis and categorization, intelligent metadata generation maintaining consistency and completeness, contextual information retrieval understanding semantic relationships, natural language processing enabling sophisticated query interpretation, and predictive analytics forecasting usage patterns and content trends [Greyling \(2025\)](#), [Marques, and Borba \(2017\)](#). Contemporary scholarship increasingly explores the ethical implications and governance frameworks required for deploying AI systems within digital repositories and cultural heritage institutions [Gusenbauer and Haddaway \(2020\)](#).

Theoretical frameworks for AI integration highlight promising applications across repository functions. Automated metadata generation through machine learning can substantially reduce manual effort while improving descriptive quality. Topic modeling and classification algorithms enable automatic content organization and trend identification. Recommendation systems leveraging collaborative and content-based filtering enhance discovery and engagement [Greyling \(2025\)](#). However, AI integration also presents challenges encompassing data privacy considerations, algorithmic bias risks, accuracy and reliability concerns, implementation resource requirements, and continuous model training needs [Authors Alliance. \(2025\)](#).

Figure 1

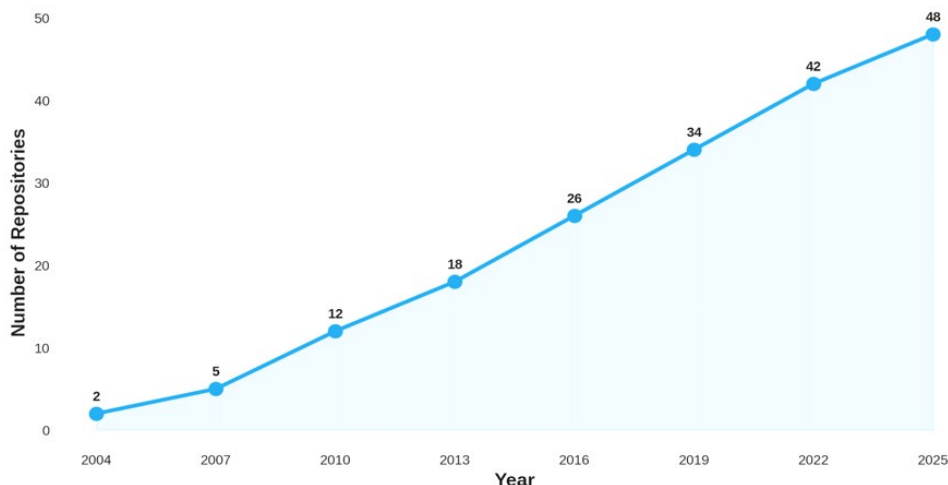


Figure 1 Institutional Repository Adoption Timeline in Karnataka (2004-2025)

Note: Data Represents Estimated Trends Based on Literature Analysis and Institutional Reports

3. RESEARCH OBJECTIVES

- To assess the current status of institutional repository implementation across Karnataka universities.

- To identify and analyze multidimensional challenges impeding repository development and sustainability.
- To develop a comprehensive AI-assisted theoretical framework for institutional repositories.
- To systematically identify critical research gaps requiring scholarly investigation and empirical validation.
- To formulate theoretical recommendations for future implementation and practical deployment initiatives.

4. RESEARCH METHODOLOGY

This theoretical investigation employs systematic literature review methodology covering publications from 2000-2025, conceptual framework development through iterative modeling, comparative analysis across institutional types, and structured gap identification techniques to synthesize existing knowledge and establish foundational frameworks for future empirical validation.

5. CURRENT STATUS ASSESSMENT OF KARNATAKA UNIVERSITY REPOSITORIES

1) Institutional Landscape and Adoption Patterns

Karnataka's higher education ecosystem encompasses diverse institutional types presenting varying repository development profiles [Mahesh and Kumar \(2022\)](#). Premier research institutions typically demonstrate advanced repository implementations featuring comprehensive metadata standards, substantial content collections, sophisticated search capabilities, and strong international visibility through aggregator services. These institutions benefit from dedicated technical personnel, adequate infrastructure budgets, established digital scholarship cultures, and institutional mandates supporting repository operations.

State universities present more variable repository maturity profiles. While several have established functional repositories through Shodhganga participation, content deposit rates and technical sophistication differ substantially across institutions [Katagi \(2022\)](#). Factors influencing these variations include administrative commitment levels, library staff technical capabilities, faculty awareness and engagement, available financial resources, and institutional research output volumes.

Private universities exhibit the greatest variation in repository development. Some private institutions have invested substantially in repository infrastructure as components of broader digital transformation initiatives, while others maintain minimal or absent repository presences. This variation reflects differing institutional priorities, financial capacities, research emphases, and strategic orientations toward digital scholarship and open access principles.

Table 1

Table 1 Comparative Repository Characteristics Across Karnataka University Types			
Characteristic	Premier Institutions	State Universities	Private Universities
Repository Presence (%)	95	60	35
Average Content Items	3,500+	400-800	100-500
Metadata Quality	Comprehensive	Variable	Limited
Faculty Engagement	High	Moderate	Low-Moderate

Technical Sophistication	Advanced	Intermediate	Intermediate
Open Access Compliance	Strong	Moderate	Variable

Note: Percentages Represent Estimated Average Distribution Across Karnataka Repositories

2) Content Analysis and Repository Population Dynamics

Content analysis reveals that electronic theses and dissertations constitute the predominant material category within Karnataka university repositories, consistent with national mandates and Shodhganga requirements [Kumar and Arora \(2015\)](#). However, inclusion of additional research outputs remains limited. Journal articles, despite representing substantial portions of faculty research productivity, appear infrequently in repositories due to copyright restrictions, publisher policies, and faculty concerns about premature disclosure [Davis and Connolly \(2007\)](#).

Metadata quality demonstrates substantial variation across repositories and institutions. Premier institutions typically maintain comprehensive metadata following Dublin Core and discipline-specific schemas, employing controlled vocabularies and authority files [Bhat \(2013\)](#). State and private universities exhibit more variable practices with frequent issues including incomplete metadata records, inconsistent field application, limited controlled vocabulary usage, inadequate rights documentation, and minimal abstract or keyword provision [Roy and Mukhopadhyay \(2022\)](#).

Table 2

Table 2 Challenges in Institutional Repository Development: A Multi-Dimensional Analysis		
Challenge Category	Specific Issues	Frequency/Severity
Content Management	Low deposit rates, limited content diversity	High
Metadata Quality	Inconsistency, incompleteness, poor standardization	High
Faculty Engagement	Reluctance to deposit, awareness gaps	Very High
Technical Infrastructure	Platform limitations, interoperability issues	Moderate
Sustainability	Funding uncertainty, staffing constraints	High
Policy Frameworks	Absent or incomplete governance structures	Very High
User Experience	Poor discoverability, limited customization	Moderate-High

Note: Percentages Represent Estimated Average Distribution Across Karnataka Repositories

Figure 2

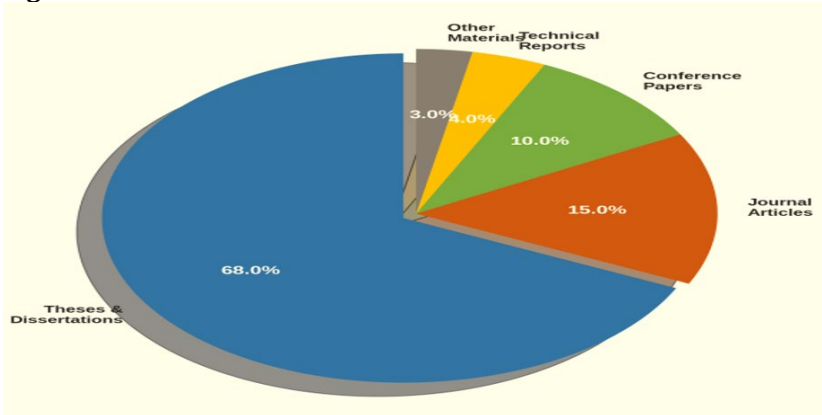


Figure 2 Distribution of Content Types in Karnataka University Repositories

Note: Percentages Represent Estimated Average Distribution Across Karnataka Repositories

6. AI-ASSISTED FRAMEWORK FOR INSTITUTIONAL REPOSITORIES

6.1. PROPOSED AI-ASSISTED THEORETICAL FRAMEWORK

- **Framework Architecture and Conceptual Design**

The proposed framework integrates artificial intelligence capabilities with existing repository infrastructure to address identified challenges while enhancing functionality, user experience, and operational efficiency [Greyling \(2025\)](#). The conceptual architecture comprises five interconnected layers operating synergistically to create an intelligent repository ecosystem. These layers include intelligent metadata management providing automated description generation and consistency maintenance, content curation and classification enabling automatic organization and trend identification, personalized discovery systems delivering customized user experiences, quality assurance mechanisms ensuring content integrity and standards compliance, and predictive analytics providing strategic insights for repository management.

Framework design emphasizes several critical principles ensuring practical applicability and sustainability. Compatibility with existing open-source platforms particularly DSpace and EPrints enables integration without complete system replacement [Velmurugan \(2013\)](#). Modular architecture allows incremental implementation beginning with high-value components. Scalability accommodates institutions of varying sizes and resources. User-centered design prioritizes intuitive interfaces and enhanced experiences. Ethical AI deployment addresses privacy, transparency, and accountability concerns [Authors Alliance. \(2025\)](#). Standards compliance maintains interoperability with external systems and aggregators.

- **Intelligent Metadata Management Layer**

Automated metadata generation represents a foundational capability addressing the labor-intensive nature of manual description creation. Natural language processing algorithms analyze document full-text to extract essential bibliographic elements including titles, author names, publication dates, abstracts, and subject keywords. Machine learning models trained on high-quality existing metadata learn institutional conventions and standards, enabling consistent application across new deposits. Metadata enrichment processes automatically enhance basic descriptions with additional contextual information. Subject classification algorithms assign appropriate disciplinary categories and keywords from controlled vocabularies. Citation extraction identifies references enabling automatic relationship mapping. Language identification and translation capabilities support multilingual metadata creation, particularly valuable for Karnataka's diverse linguistic environment.

- **Content Curation and Classification Layer**

Intelligent content curation employs machine learning classification algorithms to automatically categorize research outputs by multiple dimensions including subject disciplines, document types, research methodologies, and content formats. Topic modeling techniques identify latent themes and emerging research areas within repository collections, providing valuable intelligence for institutional research strategy and resource allocation. Content quality assessment mechanisms analyze documents across multiple quality dimensions. Completeness scoring evaluates metadata comprehensiveness and full-text availability. Format

standardization checking identifies materials requiring conversion or enhancement. Accessibility compliance assessment verifies adherence to universal design principles. Preservation risk analysis identifies content requiring format migration or additional preservation actions [Mahesh and Kumar \(2022\)](#).

Table 3

Table 3 AI Technologies and Their Repository Applications			
AI Technology	Implementation Method	Repository Function	Expected Benefits
Natural Language Processing	Text analysis, entity extraction, semantic understanding	Metadata generation, content analysis, search enhancement	Reduced manual effort, improved consistency, enhanced discoverability
Machine Learning Classification	Supervised learning, deep neural networks, ensemble methods	Content categorization, subject assignment, format identification	Automated organization, improved navigation, trend identification
Recommendation Systems	Collaborative filtering, content similarity, hybrid approaches	Personalized suggestions, related content discovery	Enhanced engagement, improved satisfaction, increased usage
Text Similarity Analysis	Vector embeddings, cosine similarity, document fingerprinting	Plagiarism detection, duplicate identification, content linking	Academic integrity, quality assurance, relationship discovery
Predictive Analytics	Time series analysis, regression models, pattern recognition	Usage forecasting, trend prediction, resource planning	Proactive management, strategic planning, resource optimization
Computer Vision	OCR, image recognition, figure extraction	Image processing, diagram indexing, accessibility enhancement	Expanded searchability, improved accessibility, enhanced usability

Figure 3

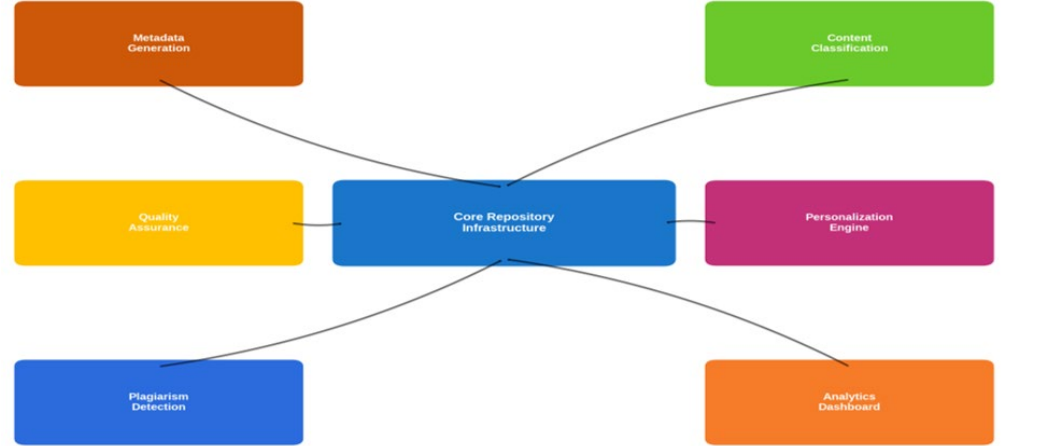


Figure 3 AI-Assisted Framework Architecture for Institutional Repositories

Note: Arrows Indicate Data Flow and Functional Integration Between Components

7. CRITICAL RESEARCH GAPS AND FUTURE INVESTIGATION PRIORITIES

Comprehensive analysis of institutional repository development in Karnataka universities reveals substantial research gaps requiring scholarly investigation and empirical validation. These gaps span technical, organizational, social, and policy dimensions, collectively representing significant opportunities for advancing repository theory and practice.

- **Absence of Regional Coordination Mechanisms**

Karnataka lacks comprehensive state-level coordination frameworks for institutional repository development, resulting in fragmented initiatives, redundant efforts, and missed opportunities for resource optimization and collaborative development. Research examining coordination framework design, governance structures, resource sharing models, policy alignment mechanisms, and implementation strategies specific to regional contexts represents a critical priority.

- **Limited Empirical Research on AI Integration**

Despite theoretical discussions regarding artificial intelligence applications in repository management, empirical research documenting actual implementations, assessing effectiveness, identifying implementation challenges, and evaluating user acceptance remains severely limited [Greyling \(2025\)](#), [Authors Alliance. \(2025\)](#). The AI-assisted framework proposed in this study requires rigorous empirical validation through controlled experiments, pilot implementations, and longitudinal evaluations.

- **Insufficient Understanding of Participation Dynamics**

While faculty participation challenges are well documented [Davis and Connolly \(2007\)](#), deep understanding of underlying motivations, barriers, and facilitators within Karnataka university contexts remains limited. Research priorities include disciplinary differences in open access attitudes and behaviors, relationships between repository participation and academic reward structures, institutional culture influences on scholarly communication practices, and effective change management strategies.

- **Limited Research on Sustainability Models**

Long-term financial and organizational sustainability represents a fundamental challenge for institutional repositories, yet research examining viable sustainability models for Indian universities remains limited. Critical questions include optimal staffing structures, sustainable funding mechanisms, cost-benefit analysis methodologies, partnership and consortium models, and strategies for maintaining institutional commitment beyond founding champions.

- **Inadequate Attention to Multilingual Content**

Karnataka's multilingual academic environment produces substantial research outputs in Kannada and other regional languages. However, institutional repositories predominantly emphasize English-language content with inadequate attention to multilingual materials. Research gaps include best practices for multilingual metadata creation, technical requirements for non-Latin script support, and preservation considerations for digital Kannada materials.

- **Underdeveloped Policy Research and Framework Development**

Comprehensive policy frameworks encompassing copyright management, preservation standards, access policies, quality control procedures, and ethical

guidelines for AI deployment remain underdeveloped within Karnataka contexts. Development of evidence-based policy templates adapted to Indian legal frameworks, institutional contexts, and cultural considerations represents an urgent priority.

- **Limited User-Centered Research**

User-centered research examining how diverse stakeholder groups discover, access, and utilize repository content remains limited within Karnataka contexts [Marques and Borba \(2017\)](#). Understanding user information-seeking behaviors, barriers to repository usage, preferences for content organization and presentation, mobile access patterns, and integration with research workflows is essential for designing effective user-centered repositories.

Table 4

Table 4 Summary of Research Gaps and Proposed Investigation Approaches		
Research Gap	Key Questions	Investigation Approach
Regional Coordination	Framework design, governance, resource sharing	Qualitative analysis, case studies
AI Integration	Implementation feasibility, effectiveness	Pilot projects, controlled studies
Participation Dynamics	Motivation, barriers, discipline variations	Mixed-methods research, surveys
Sustainability Models	Funding mechanisms, staffing structure	Organizational analysis, comparative studies
Multilingual Content	Script support, metadata creation	Technical assessment, policy research
Policy Development	Standards, IP management, ethics	Policy analysis, stakeholder consultation
User Behavior	Discovery patterns, preferences, workflows	User studies, behavioral analysis

8. THEORETICAL RECOMMENDATIONS FOR FUTURE RESEARCH AND IMPLEMENTATION

This theoretical investigation proposes recommendations for future research and eventual practical implementation of the AI-assisted framework and broader repository development initiatives. These recommendations are grounded in comprehensive literature analysis and theoretical modeling rather than empirical validation, recognizing that actual implementation will require substantial additional research, testing, and refinement based on institutional contexts and stakeholder needs.

- **Phased Approach for Future Development**

Future implementation efforts should adopt phased approaches prioritizing high-value, lower-risk components initially while building toward comprehensive integration. Initial phases might focus on automated metadata generation capabilities offering immediate practical value with relatively straightforward implementation. Subsequent phases could progressively add content classification, recommendation systems, quality assurance mechanisms, and advanced analytics. This incremental strategy enables iterative learning, stakeholder familiarization, and capability demonstration while managing implementation complexity and resource requirements.

Institutional selection for future implementation should consider diversity across institution types, sizes, and repository maturity levels to ensure framework

applicability across varied contexts. Selection criteria might include demonstrated administrative commitment through resource allocation and policy support, existing repository infrastructure providing implementation foundations, willingness to participate in research activities including data collection and evaluation, and technical capacity for system implementation and maintenance.

• Stakeholder Engagement and Capacity Building

Successful repository development requires comprehensive stakeholder engagement and capacity building strategies addressing cultural, organizational, and behavioral dimensions [Sinha and Satpathy \(2017\)](#). Faculty members require awareness programs emphasizing repository benefits, copyright guidance, deposit workflow instruction, and integration with existing research practices. Graduate students benefit from training on thesis preparation standards, repository submission procedures, and utilizing repository resources.

Change management strategies should address cultural barriers to repository adoption through multiple approaches. Aligning participation incentives with academic reward structures by recognizing repository contributions in promotion decisions can motivate faculty engagement. Celebrating early adopters creates social proof effects. Addressing copyright concerns through clear guidelines reduces participation barriers. Demonstrating tangible benefits including increased research visibility strengthens value propositions.

Table 5

Table 5 Recommended Phased Approach for Future Framework Development

Phase	Timeline	Primary Objectives	Key Components
Phase 1: Foundation	Months 1-6	Pilot site selection, stakeholder engagement	Planning, consultation, site preparation
Phase 2: Development	Months 7-18	Initial implementation, metadata automation	System setup, staff training, module 1 deployment
Phase 3: Enhancement	Months 19-30	Content curation, advanced features	Classification algorithms, quality assurance
Phase 4: Evaluation	Months 31-36	Impact assessment, scalability testing	Evaluation studies, refinement
Phase 5: Dissemination	Months 37-42	Regional deployment, knowledge transfer	Replication, policy development

9. CONCLUSION

This theoretical investigation has examined institutional repository development in Karnataka universities, identifying critical research gaps and proposing an artificial intelligence-assisted framework to enhance repository functionality and address persistent challenges. Analysis reveals that while Karnataka possesses substantial higher education infrastructure with several well-established repositories, significant variations persist across institution types in adoption maturity, content population, technical sophistication, and sustainability practices [Mahesh and Kumar \(2022\)](#), [Katagi \(2022\)](#).

The proposed AI-assisted framework offers a comprehensive, theoretically-grounded approach integrating intelligent metadata management, automated content curation, personalized discovery systems, quality assurance mechanisms, and predictive analytics capabilities [Greyling \(2025\)](#). This framework balances technological innovation with practical implementation considerations, recognizing that sustainable repository development requires coordinated attention to

technical, organizational, cultural, and policy dimensions [Sinha and Satpathy \(2017\)](#).

Seven critical research gaps have been identified requiring scholarly investigation and empirical validation. These encompass regional coordination mechanisms, technology integration strategies, stakeholder participation dynamics, sustainability models, multilingual content management, policy framework development, and user behavior understanding. Addressing these gaps through focused research programs, empirical studies, and collaborative initiatives will substantially advance institutional repository development in Karnataka while potentially providing models applicable to broader contexts.

As Karnataka universities navigate digital transformation challenges, institutional repositories represent both essential infrastructure and strategic opportunities. By embracing technological innovation, addressing identified research gaps, implementing evidence-based frameworks, and fostering collaborative networks, Karnataka can advance institutional repository development contributing to regional educational advancement and broader scholarly communication ecosystems. This theoretical investigation provides a conceptual foundation for that development trajectory, combining rigorous analysis with forward-looking frameworks to guide future research and implementation efforts.

CONFLICT OF INTERESTS

None.

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None.

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