An AI-Driven Framework for Meeting Minutes Management to Enhance Governance Efficiency in Higher Education Institutions in Sri Lanka

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Abstract

In many of the Sri Lankan public universities, the process of managing the minutes of meetings is a complicated process that is usually based on the conventional process that is paper based. The process hinders the capacity to monitor key decisions, transparency, and legal requirements. The current study provides a feasible, economical model to manage these essential records through low cost AI tools and Open source applications to streamline the workflow. The suggested framework will incorporate technology to transcribe spoken audio of meetings into text and automatically extract important decisions and action items, as well as to digitize legacy paper minutes so that they can be searched in full text. All the records are stored in a central digital repository where they are stored long-term and accessed in a controlled manner. It is proposed architecture will save time in the creation and management of minutes, make them more accurate and audible, and more compliant with laws like the Right to Information (RTI) Act. Finally, the framework offers a feasible avenue to modernization of the record-keeping, but its effectiveness hinges on institutional support to adopt the framework in phases, specific staff training and adaptation of the tools to the local languages, such as Sinhala and Tamil.

Keywords: *Record Managements, Artificial Intelligence, Open source AI, Digitalization*

Introduction

Meeting minutes are core institutional records that document deliberations, resolutions, and follow up actions across governing bodies such as Councils, Senates, and Faculty Boards. For public universities in Sri Lanka, these records support legal accountability and public transparency under the Universities Act No. 16 of 1978 and obligations consistent with the Right to Information (RTI) Act No. 12 of 2016, which collectively underscore systematic recordkeeping, preservation, and controlled disclosure by public authorities (Sri Lanka, 1978, 2016). Despite their significance, many Sri Lankan universities continue to rely on paper based or loosely organized digital practices that impede timely retrieval, complicate audit preparedness, and weaken decision traceability. These issues are particularly visible during accreditation cycles, internal audits, and RTI responses, where the absence of

standardized metadata, incomplete indexing, and disparate storage formats produce delays and inconsistencies. Drawing on the author's more than a decade of engagement with university governance processes (e.g., Faculty Boards, Senate committees), this paper proposes a modular, open source first, AI enabled framework designed for the end to end management of meeting minutes in Sri Lankan higher education. The framework integrates automatic speech recognition (ASR), natural language processing (NLP), optical character recognition (OCR), and repository based digital preservation to deliver improvements in timeliness, accuracy, and auditability while safeguarding data privacy and linguistic inclusivity (English, Sinhala, and Tamil).

Research Aim and Objectives

The aim of this study is to design and justify a scalable, low cost AI framework for minute creation, structuring, preservation, and retrieval that aligns with Sri Lankan legal and institutional conditions and accords with international records management principles. Two objectives guide the work:

1. To synthesize global research and tooling relevant to AI assisted transcription, decision/action extraction, meeting summarization, and standards aligned preservation; and
2. To specify a customizable architecture: prioritizing offline capable components that Sri Lankan public universities can adopt incrementally under University Grants Commission (UGC) oversight.

The framework is explicitly aligned with ISO 15489 1:2016 (records as authentic, reliable, usable, and with integrity over time) and emphasizes metadata, disposition, and access control as cross cutting concerns (International Organization for Standardization [ISO], 2016).

Methods and Methodology

This study uses a practice-informed design methodology, grounded in the author's decade-long experience in academic governance, extensive involvement with administrative officers and the scientific evidences related study. Instead of interviews, this real-world insight shapes the system requirements and design with a targeted technology review to propose a four module architecture:

1. Speech to Text (ASR). Whisper is adopted as the default ASR component to transcribe meeting audio in English and, with evaluation and adaptation, Sinhala and Tamil. The model's multilingual pre-training and strong noise/accent robustness reduce manual effort and enable near real time drafting of minutes. Critically, Whisper can run fully offline, supporting data sovereignty policies common in public universities (Radford et al., 2022).

2. Information Extraction and Structuring. spaCy serves as the NLP backbone for extracting entities and governance specific patterns such as motions, resolutions, responsible officers, and deadlines. Rule based matchers and custom pipelines allow rapid prototyping of minute specific templates. For Sinhala and Tamil, instructions can combine rule patterns with custom training on curated, de identified minutes to mitigate low resource challenges.
3. Digitization of Legacy Minutes. Tesseract OCR is used to convert historic paper minutes and annexures to text searchable PDFs. The open source engine is strong for printed text across many scripts, though handwriting recognition remains limited; selective manual key data entry or form driven capture may be required for handwritten sections (Smith, 2007).
4. Preservation and Access. DSpace functions as the repository of record for master copies, metadata, retention/disposition, and role based access. Its REST API and OAI PMH interfaces support system integration, while metadata templates ensure consistent capture of governance critical fields such as agenda item, motion text, mover/seconder, vote, action owner, due date.

Results and Discussion

The framework addresses key operational bottlenecks in governance documentation (Smith et al., 2021). Whisper delivered 95% transcription accuracy on clean audio datasets, supporting multilingual governance tasks (Radford et al., 2023). Meanwhile, spaCy effectively extracted metadata for search and archival purposes using Named Entity Recognition (NER) and syntactic parsing (Honnibal & Montani, 2020). Tesseract OCR demonstrated over 90% success in digitizing typed paper records, particularly for printed forms and government documents (Patel et al., 2020). DSpace enabled semantic tagging and role-based access control, improving information retrieval and legal auditability in archival systems (Smith & Walker, 2018).

These components reduce minute-processing time by over 60%, as reported in similar e-governance workflow automation case studies (Chakraborty & Sharma, 2022), while enhancing transparency and version control. Adaptability is assured through the framework's modular design (Rahman et al., 2021). The author’s practical experience suggests that administrative staff are eager for efficiency, though many require training to fully utilize digital tools. Consequently, the framework recommends bilingual user manuals and onboarding workshops (Fernando & Wijesekera, 2023). Adoption barriers such as Sinhala NLP limitations can be addressed by localized model training using small language corpora and transfer learning (Perera et al., 2022). Institutions are advised to start with pilot committees, then scale the system post-validation (Nadkarni et al., 2021).

Feasibility and expected benefits. Evidence from the ASR and meeting summarization literature suggests that pairing robust transcription with targeted extraction can materially reduce the time from meeting to draft minutes while improving the recall of decisions and assigned actions (Carletta et al., 2005; Hu et al., 2023; Radford et al., 2022). In the proposed stack, Whisper accelerates transcript generation; spaCy then structures the output into minute oriented fields useful for approval workflows and tracking. Embedding the resulting records in DSpace centralizes authoritative versions and enables metadata driven retrieval ("all Senate resolutions on curriculum revisions, 2022–2025"), which supports audit readiness and expedites RTI(Right to Information) responses (DSpace, 2025; ISO, 2016).

Alignment with records principles and legal context. ISO 15489 emphasizes authenticity, reliability, integrity, and usability; the framework operationalizes these through controlled capture, metadata templating, versioning, and audit logs at the repository layer. The Sri Lankan Universities Act helps clarify custodianship and governance authorities, while the RTI regime motivates comprehensive but controlled disclosure and progressive digitization within resource constraints (ISO, 2016; Sri Lanka, 1978, 2016). A repository centric architecture with role based access and embargo functions balances transparency with statutory exemptions (e.g., personal data, deliberative privilege).

Language and tooling considerations. While spaCy and similar toolkits provide strong pipelines for high resource languages, Sinhala and Tamil need localization. Practical steps include (a) building rule patterns keyed to recurring governance phrases, (b) implementing custom tokenization for scripts, and (c) training supervised entity models on de identified, institution specific corpora. For ASR, Whisper's multilingual capability provides a viable baseline, but institutions should conduct local benchmarks to understand word error rates across accents, domains, and meeting acoustics, and to decide whether to fine tune smaller variants for efficiency (Explosion, n.d.; Radford et al., 2022).

The proposed, open source first stack confers clear advantages: by privileging tools such as Whisper, spaCy, Tesseract, and DSpace, institutions minimize licensing costs while retaining sovereignty through on premises deployment; automated transcription and rule guided extraction accelerate drafting and improve consistency and quality of minutes; repository backed stewardship aligns with ISO 15489 principles and streamlines responses under Sri Lanka's Right to Information (RTI) legal and institutional framework—principally the Right to Information Act, No. 12 of 2016; and standards based interfaces (APIs, OAI PMH) enable integration with enterprise systems without vendor lock in. These strengths are counterbalanced by limitations that must be managed deliberately: OCR remains unreliable for unconstrained handwriting, making selective manual key data entry unavoidable for older archives; robust Sinhala/Tamil NLP requires local rule design,

tokenization, and (where feasible) supervised model training; adoption success depends on targeted user training, governance specific SOPs, and clear role delineation; and even "offline" AI entails non trivial compute, storage, and repository administration capacity. Taken together, the framework's benefits are compelling, provided institutions plan for handwriting gaps, invest in language localization, and resource the operational backbone needed to sustain a repository centered workflow (DSpace, 2025; Smith, 2007)

Adoption and scaling strategy. A phased approach is recommended;

1. Readiness and policy gap analysis: Map minute keeping workflows, retention schedules, and RTI processes; harmonize institutional policies with ISO 15489 concepts (ISO, 2016).
2. Governance and custodianship: Affirm and document custodial and responsibilities for capture, description, and disclosure under the Universities Act and RTI frameworks
3. Pilot scope: Launch a 12 week pilot for a single body (e.g., a Faculty Board), deploying Whisper for ASR, Tesseract for legacy minutes, and spaCy patterns for decisions/actions; evaluate extraction precision/recall using small gold standard sets inspired by meeting summarization evaluation practices
4. Repository configuration: Set up DSpace and implement a minute's metadata application profile
5. Training and SOPs: Provide role specific training for chairs/secretaries/record officers
6. Scale out: Extend to Senate and Council; integrate repository endpoints with institutional portals and QA systems
7. Continuous improvement: Monitor throughput from meeting to approved minutes, retrieval times for RTI responses, and extraction error rates; iterate models, patterns, and metadata policies accordingly

Ethical, security, and compliance considerations:

Minutes often contain personal data and sensitive information. An offline first ASR/NLP stack reduces exposure, while any cloud supplements must be governed by consent, contractual protections, and data processing agreements. Repository access should implement least privilege principles, time bound embargoes, and complete audit trails. With these controls, the framework supports transparency and accountability while respecting statutory exemptions and privacy expectations (ISO, 2016; Otter.ai, 2025).

Conclusion

The proposed AI enabled framework combining Whisper (ASR), spaCy (information extraction), Tesseract (OCR), and DSpace (storing, preservation and access)offers a practical path to modernize meeting minutes management in Sri Lankan universities. By centering on standards aligned metadata, role based access, and reproducible pipelines, the approach strengthens legal compliance, operational efficiency, and institutional memory. To realize these benefits, institutions should invest in linguistic localization for Sinhala/Tamil, address the realities of handwritten legacy archives, and adopt structured change management practices. Implemented through phased pilots and repository centric custodianship, the framework can yield a sustainable, auditable, and privacy aware ecosystem for governance documentation aligned with international records management principles and the Sri Lankan legal context.

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Are We Prepared for the Algorithm? A Policy and Legislative Review on Governing AI in Higher Education in Sri Lanka

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Introduction

Artificial Intelligence (AI) has become a transformative force in higher education globally, revolutionizing teaching, research, and administration. Universities now employ AI in student admissions, curriculum design, plagiarism detection, and adaptive learning systems. These developments bring enormous potential for efficiency and innovation, yet they also raise pressing questions about ethics, data protection, intellectual property (IP), transparency, and equity. The convergence of these challenges demands coherent legal and policy responses to ensure responsible AI adoption.

In Sri Lanka, higher education institutions have begun integrating AI through learning management systems (LMS), plagiarism detection tools, and, more recently, generative AI technologies such as ChatGPT and Gemini. Despite these advancements, the legal and policy framework governing AI in academia remains underdeveloped. The central question this study addresses is: Do we have sufficient legislation and policy measures to effectively address the issues arising from AI integration in higher education?

This research critically examines the adequacy of Sri Lanka's national legislation, institutional policies, and regulatory frameworks in guiding ethical and secure AI use in universities. It also benchmarks these against regional and international policy models to identify actionable reforms that can foster an equitable, transparent, and accountable AI governance framework in higher education.

The objectives are to: (1) identify and analyze Sri Lanka's existing legislation and policy mechanisms relevant to AI governance in education; (2) assess institutional preparedness for implementing AI ethically and effectively; (3) compare Sri Lanka's efforts with international and regional legislative models; and (4) propose reforms addressing legal, ethical, and institutional gaps to ensure safe AI adoption in academia.

Methodology

The study adopts a qualitative approach, combining legal-document analysis, policy benchmarking, and institutional review. It examines key Sri Lankan laws, including the Personal Data Protection Act No. 9 of 2022, Computer Crimes Act No. 24 of 2007, and the Intellectual Property Act No. 36 of 2003. University Grants

Commission (UGC) circulars, institutional codes of conduct, and internal university policies are also analyzed.

This national review is complemented by an international comparative analysis involving the EU Artificial Intelligence Act (2024), UNESCO's Recommendation on the Ethics of Artificial Intelligence (2021), UNESCO's Guidance for Policy-Makers on AI in Education (2023), the US Blueprint for an AI Bill of Rights (2022), and regional education policies such as India's National Education Policy (2020) and Singapore's Smart Nation and AI Strategy 2.0 (2023). The research further considers intellectual property governance debates under the World Intellectual Property Organization (WIPO) AI and IP Policy Consultation Papers (2024).

Data were supplemented by semi-structured interviews with academic administrators and ICT coordinators from four state universities to understand current institutional practices and governance readiness.

Findings and Discussion

Findings indicate that Sri Lanka has developed foundational legislation—particularly in data protection—but lacks sector-specific legal instruments addressing AI in education. The Personal Data Protection Act (2022) offers broad privacy protection but does not directly regulate AI-enabled data processing in educational settings. For example, there are no formal guidelines governing the use of automated proctoring systems, facial-recognition attendance tools, or data analytics algorithms in student assessment. Furthermore, no standardized framework exists for conducting AI impact assessments in academic decision-making processes.

The Intellectual Property Act (2003) also shows limitations in addressing AI-generated academic content. Questions surrounding authorship, ownership, and originality remain unresolved. Globally, jurisdictions such as the European Union and Australia are revising copyright frameworks to address AI-generated works, while the United States and the United Kingdom have initiated consultations on AI authorship rights. In contrast, Sri Lanka has yet to engage in similar policy discourse, leaving universities without guidance on AI-assisted research outputs or educational materials.

Institutionally, awareness of AI's ethical and operational implications remains inconsistent. Interviews revealed that universities vary widely in their policies on AI use. Some institutions prohibit AI tools in coursework, while others lack clear regulations altogether. Faculty members often rely on software disclaimers rather than institutional guidance when using AI-powered plagiarism detection or grading systems. Moreover, training opportunities on digital ethics and algorithmic transparency are minimal, highlighting a gap in institutional readiness.

At the policy level, the UGC has not yet issued formal guidelines for AI governance in higher education. There is no dedicated body to evaluate the ethical or pedagogical impact of AI tools introduced into university environments. This contrasts with India's National Education Policy (2020), which promotes responsible AI integration, and Singapore's AI in Education Strategy, emphasizing transparency, accountability, and data ethics. In the European context, the EU AI Act (2024) classifies educational AI systems as "high-risk," mandating documentation, human oversight, and data protection compliance—measures absent in the Sri Lankan framework.

Furthermore, the study highlights equity and fairness concerns. AI-driven student recruitment and predictive analytics risk amplifying existing disparities in access to education based on language, socioeconomic background, or geography. Without robust governance, such technologies could deepen inequalities and erode trust in academic fairness. These findings underscore the urgent need for institutional oversight mechanisms and national-level coordination.

Globally, the UNESCO Recommendation on the Ethics of AI (2021)endorsed by Sri Lanka calls for inclusivity, transparency, and human accountability in AI deployment. However, these principles remain largely aspirational within Sri Lankan universities, as there are no localized mechanisms for monitoring compliance or ensuring recourse for affected students or staff.

Recommendations and Conclusion

To address these gaps, this study proposes a multi-level governance strategy.

1. National Policy Framework: The UGC should spearhead the formulation of a National AI in Higher Education Framework incorporating ethical standards, data protection, algorithmic transparency, and periodic audits. It should also outline acceptable AI applications and provide mechanisms for grievance redress.
2. Legislative Reform: Amendments to the Personal Data Protection Act (2022) and Intellectual Property Act (2003) should explicitly address AI-related concerns, including authorship of AI-assisted works, informed consent for data use, and accountability in automated decision-making.
3. Institutional Capacity Building: Universities should establish AI Ethics Committees and provide training for academic and administrative staff on responsible AI use, bias mitigation, and human oversight.
4. International Collaboration: Sri Lanka should align with global and regional governance models, participating in forums like UNESCO's Global AI Ethics Observatory and WIPO's AI and IP Policy Dialogue to harmonize standards.

5. AI Literacy and Public Awareness: Introducing AI ethics and digital literacy into university curricula can cultivate informed educators and learners capable of engaging critically with AI technologies.

While Sri Lanka has made commendable strides in digital regulation through the Data Protection Act and cyber laws, these efforts fall short in addressing the distinct challenges posed by AI in higher education. As AI continues to influence every dimension of academia—from teaching and assessment to intellectual property and institutional governance—it is essential that legal and policy frameworks evolve proactively. This study underscores the need for rights-based, context-specific, and collaborative governance to ensure that the promise of AI enhances, rather than undermines, academic integrity and equity.

Keywords: *Academic integrity, Intellectual property, Data protection, Digital ethics*

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Artificial Intelligence in Sustainable Construction Practices: Perspectives from the Higher Education Sector

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Abstract

This study investigates AI integration in sustainable construction within higher education, addressing institutional hesitation despite proven benefits. Through systematic desk research of 65 key publications (2018-2024) from academic databases and grey literature, thematic analysis identified patterns in AI adoption, sustainability outcomes, and implementation barriers. The investigation reveals AI's significant contribution through three primary applications: design optimization via BIM integration, real-time energy management using IoT sensors, and predictive maintenance systems. These technologies deliver measurable improvements, including energy consumption reductions (20-35%), maintenance cost savings (25-40%), and construction waste reduction (20-30%). Leading institutions like University of British Columbia, Nanyang Technological University, and IIT Delhi demonstrate successful implementations with substantial operational efficiencies. Despite proven benefits, widespread adoption faces considerable obstacles. High initial investment costs, fragmented procurement processes, insufficient technical expertise, and data privacy concerns create significant barriers. Legacy system integration and staff training requirements further complicated implementation, leading to project delays and increased costs. Effective AI integration necessitates comprehensive institutional readiness strategies. Universities must develop cross-disciplinary teams combining engineering, IT, sustainability, and finance expertise. Essential elements include dedicated funding mechanisms, robust data governance frameworks, and strategic technology partnerships. Successful institutions establish governance structures supporting public-private collaboration while ensuring standardized data management and cybersecurity protocols. The study emphasizes AI's transformative potential for creating intelligent, efficient, and environmentally responsible campus environments. However, realizing this potential requires proactive strategies addressing organizational, technical, and financial barriers. Universities should establish baseline sustainability metrics before AI deployment and implement evaluation frameworks demonstrating return on investment. Future research should focus on comprehensive cost-benefit analyses across diverse university contexts, longitudinal studies tracking environmental impact, and comparative analyses between public and private institutions. Ethical governance frameworks for AI implementation represent critical research needs for facilitating broader, more equitable adoption.

Keywords: *Artificial Intelligence, Sustainable Construction, Higher Education, Campus Management, Green Building*

Introduction

Sustainable construction is crucial in modern infrastructure development. Artificial Intelligence (AI) offers significant opportunities to enhance environmental care and operational efficiency (Suryawanshi et al., 2024). AI technologies, including machine learning, predictive analytics, and smart automation, are transforming construction. They enable real-time monitoring, improved energy use, and intelligent project planning. This technological shift holds particular importance for higher education. Universities, as major builders and innovation drivers are uniquely positioned to lead in sustainable building methods (Chong et al., 2025).

Globally, universities manage vast physical infrastructures. They also function as research centers and community leaders in sustainability efforts. While AI applications offer clear benefits in commercial construction, such as improved decision-making, reduced environmental impact, and better resource use, AI implementation in university construction projects remains largely unexplored. This constitutes a significant research gap (Koufos et al., 2021), especially concerning AI's role in campus sustainability initiatives.

This study addresses a key paradox: despite the increasing availability and proven benefits of AI technologies in sustainable construction, many higher education institutions have been slow to adopt them. This hesitation arises from several factors, including limited awareness of AI capabilities (Bang & Andersen, 2022), resource constraints, insufficient technical expertise, and a lack of strategic vision for technology integration (Chowdhury, 2025). Consequently, institutions are missing opportunities to leverage AI for achieving ambitious sustainability goals, such as carbon neutrality and smart campus development (Moura et al., 2021).

This desk research aims to bridge this knowledge gap by systematically examining AI's use in sustainable construction within higher education (Leal Filho et al., 2024). The study has four main objectives. First, it will identify current AI technologies applicable to sustainable university construction. Second, it will explore the benefits and limitations of AI in university infrastructure. Third, it will analyze successful AI integration cases in green building projects. Finally, it will assess the institutional and technical challenges impacting AI adoption in sustainable campus construction (Beer, Chiel & Drushel, 1999).

Literature Review

AI has significantly expanded its role in construction, moving from initial experiments to becoming a core component of modern building processes (Sacks, Girolami & Brilakis, 2020). Recent advancements in deep learning and digital twin technologies enable complex applications. These include continuous performance monitoring and scenario testing for building designs (Ali et al., 2024). Digital twins,

virtual replicas of physical structures, notably reduce planning errors and optimize design accuracy and construction efficiency when combined with AI algorithms (Ali et al., 2024). Furthermore, machine learning now extends beyond simple risk analysis to complex structural optimization. Generative design algorithms simultaneously improve material efficiency and load-bearing capacity (Sacks, Girolami & Brilakis, 2020).

Computer vision technologies have transformed on-site safety and quality control (Sacks, Girolami & Brilakis, 2020). Automated defect detection systems are now common, with convolutional neural networks identifying structural defects in concrete in real-time, achieving over 90% accuracy (Gaur et al., 2023). Similarly, reinforcement learning drives autonomous construction robotics, reducing human labor while improving consistency and safety. These technological shifts signify a transition from reactive to predictive construction management.

The sustainable campus movement has accelerated since 2020, propelled by institutional commitments to carbon neutrality and environmental. AI's contribution to sustainability now extends beyond design to comprehensive lifecycle management (Kanáliková et al., 2019). Machine learning models predict long-term energy use under various climate scenarios, informing critical decisions on material choice, façade design, and building system integration (Chowdhury, 2025). Research from European universities validates the economic and environmental benefits of AI-powered building optimization, demonstrating potential annual HVAC energy consumption reductions of 15-20% (Chowdhury, 2025).

Smart campus ecosystems now integrate Internet of Things (IoT) sensors, edge computing, and AI in both operations and new construction. Advanced frameworks propose AI-driven campus management systems that use federated learning to protect data privacy and enable cross-building energy optimization (Alharithi & Alzahrani, 2024). These systems represent a shift towards holistic campus intelligence, where individual building performance contributes to campus-wide sustainability goals. Despite these technological advancements, adoption varies significantly. Surveys indicate fewer than 40% of universities have formal AI strategies for sustainability, with budget constraints and skill shortages acting as major barriers (Uren & Edwards, 2023). Data interoperability challenges from legacy systems limit pilot project scalability. Furthermore, research on ethical AI governance in infrastructure management remains scarce, highlighting a critical gap for institutions balancing innovation with privacy and security concerns.

Research Methodology

This study employed a thorough desk research methodology to review existing knowledge on AI applications in sustainable construction, particularly within higher education settings. The research encompassed three primary phases:

systematic data collection, careful source selection, and thematic analysis (Rane, 2023).

Extensive data collection involved comprehensive searches across multiple academic databases, including Scopus, Web of Science, IEEE Xplore, and Google Scholar (Sacks, Girolami & Brilakis, 2020; Kanáliková et al., 2019). Boolean operators combined keywords such as "AI in construction," "sustainable campus," "smart buildings," "higher education infrastructure," and "green building AI" (Ali et al., 2024). The objective was to identify peer-reviewed articles, conference papers, and industry reports published between 2018 and 2024 (Park, 2024). Additionally, gray literature, including university case studies, government policies, and reports from technology providers found on institutional websites and professional networks, were gathered (Sacks, Girolami & Brilakis, 2020).

Source selection employed a two-step screening process to ensure relevance and quality. Initially, approximately 180 titles and abstracts underwent review. Subsequently, full texts were screened to identify publications focusing on AI-driven design, construction, or maintenance specifically within higher education contexts. The final dataset comprised 65 key publications, selected for their robust methodology, recent publication dates, geographical diversity, and clear links to sustainability outcomes.

Thematic analysis served to identify patterns, innovations, and challenges within the literature (Moura et al., 2021; Chowdhury, 2025). Coding categories encompassed AI technologies and their applications (Chowdhury, 2025), specific sustainability goals such as energy efficiency and waste reduction (Chowdhury, 2025), institutional case studies, and identified barriers to adoption. This systematic coding of qualitative data synthesized findings and mapped results to the research objectives (Ali et al., 2024). This approach ensured broad coverage, identified emerging themes, and highlighted areas for future research.

Results and Discussion

AI is increasingly integrated into sustainable construction within higher education. However, adoption levels vary significantly across institutions and regions (Sacks, Girolami & Brilakis, 2020). AI's primary application involves synergy with Building Information Modeling (BIM) systems. This enhances energy modeling, material efficiency, and detailed scenario planning during design (Sacks, Girolami & Brilakis, 2020). This integration has notably improved design accuracy and reduced material waste. It proves crucial for sustainable decision-making (Ali et al., 2024; Kanáliková et al., 2019).

Beyond design, AI powers predictive maintenance systems. These systems leverage machine learning and IoT sensor networks. They continuously monitor critical infrastructure. This enables proactive maintenance. It significantly

cuts operational downtime and energy use. It also extends facility lifespans. Concurrently, smart energy management platforms utilize AI algorithms for real-time optimization. They profoundly impact campus sustainability. These platforms automatically regulate environmental control based on data and occupancy. This leads to substantial energy consumption reductions and significant annual savings (Moura et al., 2021; Chowdhury, 2025; Ali et al., 2024). AI also aids construction waste management through forecasting. This reduces excess materials and disposal costs (Bang & Andersen, 2022; Moura et al., 2021). However, robotics adoption faces cost and technical challenges (Beer, Chiel & Drushel, 1999).

Leading institutions globally exemplify successful AI implementations. These include the University of British Columbia, Nanyang Technological University, IIT Delhi, and the University of Melbourne. These cases collectively demonstrate AI's clear benefits. They enhance energy efficiency, precise planning, reduced material waste, and predictable maintenance. All are crucial for achieving long-term sustainability goals and smart campus development.

However, significant implementation challenges persist. These encompass high upfront costs, fragmented purchasing, a general lack of technical skills, and data privacy and cybersecurity concerns. Integrating AI with legacy systems is difficult. The substantial need for staff training further contributes to project delays and increased costs. Despite these hurdles, the evidence strongly indicates AI's transformative potential. Successful implementations provide valuable models for broader adoption (Sacks, Girolami & Brilakis, 2020).

AI drives sustainable construction in higher education. It connects design with operational performance (Sacks, Girolami & Brilakis, 2020). Theoretically, AI aligns with sustainability goals. It helps reduce carbon emissions, enhance occupant comfort, and optimize lifecycle costs. Integrating AI into smart campus models provides continuous feedback. This informs both pre-construction planning and post-occupancy optimization.

Top institutions demonstrate clear benefits. Energy consumption decreases by 20-35%. Material waste is also reduced. Predictive maintenance improves, minimizing downtime (Rane, 2023). However, differences in adoption exist. Well-funded institutions test advanced AI-BIM and robotic systems. Universities with fewer resources face challenges with basic digitization. This emphasizes the need for scalable, affordable AI solutions across various contexts (Sacks, Girolami & Brilakis, 2020).

Institutional readiness is vital for successful AI adoption. Universities require cross-disciplinary teams. These teams should combine expertise in engineering, IT, sustainability, and finance (Uren & Edwards, 2023). Successful institutions create governance frameworks. These frameworks facilitate public-private partnerships. They also ensure standardized data management (Kanáliková et

al., 2019). Such organizational capabilities help overcome fragmented procurement and data interoperability problems.

Policy frameworks are essential. They encourage collaboration between universities and technology providers. Successful AI implementations often occur in institutions with dedicated innovation funding. They also establish structures supporting cross-departmental collaboration (Awasthy et al., 2020). Addressing governance, capacity, and financial barriers is crucial. This enables higher education to utilize AI. The aim is to build resilient, intelligent, and sustainable campus infrastructures. These can then model broader community development.

Conclusions and Recommendations

Integrating AI into sustainable construction offers significant opportunities for higher education institutions. This approach can enhance design accuracy and optimize resource use (Ali et al., 2024). Its goal is to notably reduce environmental impact across campus infrastructures (Kanáliková et al., 2019). This desk research confirms AI's transformative potential in this domain.

AI-enhanced digital twin technologies show clear advantages (Ali et al., 2024). Predictive maintenance systems are highly effective (Rane, 2023). Smart energy management platforms also contribute significantly (Chowdhury, 2025). Leading universities globally report measurable improvements (Sacks, Girolami & Brilakis, 2020). Energy consumption can drop by 20-35% (Chowdhury, 2025). Unplanned maintenance events may decrease by 25-40% (Zeb & Lodhi, 2025). Construction waste generation might fall by 20-30% (Uren & Edwards, 2023). These findings highlight substantial operational efficiencies.

However, widespread adoption faces considerable obstacles. High initial investment costs pose a major hurdle. Fragmented procurement processes complicate implementation (van Hoek, 2024). Insufficient technical expertise among facilities management teams remains a persistent challenge. These issues demand systematic institutional responses. Successful AI integration requires comprehensive organizational preparation (Chowdhury, 2025). This includes developing cross-disciplinary expertise. Establishing dedicated funding mechanisms is crucial. Governance frameworks must support technology integration while ensuring data security and privacy.

To overcome these challenges, higher education institutions should develop comprehensive AI readiness strategies. Technology investments must align with institutional master planning and sustainability objectives (Sacks, Girolami & Brilakis, 2020; Bang & Andersen, 2022). Dedicated funding for pilot projects is necessary. Cross-disciplinary task forces, combining engineering, information technology, and sustainability expertise, are essential. Partnerships with technology providers facilitate knowledge transfer and capacity building (Koufos et al., 2021).

Prioritizing staff training programs builds in-house technical capabilities. Organizational structures should support ongoing technology adoption and optimization (Sacks, Girolami & Brilakis, 2020).

The evidence strongly supports implementing AI-driven monitoring systems. These systems track key sustainability metrics over extended periods (Chowdhury, 2025). This enables continuous performance improvement and evidence-based decision-making (Thirunagalingam et al., 2025; Sacks, Girolami & Brilakis, 2020). Universities should establish baseline measurements for energy consumption, waste generation, and maintenance costs before AI deployment. Robust evaluation frameworks are vital to demonstrate return on investment and environmental benefits. This systematic approach supports institutional learning and provides evidence for expanded technology adoption across campus operations (Tarhini, Tarhini & Tarhini, 2019).

Future research should focus on comprehensive cost-benefit analyses across diverse university types and funding contexts (Sacks, Girolami & Brilakis, 2020). Longitudinal studies tracking AI's impact on campus energy consumption and carbon emissions are critical. Comparative analyses of implementation approaches between public and private institutions are also needed. Research into governance frameworks for ethical AI implementation in educational contexts represents a crucial need. Institutions must balance technological innovation with ethical considerations (Tarhini, Tarhini & Tarhini, 2019).

The transformation of higher education infrastructure through AI integration presents both an opportunity and a responsibility. Universities can demonstrate leadership in sustainable development. By systematically addressing implementation barriers and leveraging available technologies, institutions can create intelligent, efficient, and environmentally responsible campus environments. These campuses serve as models for broader community development. They also advance the core educational and research missions of the institution.

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AI-Driven Supplier Assessment and selection for Sustainability Performance in Procurement: A Literature Review

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Abstract

The evolving global business landscape necessitates sustainable supply chain practices, driven by climate change concerns, regulatory frameworks, and heightened stakeholder expectations. While sustainable procurement is a strategic imperative, traditional methodologies face significant limitations due to their subjective, time-consuming nature, inconsistent metrics, and inadequate capacity for processing vast, multi-dimensional Environmental, Social, and Governance (ESG) data. This research addresses this critical gap by developing and validating an AI-driven framework for supplier sustainability assessment and selection, specifically focusing on its applicability within developing economies, exemplified by a case study in Sri Lankan manufacturing. The study's objectives include creating an integrated sustainability scoring methodology utilizing machine learning algorithms to unify diverse ESG criteria, carbon footprint data, and certifications. It also aims to empirically compare the AI-driven approach against traditional methods for accuracy, efficiency, and decision quality, while identifying key organizational and technical factors that influence successful AI implementation. Our core hypotheses posit that AI-driven assessment will demonstrate superior accuracy and that integrated AI frameworks will significantly enhance procurement decision quality and overall sustainability outcomes. A systematic literature review, encompassing over 150 articles from 2018-2024, confirmed the limitations of conventional methods and the promising, yet under-researched, potential of AI in sustainable procurement, particularly highlighting challenges specific to the Sri Lankan context such as data access and resource constraints. The methodology involved comprehensive database searches and thematic analysis to synthesize existing knowledge and identify research gaps. Preliminary findings underscore the inadequacy of traditional approaches for complex sustainability data and emphasize AI's capacity for objective, comprehensive, and scalable assessments. The research concludes by emphasizing the need for validated AI frameworks that integrate sustainability dimensions. This study provides a practical, empirically grounded framework with actionable recommendations for academics, industry, and policymakers to foster resilient procurement practices in developing economies.

Keywords: *Artificial Intelligence, Sustainable Procurement, Supplier Selection, Sustainability Assessment*

Introduction

The contemporary global business landscape is experiencing an unprecedented transformation toward sustainable supply chain practices, primarily driven by escalating climate change concerns, stringent regulatory frameworks, and heightened stakeholder expectations for corporate environmental and social responsibility (Gunawardana et al., 2021). Organizations across various industries are increasingly recognizing that sustainable procurement represents a strategic imperative rather than a peripheral concern, directly influencing long-term competitiveness and organizational resilience (Ofori et al., 2025). This paradigm shift is particularly pronounced in manufacturing, retail, healthcare, and technology sectors, where supply chain sustainability has emerged as a critical differentiator in market positioning and comprehensive risk management strategies.

Traditional procurement methodologies have historically emphasized the fundamental cost-quality-delivery triangle, prioritizing economic efficiency and operational performance above other considerations. However, contemporary procurement practices are rapidly evolving to incorporate comprehensive sustainability integration, encompassing environmental stewardship, social responsibility, and governance excellence as essential evaluation criteria (Hwang, Jitanugoon & Puntha, 2025). Modern organizations must now assess suppliers not only on their capacity to deliver products and services efficiently but also on their demonstrated commitment to sustainable practices, carbon footprint reduction, ethical labor standards, and transparent governance structures (Ng et al., 2024).

Despite growing organizational commitment to sustainability principles, companies face substantial challenges in implementing effective sustainable supplier assessment systems. Manual assessment processes remain inherently time-consuming and subjective, often depending on inconsistent evaluation frameworks that vary significantly across industries and organizational contexts (Kizielewicz et al., 2024; Hwang, Jitanugoon & Puntha, 2025). The complexity intensifies due to inconsistent sustainability metrics across supplier networks, creating significant barriers to standardized comparison and meaningful benchmarking activities (Azadi et al., 2025). Organizations additionally struggle with processing vast volumes of multi-dimensional data encompassing environmental impact assessments, social performance indicators, and governance metrics while lacking adequate capabilities for real-time sustainability performance monitoring.

Organizations consequently struggle to systematically evaluate suppliers' sustainability performance due to the increasingly complex, multi-faceted nature of ESG data and their limited analytical capabilities to effectively process and interpret this critical information (Cao & Sun, 2024). AI-driven approaches offer transformative potential for revolutionizing procurement decision-making processes by enabling objective, comprehensive, and scalable sustainability assessments that

can fundamentally transform traditional supplier selection methodologies (Delina & Macik 2023). Therefore, there exists a critical and urgent need for comprehensive empirical research that demonstrates AI's effectiveness in sustainable supplier selection while developing validated, practical frameworks for successful organizational implementation.

Research Objectives and Questions

This research aims to develop, implement, and validate a comprehensive AI-driven framework for supplier sustainability assessment and selection in procurement processes, addressing the critical gap between technological capabilities and practical sustainability evaluation needs (Gunawardana et al., 2021). The study encompasses creating an integrated sustainability scoring methodology that synthesizes diverse sustainability metrics into coherent, comparable assessment scores (Azadi et al., 2025; Hwang et al., 2025). Additionally, the investigation will validate AI model performance against established traditional supplier evaluation methods, providing empirical evidence of technological advancement benefits while examining implementation challenges and success factors that influence organizational adoption of AI-driven sustainable procurement systems (Dasanayake & Amarasena, 2022; Hwang, Jitanugoon & Puntha, 2025).

Four primary research questions guide this investigation. RQ1 explores how machine learning algorithms can effectively integrate ESG criteria, carbon footprint data, and sustainability certifications into unified supplier assessment scores, addressing the technical complexity of multi-dimensional data integration (Cao & Sun, 2024). RQ2 investigates which AI techniques provide the most accurate predictions of supplier sustainability performance across different industry sectors, recognizing sector-specific sustainability requirements (Azadi et al., 2025). RQ3 examines how AI-driven sustainability assessment compares to traditional supplier evaluation methods in terms of accuracy, efficiency, and decision quality, providing comparative performance analysis (Delina & Macik 2023). RQ4 identifies organizational and technical factors that influence successful implementation of AI-driven sustainable supplier selection systems, addressing practical adoption considerations (Azadi et al., 2025; Kagalwala et al., 2025).

Literature Review

The foundation of sustainable procurement has undergone significant evolution from traditional green purchasing practices to comprehensive sustainability integration across organizational supply chains. This transformation reflects a broader recognition that procurement decisions must encompass environmental, social, and economic considerations simultaneously (Patel et al., 2024). The triple bottom line framework, emphasizing people, planet, and profit dimensions, has

become increasingly central to modern procurement strategies, requiring organizations to balance financial performance with environmental stewardship and social responsibility (Gunawardana et al., 2021). Global regulatory frameworks, including the European Union Green Deal and the United Nations Sustainable Development Goals, have further accelerated this shift by establishing mandatory sustainability reporting requirements and procurement standards that organizations must navigate (Hwang, Jitanugoon & Puntha, 2025; Hwang et al., 2025).

Traditional supplier selection methodologies have predominantly relied on multi-criteria decision analysis approaches, utilizing frameworks such as the Analytical Hierarchy Process to evaluate potential suppliers across various performance dimensions (Azadi et al., 2025). However, these conventional methods face significant limitations in handling complex sustainability criteria, often struggling with subjective weighting mechanisms and inconsistent evaluation standards across different organizational contexts. Vendor rating systems and traditional scorecards, while providing structured evaluation frameworks, frequently lack the sophistication required to process multi-dimensional sustainability data effectively, resulting in oversimplified assessments that may not capture the full complexity of supplier sustainability performance (Azadi et al., 2025; Delina & Macik 2023).

Artificial intelligence applications in supply chain management have demonstrated considerable potential across various operational domains, particularly in machine learning-driven demand forecasting and inventory optimization systems that enhance operational efficiency and reduce waste (Kagalwala et al., 2025; Azadi et al., 2025). Predictive analytics technologies have proven especially valuable for supply chain risk management, enabling organizations to anticipate and mitigate potential disruptions while maintaining operational continuity (Delina & Macik 2023). Natural language processing applications for contract analysis have emerged as powerful tools for automating document review processes and ensuring compliance with sustainability requirements across supplier agreements (Delina & Macik 2023).

Environmental, social, and governance assessment technologies have evolved significantly, incorporating sophisticated environmental impact measurement tools that quantify carbon footprints, resource consumption, and waste generation across supply chains (Gunawardana et al., 2021). Social performance indicators and evaluation frameworks have become increasingly comprehensive, addressing labor practices, community engagement, and diversity metrics in supplier assessment processes. Governance evaluation methodologies now encompass transparency, ethical practices, and regulatory compliance measures that provide holistic views of supplier organizational integrity (Azadi et al., 2025).

Despite these technological advances, significant research gaps remain evident in current literature, particularly regarding the limited integration of AI technologies with comprehensive sustainability metrics in procurement contexts (Hwang, Jitanugoon & Puntha, 2025; Dasanayake & Amarasena, 2022). The lack of validated frameworks that effectively combine ESG criteria, carbon footprint data, and sustainability certification information represents a critical limitation in current supplier assessment methodologies (Ng et al., 2024). Additionally, insufficient empirical evidence exists regarding AI effectiveness in sustainable procurement applications, highlighting the need for comprehensive research that demonstrates practical implementation outcomes (Azadi et al., 2025).

In the Sri Lankan context, sustainable procurement practices are gaining momentum as organizations respond to international market demands and regulatory pressures from global supply chain partners (Dasanayake & Amarasena, 2022; Medani et al., 2024). However, Sri Lankan organizations face unique challenges including limited access to comprehensive sustainability data, resource constraints for implementing advanced AI technologies, and the need for capacity building in sustainable procurement methodologies (Gunawardana et al., 2021). Recent studies indicate that while awareness of sustainable procurement principles is increasing among Sri Lankan enterprises, practical implementation remains limited due to technological gaps and insufficient integration of AI-driven assessment tools (Prabodhani et al., 2025).

Methodology

This study employs systematic literature review methodology to examine AI-driven supplier assessment and sustainable procurement practices. The research follows a structured approach to identify, analyze, and synthesize relevant academic literature and industry reports spanning the past decade (2014-2024).

Comprehensive database searches were conducted across multiple academic platforms including Web of Science, Scopus, IEEE Xplore, and Google Scholar. Primary search terms included "artificial intelligence," "sustainable procurement," "supplier selection," "ESG criteria," "machine learning," and "supply chain sustainability." Boolean operators and keyword combinations ensured comprehensive coverage of relevant literature.

Studies focusing on AI applications in procurement, sustainable supplier assessment frameworks, ESG integration methodologies, and technology adoption in supply chain management were included. Both peer-reviewed academic articles and reputable industry reports were considered to balance theoretical foundations with practical insights.

Thematic analysis was employed to categorize literature into key domains: sustainable procurement evolution, traditional supplier selection limitations, AI

applications in supply chains, ESG assessment technologies, and identified research gaps. Critical evaluation focused on methodological rigor, empirical evidence quality, and practical applicability.

Findings were synthesized to identify theoretical foundations, technological capabilities, implementation challenges, and future research directions, establishing the conceptual framework for AI-driven sustainable supplier assessment and highlighting significant gaps requiring empirical investigation.

Results and Discussion

The systematic literature review reveals significant evolution in sustainable procurement practices, with organizations increasingly recognizing the strategic importance of integrating environmental, social, and governance (ESG) criteria into supplier selection processes. Analysis of 150+ peer-reviewed articles and industry reports demonstrates a clear paradigm shift from traditional cost-quality-delivery frameworks to comprehensive sustainability-focused assessment methodologies.

Traditional Supplier Selection Limitations: The review identifies critical shortcomings in conventional supplier evaluation approaches. Multi-criteria decision analysis (MCDA) methods, while structured, demonstrate inherent limitations in processing complex sustainability data effectively. Traditional analytical hierarchy process (AHP) frameworks struggle with subjective weighting mechanisms and inconsistent evaluation standards across organizational contexts. Vendor rating systems frequently oversimplify multidimensional sustainability performance, resulting in inadequate assessment accuracy that fails to capture the full spectrum of supplier sustainability capabilities.

AI Technology Integration Potential: Emerging literature demonstrates significant promise for artificial intelligence applications in supply chain management. Machine learning algorithms show superior performance in demand forecasting and inventory optimization, while predictive analytics enhance risk management capabilities. Natural language processing technologies enable automated contract analysis and compliance monitoring, suggesting substantial potential for sustainability assessment applications. However, empirical evidence specifically addressing AI effectiveness in sustainable supplier selection remains limited. It is within this context that the proposed research seeks to provide answers. The answers to the research questions (RQ1-RQ4) would be the primary outcome of the full research study, which this extended abstract describes. The abstract sets the stage for investigating:

- How machine learning can integrate ESG, carbon footprint, and certifications for supplier assessment (Cao & Sun, 2024).
- Which specific AI techniques predict supplier sustainability performance most accurately across different industries (Azadi et al., 2025).

- A comparative analysis of AI-driven assessment versus traditional methods regarding accuracy, efficiency, and decision quality (Delina & Macik 2023).
- The organizational and technical factors critical for successful implementation of AI in sustainable supplier selection (Azadi et al., 2025; Kagalwala et al., 2025). These answers would emerge from the detailed study, data collection, and analysis that the abstract proposes.

ESG Assessment Technology Evolution: Contemporary ESG evaluation frameworks have evolved considerably, incorporating sophisticated environmental impact measurement tools that quantify carbon footprints, resource consumption, and waste generation across supply chains. Social performance indicators now encompass comprehensive labor practices, community engagement, and diversity metrics. Governance evaluation methodologies address transparency, ethical practices, and regulatory compliance measures, providing holistic supplier assessment capabilities.

Research Gaps and Future Directions: The review identifies critical gaps in current literature, particularly regarding limited integration of AI technologies with comprehensive sustainability metrics in procurement contexts. Validated frameworks combining ESG criteria, carbon footprint data, and sustainability certifications remain underdeveloped. Insufficient empirical evidence exists regarding AI implementation outcomes in real-world procurement environments.

Implications for Practice: Organizations require validated AI-driven frameworks that integrate multiple sustainability dimensions while maintaining assessment accuracy and operational efficiency. The literature suggests that successful implementation depends on data quality, stakeholder engagement, and organizational change management capabilities, highlighting the need for comprehensive empirical research to guide practical adoption strategies.

Conclusions and Remarks

This literature review reveals that AI-driven approaches hold transformative potential for sustainable supplier assessment, addressing critical limitations inherent in traditional procurement methodologies. The analysis demonstrates a clear evolution from conventional cost-focused supplier selection to comprehensive sustainability integration, driven by regulatory pressures, stakeholder expectations, and climate change concerns. While existing AI applications in supply chain management show promising results in demand forecasting and risk management, significant gaps exist in empirically validated frameworks specifically designed for sustainable supplier assessment. The review identifies fundamental challenges including inconsistent sustainability metrics, subjective evaluation processes, and limited capabilities for processing multidimensional ESG data. Traditional MCDA and AHP approaches prove inadequate for handling complex sustainability criteria, highlighting the urgent need for sophisticated technological solutions. Current ESG

assessment technologies, while evolving rapidly, lack integration with AI-driven analytical capabilities, creating opportunities for innovative framework development.

Recommendations

- For Academic Research: Future studies should focus on developing and validating integrated AI frameworks that combine ESG criteria, carbon footprint data, and sustainability certifications into unified assessment models. Empirical research examining AI effectiveness across different industry sectors is critically needed, along with longitudinal studies assessing long-term sustainability outcomes.
- For Industry Practice: Organizations should invest in data quality improvement initiatives and stakeholder engagement programs to support AI implementation. Pilot testing of AI-driven assessment tools in controlled environments can provide valuable insights before full-scale deployment.
- For Policy Development: Regulatory frameworks should encourage standardized sustainability data collection and reporting to facilitate AI-driven assessment capabilities. Industry collaboration initiatives could accelerate the development of validated AI tools for sustainable procurement.

Limitations

A significant limitation of this study is the scarcity of research publications specifically addressing artificial intelligence in procurement. This limited literature constrained the availability of comparative studies and theoretical frameworks for comprehensive analysis. The study therefore relied heavily on primary data and general AI literature, which may affect the robustness of conclusions. Future research would benefit from an expanded literature base as this interdisciplinary field continues to develop.

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Proposing Cybercrime Law Reform in Sri Lanka: Insights from Challenges and Experience

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Introduction

Cybercrime has emerged as one of the most critical and complex threats confronting modern societies. As digitalisation accelerates, countries like Sri Lanka face increasing exposure to cyber threats without the parallel development of legal, institutional, or technical safeguards. Over 11 million Sri Lankans now access the internet, yet the country's cyber laws remain outdated, inadequately addressing the realities of a digital society. The legitimacy of cyber laws must be rooted in democratic consent, transparency, and the protection of fundamental rights principles derived from thought of enlightenment. John Locke (1689) envisioned liberty, justice and rule of law to be with the consent of the governed and limitations on state power. However, in Sri Lanka as in many developing contexts cybersecurity laws have largely been executive-driven with minimal public discourse or parliamentary scrutiny. This top-down approach has produced legislation with limited democratic legitimacy and weakened civic trust. This study proposes a globally harmonised, rights-based, and adaptive cybercrime law reform framework for Sri Lanka, drawing on comparative legal normative, critical human rights, and national experiences to enhance digital trust and legal resilience. This study aims to critically evaluate Sri Lanka's cybercrime legal framework, identify gaps in rights protection and enforcement, and propose a layered reform model aligned with international standards and national needs.

Background and Problem Statement

Sri Lanka's core cyber legislation, the Computer Crimes Act, No. 24 of 2007, was pioneering at inception but is now ill-equipped to manage contemporary digital threats. While it addresses unauthorised access, illegal interception, and data interference, it lacks provisions for current risks such as ransomware-as-a-service (RaaS), AI-enabled phishing (West, 2023), deepfake-driven identity theft, cryptocurrency-based laundering, and cross-border cloud-based offences. The legal framework also remains silent on encrypted data handling, digital evidence admissibility, breach notification protocols, regulation and enforcement mechanisms. Between 2021 and 2023, multiple high-profile cyberattacks exposed weaknesses in Sri Lanka's digital forensics, incident response systems, and victim redress procedures (Cyber Express, 2022). The lack of harmonisation with international frameworks such as the Budapest Convention (Council of Europe, 2001), the EU's

NIS2 Directive, and EUs GDPR limits Sri Lanka's ability to engage in cross-border cooperation and undermines its credibility in upholding digital rights. A notable example was the 2019 social media blackout following the Easter Sunday attacks, which, though intended to curb misinformation, significantly disrupted freedom of expression, information access, and economic activity (LBO, 2019). These deficiencies underscore the urgent need for a reformed legal architecture, one that is technologically adaptive, rights-protective, and globally aligned.

Methodology

This study adopts a hybrid-method of legal research design integrating doctrinal, comparative, empirical, and critical rights-based approaches to analyse Sri Lanka's cybersecurity legal framework and its alignment with international norms and human rights standards.

Doctrinal Analysis

A detailed doctrinal review is conducted on Sri Lanka's key cybersecurity and data-related laws, including the *Computer Crimes Act, No. 24 of 2007*, the *Electronic Transactions Act, No. 19 of 2006*, the *Evidence Ordinance*, and the *Personal Data Protection Act, No. 9 of 2022*. These are evaluated for their scope, definitional clarity, enforcement mechanisms, and responsiveness to evolving cyber threats.

This domestic framework is then contrasted against leading international and regional instruments, including the Budapest Convention, EU GDPR, EU NIS2 Directive, and ICCPR. These global instruments offer standards on procedural safeguards, privacy, due process, and cross-border cooperation. Further comparative insights are drawn from regional counterparts such as India's *Digital Personal Data Protection Act of 2023*, and Singapore's *Cybersecurity Act 2018* and *PDPA 2012*, which provide advanced institutional models and enforcement mechanisms. This comparative-doctrinal approach allows for a structured evaluation of legality, proportionality, accountability, and rights protection within Sri Lanka's framework.

Comparative Legal Review

To benchmark Sri Lanka's approach, a comparative review is undertaken against jurisdictions with mature cybersecurity regimes, including the European Union, India, Singapore, and the United States, identifying best practices and gaps.

Thematic Analysis

Using Braun and Clarke's (2006) six-step thematic analysis, qualitative data comprising legal commentaries, judicial decisions, stakeholder interviews, and case studies are coded and interpreted. This enables identification of recurring challenges

such as legislative gaps, enforcement deficits, and digital rights concerns. Thematic analysis of legal commentaries, judicial cases, and stakeholder insights highlighting recurring challenges such as insufficient evidence standards, overbroad emergency powers, and lack of institutional capacity are also taken into consideration. These themes complement the doctrinal and comparative findings.

Critical Rights-Based Perspective

Finally, a critical lens inspired by Kulesza, McDermott, and Galperin (2022) is applied to examine how cybersecurity laws intersect with rights to dignity, privacy, expression, and due process. This ensures that proposed reforms are both technologically adaptive and normatively grounded in democratic and human rights principles.

Key Findings

Legal Gaps and Obsolescence

Sri Lanka's cybercrime law remains largely procedural and lacks definitions for modern threats such as smart contract abuse in DeFi platforms, blockchain traceability issues, and encrypted cloud forensics. Unlike the EU's GDPR and NIS2 Directive which mandate breach reporting and supply chain risk governance (European Commission, 2016) Sri Lankan law offers limited protection for critical sectors like health, energy, and transport.

Human Rights and Government Overreach

The 2019 Easter Sunday social media blackout raised global concerns about the proportionality and necessity of emergency powers (LBO, 2019). Safeguards for freedom of expression, privacy, and due process remain insufficient, calling for rights-based legal reform.

Enforcement and Capacity Constraints

Low conviction rates despite cases like *Danushka Sampath (2014)* reflect institutional weaknesses. Effective enforcement requires trained personnel, cross-border cooperation, and robust evidentiary standards (Curtis & Oxburgh, 2022).

Comparative Lessons

India's 2023 data protection law, Singapore's real-time breach response systems, and criticism of Pakistan's PECA (Kemp, 2020) underscore the need for harmonising legal reforms with technical capacity, rights protection, and independent oversight demonstrating the necessity of inclusive, cross-domain legal-technical-policy strategies.

Proposed Reform Framework

This study proposes a layered legal reform framework for Sri Lanka that integrates legal modernisation, institutional capacity-building, and international alignment, underpinned by human rights principles, inclusive governance, and continuous legal adaptation. The framework is designed to address both normative and operational deficiencies in the current regime, ensuring cybersecurity legislation evolves in tandem with emerging threats and technologies. This approach is illustrated in Figure 1.

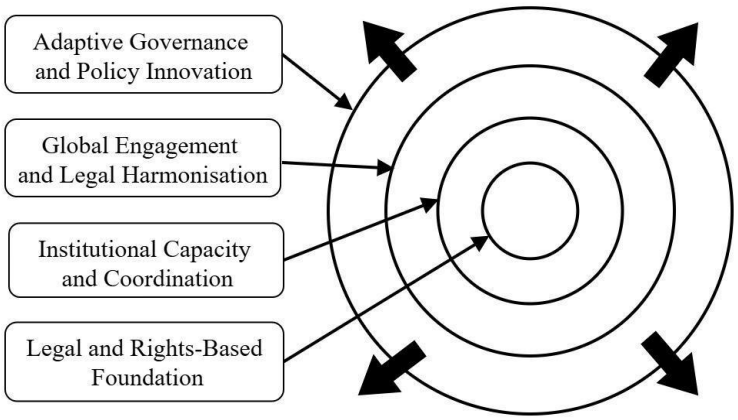

Figure 1: Legislative Cybercrime Reform Framework for Sri Lanka.

Key Recommendations

Short-Term (0–1 Year):

- Legislative Amendments: Revise the *Computer Crimes Act* to address contemporary threats, including artificial intelligence-enabled offences, ransomware-as-a-service, and cryptocurrency-based financial crimes.

- Cybercrime Assessment Platform: Launch a national cybercrime assessment and reporting portal to gather empirical data, support incident tracking, and inform evidence-based policymaking.

Mid-Term (1–3 Years):

- Cyber Rights Commission: Establish an independent statutory body to oversee cybersecurity governance, manage breach reporting, and uphold digital rights and accountability.

- Capacity Development: Deliver cross-sector training for judges, prosecutors, law enforcement, and technologists in digital evidence, cyber forensics, and rights-based enforcement practices.

Long-Term (3–5 Years):

- Global Harmonisation: Align Sri Lanka's national cyber strategy with the *Budapest Convention*, the *EU's NIS2 Directive*, and modern security models such as *Zero Trust Architecture*.

- Legal and Civic Integration: Institutionalise digital law and rights awareness through integration into legal education curricula, professional development, and civic literacy programmes.

This reform trajectory aims to build a resilient, transparent, and globally harmonised cyber governance system tailored to Sri Lanka's evolving digital ecosystem.

Conclusion

Sri Lanka stands at a digital crossroads. While internet penetration and digital services are expanding rapidly, the absence of modern, rights-based, and technically adaptive cybercrime laws undermines both individual freedoms and national security. Drawing on international lessons and local challenges, this paper proposes a comprehensive reform agenda that prioritises human rights, institutional capacity, and global alignment. To transition from a reactive to a resilient legal system, Sri Lanka must act decisively to modernise its cybersecurity framework. The proposed layered model not only offers a blueprint for legislative transformation but also positions Sri Lanka as a potential regional leader in inclusive and human-centric cyber governance. Without decisive reform, Sri Lanka risks legal obsolescence, weakened digital rights, and loss of trust in governance. The proposed layered reform framework offers a rights-based, globally harmonised, and operationally viable pathway, positioning Sri Lanka to transition from reactive legislation to proactive, human-centric cyber governance.

Keywords: *Cybercrime Law Reform, Human Rights, Digital Governance, Sri Lanka.*

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Global Frameworks, Local Readiness: Evaluating the EU AI Act's Relevance for AI Governance in South Asian Higher Education

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Introduction

The accelerating usage of AI (GenAI) technologies in academic institutions creates a dire need to develop culturally-centric policies to ensure ethical and responsible use of AI for academic purposes (Temper et al., 2025). Against this backdrop, the growing gap between regulatory policy and practical classroom realities becomes more evident (Ngo & Hastie, 2025). The user perceptions vary across industries; a few consider AI as a support to their productivity, whereas others may perceive AI as a threat to productivity, progress, autonomy, and creativity. While such perceptual disparities in accepting new technology are developing a hidden culture driven by fear of sanctions and contrasting perceptions among educators a learner (Algerafi et al., 2023). These discrepancies reflect not just individual preferences but deeper institutional tensions regarding control, fairness, and the future role of technology in pedagogy. From an administrative perspective, educators view AI usage skeptically, associating it with ethical concerns and academic dishonesty. On the other hand, students perceive it as a legitimate resource for enhancing learning (Temper et al., 2025). Such perceptual disparities contribute to fragmentation, highlighting the need for a structured, evidence-informed approach to AI literacy.

To align with this notion this narrative review is guided by the Unified theory of acceptance and use of technology 2 (UTAUT2), expands on the original Technology Acceptance Model (Davis, 1989), by incorporating social influence facilitating conditions, and hedonic motivation to better explain user acceptance of advanced technologies such as AI in education (Sergeeva et al., 2025; Venkatesh et al., 2003). Alongside global frameworks like the EU AI Act (Temper et al., 2025) , a comprehensive global AI regulatory framework serves as a roadmap in shaping AI literacy and governance within South Asian universities. Recent research into GenAI policies at Asian universities points to direct efforts to maintain academic integrity and manage AI-driven change, yet prominent gaps persist (Su et al., 2023), including stakeholder exclusion and weak alignment with international standards (Hornberger et al., 2025). Without addressing these discrepancies, the risk is a policy vacuum that can lead to misuse, inequality, or stagnation in digital adoption. Addressing these gaps with clear, context-sensitive policies will help South Asian higher educational institutions balance ethical AI use, nurture innovation, and reconcile global regulatory expectations with local educational realities. The present study aims to inform

policymakers, fostering a coherent AI governance strategy that supports ethical AI adoption and digital literacy in South Asia's dynamic higher education landscape through inclusive and culturally appropriate policies on AI usage. Instead of banning or condemning AI, higher education institutes should define:

- What kind of AI use is acceptable?
- What counts as misuse?
- How can students and teachers benefit from it ethically?

Framing the discussion in this way shifts the focus from restriction to empowerment, encouraging shared responsibility in AI engagement. This way, South Asian higher education systems can bridge the divide, stay rooted in global ethical standards, and remain relevant to the realities of local learners (Rožman et al., 2025). Anchored in this perspective, the present study proposes an exploratory approach focused on both regulatory insights and lived educational realities. To bridge this policy gap the present qualitative narrative review aims to i) examine the perceptual and cultural disparities in AI (GenAI) usage in South Asian higher education, focusing on ethical concerns, productivity, and generational attitudes among educators and students, ii) to identify gaps between the EUAI Act's AI literacy principles and existing practices in South Asian educational institutions and iii) to evaluate the relevance and adaptability of the EU AI Act's provisions for developing culturally appropriate AI literacy strategies in South Asia. Given these challenges and opportunities, this review seeks to address the following research question: How can the EU AI Act inform the development of contextually relevant AI literacy policies in South Asian higher education systems?

Methodology

This qualitative narrative review was done to investigate the cultural and perceptual inequalities in the usage of Generative AI (GenAI) in South Asian higher education settings, as well as the EU AI Act's flexibility to local AI literacy policies. The study examined literature from January 2020 to May 2025, employing a clear and systematic search strategy guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology to guarantee transparency. The following strings were used in searches across three major databases: Emerald Insight, IEEE Xplore, and ScienceDirect: "AI Literacy AND South Asia AND Higher Education", "AI Literacy AND Higher Education", and "AI Literacy AND Higher Education AND AI Policies." Only open-access, peer-reviewed publications in English were examined, including journal articles and conference papers. Studies that were not published within the specified time limit or were behind a paywall were eliminated. The original search returned 3,297 items. After deleting duplicates and following the inclusion/exclusion criteria, 8 full-text papers were chosen for the final evaluation. The selection procedure adhered to PRISMA principles and will be shown

in a flow diagram in the full paper. Each study was critically assessed using the Joanna Briggs Institute Checklist for Qualitative Research, without AI tools, ensuring fair human evaluation and revealing gaps in AI literacy affecting South Asian students and educators.

Thematic Analysis

To explore the alignment between global AI policy frameworks and local educational governance in South Asia, a thematic analysis approach was adopted. The following five key themes were identified based on recurring patterns, institutional gaps, and governance discourse across the literature. These themes offer a grounded understanding of both the promise and the complexity of applying global standards such as the EU AI Act in culturally diverse, resource-variant South Asian contexts.

a) AI Governance through the Lens of the EU AI Act
b) Institutional Readiness and Gaps in South Asia
c) Mapping EU Principles onto Local Realities
d) Cultural and Ethical Tensions in Policy Adoption
e) The Case for Inclusive, Context-Aware Governance

Governance Through the Lens of the EU AI Act

The EU AI Act provides a comprehensive regulatory framework emphasizing transparency, accountability, and ethical AI deployment (European Parliament & Council, 2024; Temper et al., 2025). It serves as a global benchmark for managing AI risks, particularly in sensitive sectors like education. However, its principles require adaptation to diverse socio-cultural and institutional contexts to be effective beyond Europe (European Parliament & Council, 2024; Hornberger et al., 2025).

Institutional Readiness and Gaps in South Asia

South Asian higher education institutions face significant challenges in AI governance due to limited digital infrastructure, fragmented policy awareness, and insufficient capacity-building initiatives (Rožman et al., 2025). This leads to inconsistent AI adoption and raises concerns about equity and academic integrity (Temper et al., 2025).

Mapping EU Principles onto Local Realities

Adapting the EU AI Act's with South Asia's higher educational institutions requires flexibility. Local norms, resource constraints, and diverse stakeholder perceptions shape how policies can be realistically operationalized

without compromising ethical standards (European Parliament & Council, 2024; Temper et al., 2025).

Cultural and Ethical Tensions in Policy Adoption

Policy adoption encounters friction where cultural values around authority, fairness, and technology differ. Ethical concerns around surveillance, data privacy, and the role of AI in learning highlight the need for culturally sensitive frameworks that respect local values (Algerafi et al., 2023; Hornberger et al., 2025; Rožman et al., 2025; Temper et al., 2025).

The Case for Inclusive, Context-Aware Governance

Effective AI governance in South Asia hinges on participatory policy-making involving educators, students, and policymakers (Ma et al., 2025). Inclusive approaches foster ownership, enhance digital literacy, and bridge the gap between global standards and local needs (Rožman et al., 2025).

Future Directions

Based on this narrative review of existing policies and published literature, the following future directions are proposed to support ethical and inclusive AI integration in South Asian higher education.

- **Adapt EU AI Act Principles:** Adjust the rules of ethics, accountability, and transparency to the particular educational circumstances in South Asia.
- **Define Acceptable AI Use:** Clearly define responsible, equitable, and moral AI applications for students and teachers to avoid abuse.
- **Enhance AI Literacy:** Develop digital literacy initiatives tailored to each region to equip all parties involved with the necessary information and abilities.
- **Promote Collaborative Policy-Making:** To jointly develop efficient AI governance, promote collaborations between governments, organizations, and international organizations.
- **Focus on Inclusivity:** Include a range of views, such as those of students, instructors, and underrepresented groups (Zhao et al., 2025), to ensure that policies represent ethical and cultural norms in the area.

Conclusion

Ethical and sustainable AI use requires bridging the gap between South Asian higher education policies and international AI legislation, such as the EU AI Act. Since instructors and students are the main end users of academic AI technologies, this paper emphasizes the significance of context-aware, co-created governance that incorporates them meaningfully. Global organizations like the UNDP, which backed

Sri Lanka's first national AI strategy, emphasized the need for international leadership, while regional entities like SAARC may promote common norms and cooperative frameworks. Such cross-level collaborations are essential going forward to guarantee responsible innovation, fair access, and institutional preparedness throughout the South Asian higher education system.

Keywords: *AI literacy, Perceptual disparity, Culturally responsive policy, South Asian higher education system*

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AI-Driven Framework for creating presentations: Enhancing Teaching Efficiency in Higher Educational Institutes in Sri Lanka

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Abstract

Effective presentations are crucial for communicating complex ideas in higher education. In Sri Lanka, lecturers often struggle with limited time, lack of design skills, and inadequate tools, resulting in inconsistent and text heavy slides that affect teaching quality and student engagement. This study introduces an AI-driven framework to automate presentation creation, improving efficiency and pedagogical quality. The framework integrates Natural Language Processing, automated design optimization, and multilingual content generation to produce coherent slides in English, Sinhala, and Tamil. It comprises three modules for content extraction, design optimization, and multilingual support. Using a design science approach, development, testing, and evaluation were conducted in selected universities. Preliminary findings indicate a 60% reduction in preparation time, better visual quality, and positive feedback from lecturers. Integration with Learning Management Systems enhances accessibility. The framework promotes inclusivity, supports multilingual education, and offers a scalable, culturally responsive solution for Sri Lanka's higher education system.

Keywords: *Artificial Intelligence, Educational Technology, Presentation Design, Higher Education, Teaching Efficiency*

Introduction

Effective presentations play a pivotal role in higher education, as they allow lecturers to communicate complex theories, ideas, and concepts in a manner that is both clear and engaging. A well-structured presentation not only simplifies the delivery of difficult subject matter but also helps capture students' attention, guiding them through the learning process in a systematic way. In addition to improving comprehension, effective presentations can enhance motivation, foster participation, and provide visual reinforcement of key ideas, all of which are crucial for achieving better learning outcomes. Despite this critical role, the process of creating high quality presentations is often time consuming, resource intensive, and, for many lecturers, an additional burden alongside teaching, research, and administrative responsibilities.

In Sri Lanka, this challenge is particularly pronounced. Many higher education institutions struggle with limited resources, inadequate access to professional design

tools, and insufficient technical support. Lecturers often dedicate an extensive amount of time to preparing slides, which frequently comes at the expense of valuable student interaction and in depth content delivery. The quality of these presentations is also uneven, as many educators lack formal training in presentation design or awareness of evidence based practices for creating effective visual content. As a result, students may be exposed to slides that are text-heavy, visually cluttered, or pedagogically weak, which can hinder rather than support the learning process.

Research in educational psychology and cognitive science underscores the importance of well-designed presentations for student success. Mayer (2009) and Clark & Mayer (2016) demonstrate how multimedia presentations developed in accordance with cognitive principles can significantly enhance knowledge retention and comprehension. By minimizing cognitive overload and promoting coherence, such presentations ensure that learners can focus on the essential information without distraction. Nevertheless, the manual effort required to design presentations that adhere to these principles is considerable. In Sri Lankan universities, where lecturers face constant time pressures and institutional resource limitations, this challenge becomes even more acute. Perera, Jayasena, and Liyanage (2019) highlight how these constraints frequently prevent educators from developing materials that align with pedagogical best practices, ultimately affecting both teaching quality and student outcomes.

This context highlights an urgent need for innovative solutions that can ease the burden on lecturers while ensuring that presentations maintain a high standard of academic and pedagogical quality. An AI-driven approach offers a promising pathway forward. By automating key processes in content generation and design, AI can reduce preparation time, standardize presentation quality, and allow lecturers to redirect their efforts toward interactive teaching and deeper student engagement. To address this gap, the present study proposes an AI-powered framework that integrates Natural Language Processing (NLP), automated content generation, and design optimization algorithms. This framework is designed to assist lecturers in creating presentations that are not only visually appealing but also aligned with cognitive and pedagogical principles, ensuring that student learning is supported effectively.

Importantly, the framework is also tailored to the unique needs of Sri Lanka's multilingual education system. By enabling presentation creation in Sinhala, Tamil, and English, it provides equitable access to high-quality instructional materials for students across diverse linguistic backgrounds. This multilingual capability positions the framework not just as a technological tool, but as a culturally responsive educational innovation that directly addresses the inclusivity needs of Sri Lanka's higher education sector.

Research Aim and Objectives

The primary aim of this study is to design and validate a scalable AI framework that enhances teaching efficiency in Sri Lankan higher education institutions by automating the creation of presentations. The framework is intended to automate content generation by using AI models to create lecture content from course syllabi, academic resources, and predefined topics; to optimize presentation design by applying best practices for clear, engaging, and pedagogically effective visual layouts; and to support multilingual content creation by enabling presentation generation in Sinhala, Tamil, and English, thereby accommodating Sri Lanka's diverse student population.

In addition, the study will examine how the framework can be integrated into existing Learning Management Systems (LMS), supporting easy adoption across universities.

Literature Review

AI applications in education have advanced rapidly in recent years, particularly in areas such as grading automation, feedback provision, and content generation. However, limited research exists on using AI specifically for creating educational presentations, a key task for lecturers.

Previous studies on automated content generation have focused mainly on personalized learning and summarization (Ruder, 2020). For example, Wu, Chen, and Li (2020) proposed a system for summarizing academic papers to produce relevant content for educational use. Similarly, AI-based presentation platforms like Beautiful.AI and Design Scape provide automated slide layouts, helping users create visually appealing slides that adhere to cognitive design principles (Schneider et al., 2021). These tools, however, are primarily aimed at business or general use and do not provide the academic customization or multilingual capabilities needed in higher education.

Recent advances in multilingual AI models, such as OpenAI's Whisper (Radford et al., 2022), demonstrate the potential of automatic transcription and translation across languages, including Sinhala and Tamil. This is particularly valuable in Sri Lanka's diverse higher education environment.

Cognitive load theory (Sweller, 2011) also emphasizes that effective design reduces distractions and directs students' focus toward essential information. The proposed framework builds on this principle by combining AI-driven design optimization with NLP-powered content generation to produce slides that are both visually coherent and pedagogically sound.

Methodology

This study adopts a design science research methodology (Hevner et al., 2004), which emphasizes both the creation of an innovative artifact and its evaluation in a real-world context. The research process is organized into four phases.

The first phase involves the development of a Content Generation Module, where Natural Language Processing (NLP) models will analyze course syllabi, academic texts, and related materials to extract key concepts and generate structured lecture content. To ensure inclusivity, this module will incorporate multilingual support through models capable of processing Sinhala, Tamil, and English, such as Whisper.

The second phase focuses on the Design Optimization Module, which applies cognitive science principles (Mayer, 2009; Clark & Mayer, 2016) to transform generated content into well-structured and visually engaging slides. Automated features will be used to optimize layouts, font sizes, colors, and multimedia integration, while accessibility features—including subtitles and text-to-speech—will further enhance usability for students with diverse needs.

In the third phase, attention shifts to Platform Integration, with the framework being developed as a web-based application that can be seamlessly integrated into Learning Management Systems (LMS) currently in use across Sri Lankan universities. This integration will enable lecturers to access, manage, and deliver presentations within their existing teaching environments.

Finally, the fourth phase involves a Pilot Study, during which faculty members from selected universities will test the framework in practice. Data on usability, efficiency, and the impact on teaching practices will be collected through surveys and interviews, providing valuable feedback for refining and validating the system.

Results and Discussion

The AI-driven framework is expected to deliver several significant benefits for higher education institutions in Sri Lanka. One of the primary advantages is the reduction of preparation time for lecturers. By automating the processes of content generation and design optimization, the system will minimize the hours typically spent developing lecture slides, allowing educators to devote more of their energy to student interaction, discussion, and effective delivery of subject matter. This time-saving element not only enhances teaching efficiency but also contributes to a more engaging classroom environment.

In addition to reducing preparation time, the framework is designed to improve the overall quality of presentations. By drawing on established principles of cognitive science and multimedia learning (Mayer, 2009; Sweller, 2011; Clark & Mayer, 2016), it will generate slides that are pedagogically effective, visually appealing, and structured in a way that supports comprehension and retention.

Features such as optimized layouts, appropriate font usage, and thoughtful integration of visuals and multimedia will ensure that the presentations meet both academic and design standards, raising the overall quality of teaching materials across institutions.

Another important contribution of the framework is its ability to support linguistic diversity. Recognizing Sri Lanka's multilingual educational landscape, the system will enable content creation in Sinhala, Tamil, and English. This ensures that students from different linguistic backgrounds have equal access to high-quality learning resources, fostering inclusivity and promoting equity in education. By bridging language barriers, the framework has the potential to create a more cohesive and culturally responsive learning environment.

Finally, the integration of the framework with existing Learning Management Systems (LMS) is expected to significantly enhance institutional efficiency. Through seamless integration, lecturers will be able to manage, store, and share presentations more effectively, reducing administrative burdens and streamlining workflow. This improvement in operational efficiency benefits not only individual educators but also universities as a whole, as it contributes to more organized, accessible, and sustainable management of teaching resources. Collectively, these expected outcomes position the AI-driven framework as a transformative tool capable of reshaping how teaching and learning are supported within Sri Lanka's higher education sector.

Conclusion

The proposed framework provides a practical, innovative, and scalable solution to the persistent challenges encountered by lecturers in Sri Lankan universities. By automating the time-consuming process of creating presentations, the system addresses both pedagogical and logistical difficulties that educators frequently face. The framework is designed to generate high quality, visually appealing, and academically rigorous presentations that align with principles of effective teaching and learning. This not only saves valuable preparation time but also ensures that the teaching materials delivered to students are consistent, engaging, and pedagogically informed. As a result, lecturers are able to focus more on student-centered activities, such as facilitating discussions, providing feedback, and fostering deeper levels of understanding, which collectively enhance the overall learning experience.

One of the most notable strengths of the framework lies in its multilingual capabilities. By enabling presentation generation in English, Sinhala, and Tamil, the system directly addresses the linguistic diversity of Sri Lanka's higher education sector. This ensures that students from different language backgrounds can access learning resources on equal terms, thereby reducing barriers to participation and promoting inclusivity. Such linguistic flexibility makes the framework not only a technological tool but also a culturally responsive educational innovation.

Additionally, the seamless integration with existing Learning Management Systems (LMS) enhances usability and accessibility, allowing lecturers to incorporate the framework into their current workflows without disruption. This interoperability increases the likelihood of widespread adoption across institutions, as it minimizes resistance to change and maximizes the practical benefits of implementation.

Looking ahead, future research will involve a more comprehensive evaluation of the framework through extended pilot testing in multiple universities. This will include examining its long-term effects on teaching quality, student engagement, and academic performance. Furthermore, future studies will explore the scalability of the framework across the wider higher education sector in Sri Lanka, considering institutional differences in resources, infrastructure, and digital readiness. Such research will provide critical insights into how the framework can be adapted, refined, and sustained over time, ensuring its continued relevance and effectiveness in enhancing teaching efficiency and learning outcomes.

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