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From Linguistic Friction to Cognitive Equity: Introducing the AI-Mediated Accessibility Equalisation (AMAE) Framework for Non-English-Medium Learners in Indian Academic Libraries

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ABSTRACT

Purpose: Academic libraries in India deliver digital resources overwhelmingly in English, in a country where only about one in ten people reports any facility in that language. This paper introduces the AI-Mediated Accessibility Equalisation (AMAE) framework, explaining how artificial intelligence can reduce the Linguistic-Cognitive Accessibility Friction (LCAF) that non-English-medium learners experience.

Design/methodology/approach: The paper follows a theory synthesis design (Jaakkola, 2020), integrating Cognitive Load Theory, translanguaging theory, UTAUT, multi-level digital divide scholarship, information poverty theory, and the critique of linguistic imperialism, from which five testable propositions are derived.

Findings: AMAE comprises five intervention dimensions — Linguistic Translation, Cognitive Simplification, Interactive Dialogic, Modality, and Adaptive Personalisation Equalisation — governed by a cross-cutting Equity-Safeguard Layer. It repositions language as a stratum modulating all three levels of the digital divide, and specifies how AI offloads the extraneous cognitive load of English-language processing.

Research implications: The five propositions define a four-track empirical agenda covering instrument development, quasi-experimental testing in college libraries, adversarial auditing of translation quality, and comparative replication in other multilingual systems.

Practical implications: Libraries can equalise metadata, abstracts, open-access holdings, and library-authored content immediately, extending to licensed full text only where agreements permit derivative works. An incremental service stack, a governance policy, and consortium negotiating priorities are set out.

Originality/value: AMAE is, to the authors' knowledge, the first framework uniting cognitive load, translanguaging, and digital divide perspectives in an AI-mediated accessibility model for academic libraries in a multilingual developing-country setting, completing the authors' cumulative LCAF-DURA-AMAE research programme.

Keywords: artificial intelligence; academic libraries; cognitive equity; digital divide; machine translation; cognitive load theory

1. Introduction

A structural paradox sits at the heart of Indian higher education. Census returns show that the country's 22 scheduled languages are the mother tongues of 96.71 per cent of the population, Hindi alone accounting for 43.63 per cent of speakers under its broad grouping, whereas English — the language in which the overwhelming majority of scholarly databases, e-journals, institutional repositories, and discovery layers operate — is reported as a first language by a mere 0.02 per cent of Indians and as a language known in any capacity by roughly one in ten (Office of the Registrar General and Census Commissioner, India, 2018). "India scored 484 in the EF EPI 2025, placing it in the low-proficiency band among 123 countries and regions, indicating its position in the EF English Proficiency Index 2025 (EF Education First, 2025). Yet the digital collections that Indian academic libraries curate, license, and promote — from e-ShodhSindhu consortium journals to international full-text databases — remain almost exclusively Anglophone artefacts.

The consequence of this mismatch is not merely inconvenience. For the Hindi-medium or regional-language-medium undergraduate encountering an English-only discovery interface, every act of searching, skimming, evaluating, and reading imposes a second, hidden task: real-time linguistic decoding that competes with disciplinary comprehension for the same scarce working-memory resources (Sweller, 1988; Sweller et al., 1998). In earlier work we conceptualised this hidden burden as Linguistic-Cognitive Accessibility Friction (LCAF): the extraneous cognitive load imposed on non-English-medium learners by the linguistic form, rather than the intellectual substance, of digital library resources (Dheeraj & Sharma, 2026). LCAF explains a persistent empirical puzzle in Indian user studies — why students with adequate devices, connectivity, and formal digital skills nevertheless under-utilise the very resources their institutions pay to provide. In the IETE Technical Review, Kumar (2025) puts the bigger dilemma into a concise context: in cases where the

instruction is conducted in the second language, students find it hard not due to the inherent complexity of the matter, but because the very mode of delivery becomes an impediment to understanding. The magnitude of this effect can be quantified, and evidence from adjacent fields indicates that it is substantial. In a within-subject comparison at King Abdulaziz University, Arabic-speaking students were markedly more likely to achieve a good knowledge score on an Arabic-language questionnaire than on the identical English version (Gazzaz et al., 2023); Section 3.1 examines that study in detail. Because instrument content was held constant, the difference is attributable to language rather than to knowledge. There is no reason to suppose that Indian students working through English-language academic material respond any differently.

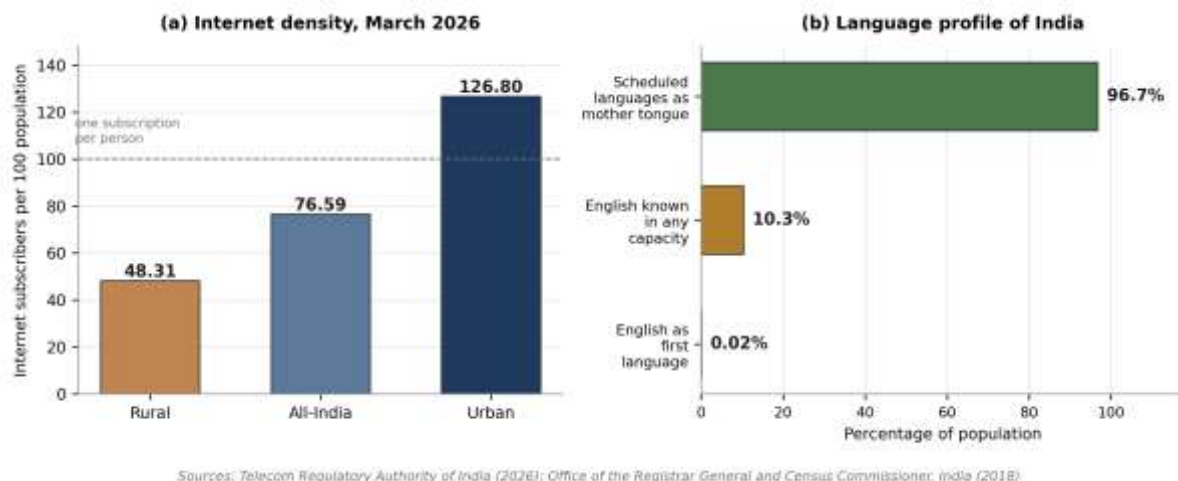


Figure 1. The linguistic accessibility gap in Indian higher education. Panel (a) reports internet subscribers per 100 population at the end of March 2026; panel (b) reports the language profile of the population. Together the panels show that infrastructural inequality and linguistic exclusion are distinct problems: connectivity has expanded far faster than the share of the population able to use an Anglophone scholarly record. Sources: Telecom Regulatory Authority of India (2026); Office of the Registrar General and Census Commissioner, India (2018).

Until recently the solutions to this friction proposed by the library profession were palliative: bilingual signage, occasional user education in the vernacular, and the preparation of translated finding aids, usually slow to produce and costly to maintain. Generative artificial intelligence, over the period 2022–2026, has altered this remedial calculus considerably. Neural machine translation systems now cover all 22 scheduled Indian languages with open models such as IndicTrans2 (Gala et al., 2023); the Government of India's Bhashini mission exposes public translation and speech application programming interfaces as digital public infrastructure (Ministry of Electronics and Information Technology, 2022); and large language models can summarise, simplify, and converse in Indian languages at negligible marginal cost. For the first time, the technological capacity exists to equalise linguistic accessibility at the point of use rather than at the point of production.

Capacity, however, is not a framework. The emerging literature on artificial intelligence in libraries has concentrated on chatbot deployment, reference automation, and professional competencies (Adetayo, 2023; Cox, 2023; Cox & Mazumdar, 2024; Panda & Kaur, 2023), while the digital divide literature has theorised access, skills, and outcomes without treating language as an analytic layer in its own right (Scheerder et al., 2017; van Deursen & van Dijk, 2019). No existing framework sets out how, why, and under what safeguards AI tools can convert linguistic friction into cognitive equity for non-English-medium library users. This paper provides such a framework.

This paper presents the AI-Mediated Accessibility Equalisation (AMAE) framework: a prescriptive conceptual framework comprising five intervention dimensions and a single cross-cutting safeguard layer, grounded in six established theoretical traditions and specified through five testable propositions. AMAE forms the third stage of a deliberate three-stage research programme. LCAF diagnoses the problem by naming the hidden cognitive load; the DURA model — Digital Usage and Resource Accessibility — describes, through its four dimensions of Digital Infrastructure Accessibility, User Digital Competency, Resource Relevance and Quality, and Awareness and Motivational Factors, the accessibility terrain on which that load operates (Dheeraj & Sharma, 2026); and AMAE now prescribes the AI-mediated remedy. The arc is therefore one of diagnosis, description, and solution.

The remainder of the paper is organised as follows. Section 2 outlines the conceptual research design. Section 3 analyses four clusters of literature that converge on the problem space and identifies the gap. Section 4 assembles the theoretical foundations. Section 5 presents the AMAE framework, its dimensions, its

propositions, its differentiation from competing approaches, and its cross-walk to LCAF and DURA. Section 6 draws implications for theory, practice, and policy. Section 7 charts an empirical research agenda and Section 8 concludes.

2. Conceptual Research Design

Conceptual articles are frequently criticised for lacking an explicit research design, and reviewers increasingly expect authors to state which template they follow and why (Hulland, 2020; Jaakkola, 2020; MacInnis, 2011). Jaakkola (2020) distinguishes four approaches to conceptual work — theory synthesis, theory adaptation, typology, and model — differing in their aims, their use of source theories, and their contribution potential. This paper adopts a theory synthesis design with a model-building component.

The rationale is as follows. The phenomenon of interest — linguistically induced under-utilisation of digital library resources, and its potential mitigation by artificial intelligence — is presently addressed by several literatures that do not speak to one another. The load mechanism is explained by cognitive psychology, the pedagogical worth of the mother tongue by applied linguistics, structural inequality by the digital divide research, language technology by providing an instrument without a theory of linguistic equity, and language technology by library AI scholarship as a part of the background. Theory synthesis is the right template right where a phenomenon is still under-theorised as the corresponding insights are spread across disciplines (Jaakkola, 2020). The synthesis is then evolved into a model - a set of articulated dimensions with directional propositions - in such a way that it becomes empirically testable not just suggestive.

The source theories were selected on three grounds: each is well established in its home discipline, each carries explanatory weight for one or another aspect of linguistic accessibility, and none is redundant of the others. Section 4 and Table 2 make their respective roles explicit, in keeping with Jaakkola's (2020) requirement that the selection and function of theories in a conceptual paper be justified rather than assumed. Literature was identified through structured searches of Scopus, Web of Science, and Google Scholar. Three term clusters were combined with Boolean operators: a language cluster ("language barrier" OR "non-native English" OR "English-medium instruction" OR multilingual OR vernacular), an accessibility cluster ("cognitive load" OR "digital divide" OR "information poverty" OR "library anxiety"), and a technology cluster ("machine translation" OR "artificial intelligence" OR "large language model" OR chatbot) restricted to library, information science, and education contexts. Foundational theoretical sources were admitted without date restriction; the artificial-intelligence literature was restricted to 2022 onwards to capture the generative turn. Peer-reviewed articles, authoritative policy documents, and major technical reports in English were included; conference abstracts, editorials, and non-peer-reviewed commentary were excluded. Records were screened on title and abstract and the retained set was extended by forward and backward citation chaining of key sources. The paper makes no empirical claims; its contribution lies in the framework and the research agenda it sets out.

3. Literature Review

3.1 Language barriers, library anxiety, and information poverty

User research has produced a long line of studies showing that language is among the most persistent obstacles to the use of library resources. Mellon (1986) defined library anxiety as an affective state in which students confronting an information-retrieval task become sufficiently apprehensive that they cannot address it effectively; Bostick (1992) subsequently operationalised the construct across five dimensions in the Library Anxiety Scale. Sinnasamy and Abdul Karim (2016) reviewed several decades of work on library anxiety among non-native speakers of English. They found that this group faces anxiety factors seldom registered in studies of native speakers, and that the problem has intensified as academic collections have become more electronic and more thoroughly Anglophone. The set of barriers they identified — language, retrieval, library skills, technology, environment, and affective barriers — corresponds closely to the accessibility dimensions addressed by the present framework.

The comprehension process underlying these affective findings emerges with unusual clarity in a non-library context. Gazzaz et al. (2023) administered identical knowledge, attitude, and practice questionnaires in Arabic and in English to 507 Arabic-speaking students, four weeks apart. Scores were significantly higher on the first-language version in the knowledge and attitude domains, with an odds ratio of 4.537 for achieving a good knowledge score in Arabic rather than English; no significant difference emerged in the practice domain. Because the content of the instruments remained identical, the difference in the affected domains is attributable to language alone. The sociological context of information poverty (Chatman, 1996) gives these results a sociological touch: the information world is viewed as something outsiders to the self engage in secrecy, lies, and self-defensive non-seeking. The non-English-medium student in an Anglophone digital library is a linguistic outsider in precisely Chatman's sense, and the observable under-utilisation of licensed resources is, in part, self-protective behaviour rather than ignorance or apathy.

3.2 English-medium instruction and the Indian linguistic reality

The English-medium instruction (EMI) literature supplies the educational backdrop. Macaro et al.'s (2018) systematic review across higher education concluded that evidence for content-learning benefits of EMI is thin while evidence of comprehension cost is substantial; Lin and Lei (2021) subsequently demonstrated that medium of instruction and English proficiency jointly condition content learning outcomes. In India these dynamics operate at continental scale. All India Survey on Higher Education data record approximately 45.0 million enrolled students at a gross enrolment ratio of 30.0 (Ministry of Education, 2026), drawn substantially from schools whose media of instruction — enumerated in more than thirty codes in the UDISE+ data capture framework — are Indian languages. The National Education Policy 2020 (NEP 2020) explicitly champions mother-tongue and regional-language education, recommending home-language instruction until at least Grade 5 and preferably Grade 8, and setting a gross enrolment ratio target of 50 per cent for 2035 (Ministry of Education, 2020). The policy thereby guarantees that the pipeline of non-English-medium entrants to higher education will widen, not narrow — even as the scholarly record they must consult remains Anglophone. Kumar (2025) names the resulting predicament a linguistic adaptation challenge, observing that post-NEP 2020 institutions increasingly recognise the role of Indian languages in enhancing comprehension and reducing cognitive strain.

3.3 Cross-language information retrieval and Indian-language machine translation

Information science has long recognised the retrieval face of the language problem. Cross-language information retrieval matured around query translation, document translation, and latent cross-lingual representations, and has been re-energised by multilingual embeddings and large language models. What distinguishes the present moment is the Indian-language capability frontier. AI4Bharat's IndicTrans2 is the first open-source translation model to cover all 22 scheduled languages of the Eighth Schedule, trained on the Bharat Parallel Corpus Collection of roughly 230 million bitext pairs (Gala et al., 2023). The Bhashini National Language Translation Mission, launched in 2022, wraps such models in public application programming interfaces spanning translation, transliteration, speech recognition, and speech synthesis (Ministry of Electronics and Information Technology, 2022). National digital education infrastructure — the National Digital Library of India, SWAYAM, e-PG Pathshala, and the e-ShodhSindhu consortium — provides institutional rails onto which these capabilities can be mounted (National Digital Library of India, n.d.). The technical preconditions for language-equalised library service now exist as public goods.

The profession has, moreover, already demonstrated appetite for vernacular service provision in pre-AI form. North American academic libraries have deployed vernacular-language orientation videos for non-native English-speaking students, with reported gains in learning and affective response (Zhao & Mawhinney, 2020). AMAE can therefore be read as the generalisation and automation of an intervention librarians have independently found valuable, rather than as an unfamiliar technological imposition.

3.4 Artificial intelligence in libraries, 2022–2026

Library and information science responded rapidly to the generative AI turn. Cox and Mazumdar (2024) supplied a working definition of artificial intelligence for librarians; Cox (2023) analysed how AI reconfigures academic library work through the lens of professional competencies; Adetayo (2023) and Panda and Kaur (2023) examined ChatGPT-class chatbots as successors to scripted virtual reference; Lund and Wang (2023) assessed implications for academia at large; and Rodriguez and Mune (2022) reported early operational chatbot deployment in an academic library. Two features of this literature motivate AMAE. First, multilingual capability — arguably the most significant affordance of large language models for the Global South — remains peripheral in library AI scholarship, which is dominated by Anglophone use cases. Second, the ethics stream warns that naïve deployment can deepen rather than dissolve linguistic inequity: Liang et al. (2023) demonstrated that commercial GPT detectors misclassified essays by non-native English writers as machine-generated at an average false-positive rate of 61.3 per cent while judging native-speaker essays almost perfectly — direct evidence that AI systems trained on Anglophone norms can systematically penalise the very learners AMAE seeks to serve. Any equalisation model can thus only incorporate safeguards during its development and not as an afterthought (UNESCO, 2021).

3.5 The gap

In these four clusters there is a lacuna. The barrier literature papers record the problem, but do not model a solution. The literature on EMI and policy can be used to find out why the affected population is high and increasing but halts at the door of the library. Cross-language retrieval and Indian machine translation can provide tools that do not have a service theory. Libraries AI scholarship provides a service discourse without a linguistic-equity theory. There is no published framework that combines cognitive load, translanguaging, technology acceptance and multi-level digital divide reasoning into a prescriptive model of the role of AI in facilitating linguistic accessibility to academic libraries. All the quantitative indicators on which the argument is based are united in Table 1. AMAE is designed to fill this gap exactly; Section 5.5 makes a clear distinction between it and its closest existing counterparts.

Table 1. The empirical basis of the linguistic accessibility problem: key indicators

Indicator	Value	Period	Source
Population reporting a scheduled language as mother tongue	96.71 per cent	Census 2011	Office of the Registrar General and Census Commissioner, India (2018)
Population reporting English as first language	0.02 per cent	Census 2011	Office of the Registrar General and Census Commissioner, India (2018)
Population reporting any facility in English	approx. 10 per cent	Census 2011	Office of the Registrar General and Census Commissioner, India (2018)
EF English Proficiency Index score (low-proficiency band)	484 (low band); 123 countries ranked"	2025	EF Education First (2025)
Higher education enrolment	45.0 million (4.50 crore)	2023–24	Ministry of Education, Government of India (2026)
Gross enrolment ratio in higher education	30.0	2023–24	Ministry of Education, Government of India (2026)
Internet subscribers per 100 population, rural	48.31	March 2026	Telecom Regulatory Authority of India (2026)
Internet subscribers per 100 population, urban	126.80	March 2026	Telecom Regulatory Authority of India (2026)
Odds of a good knowledge score in the first language rather than English	OR = 4.537 (p < 0.001)	2023	Gazzaz et al. (2023)
False-positive rate of GPT detectors on non-native English writing	61.3 per cent (mean)	2023	Liang et al. (2023)
Scheduled Indian languages covered by open neural machine translation	22 of 22	2023	Gala et al. (2023)

Note: Census data is based on the most recent detailed data on Indian language demography, the 2011 enumeration. English proficiency percentages do not directly compare to the EF index, which quantifies tested proficiency on adult learners who are self selected.

4. Theoretical Foundations

AMAE is purposefully multi-theoretic. There are six traditions each that shed light on a single aspect of the linguistic accessibility problem and each is drawn to a certain architectural feature of the framework. Table 2 gives a summary of the role attributed to each theory, which is necessary according to Jaakkola (2020), who emphasizes that a theory synthesis must clarify the role that their source theories play.

Table 2. Source theories synthesised in the AMAE framework and their assigned roles

Source theory	Key reference	Facet of the problem explained	Role in AMAE
Cognitive Load Theory	Sweller (1988); Sweller et al. (1998)	Why English processing suppresses comprehension	Core causal mechanism; defines LCAF as extraneous load
Translanguaging	García & Wei (2014, 2015)	Why the mother tongue is a resource, not a deficit	Legitimises AI translation as pedagogically sound
UTAUT	Venkatesh et al. (2003, 2012)	Why available tools may go unused	Supplies moderators; guards against determinism
Multi-level digital divide	van Deursen & van Dijk (2019); Scheerder et al.	How access, skills, and outcomes diverge	Site of theoretical extension: language as cross-cutting stratum

Source theory	Key reference	Facet of the problem explained	Role in AMAE
	(2017)		
Information poverty	Chatman (1996)	Why affected users avoid help-seeking	Grounds the dialogic dimension; outsider-insider transition
Linguistic imperialism	Phillipson (1992); Zeng & Yang (2024)	Why scholarly infrastructure is Anglophone	Critical frame; positions AMAE as counter-hegemonic

Source: Authors' own construction.

4.1 Cognitive Load Theory: the mechanism of friction

Cognitive Load Theory Cognitive load theory is based on the premise that working memory is devastatingly capacity-bound and that learning settings are successful or fail based on their ability to allocate three types of load: intrinsic load due to the material, extraneous load due to the presentation format and germane load due to schema construction (Paas et al., 2003; Sweller, 1988; Sweller et al., 1998). The theory offers AMAE its fundamental causal process. To a Hindi-medium learner, the decoding of an English abstract is a good example of extraneous load: it is created by linguistic wrapping of the information and adds no value to disciplinary schema-building. Because working memory is zero-sum, every unit of capacity consumed by translation-in-the-head is a unit unavailable for comprehension. LCAF is, in these terms, chronically elevated extraneous load of linguistic origin. It follows deductively that any technology which externalises the decoding task — machine translation, mother-tongue summarisation, vernacular dialogue — releases working-memory capacity for germane processing. Equalisation, on this account, is not a metaphor but a redistribution of cognitive load. Figure 2 represents this redistribution schematically.

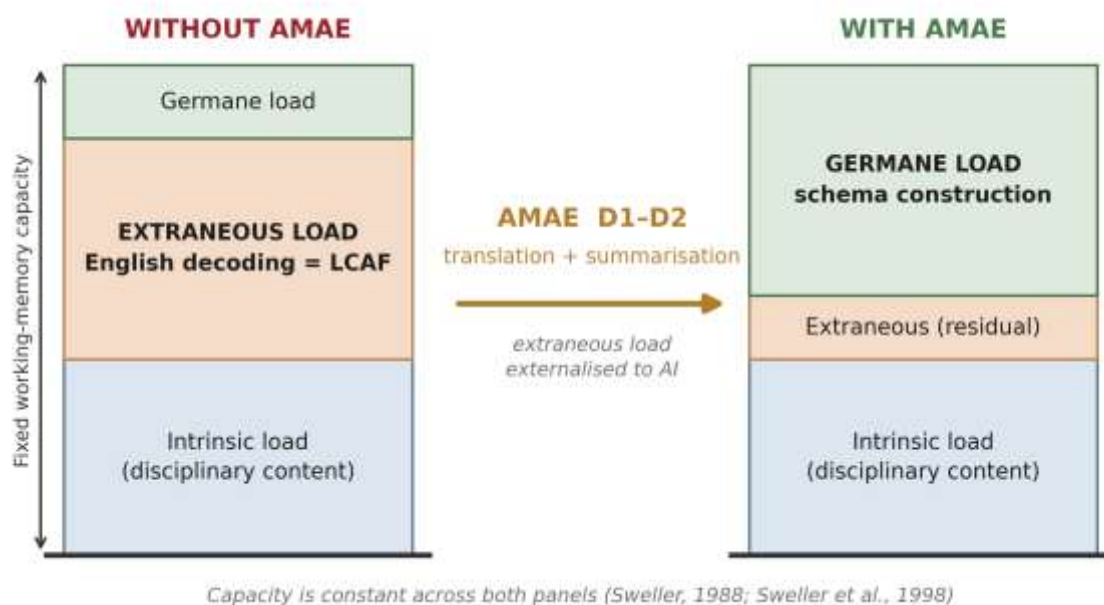


Figure 2. Cognitive load redistribution under AMAE. Total working-memory capacity is fixed; the translation and simplification dimensions (D1–D2) externalise the extraneous load of English decoding, releasing capacity for germane, schema-building processing. The schematic is confined to the two dimensions that act directly on cognitive load; D3–D5 operate on access and engagement and are represented in Figure 4. Source: Authors' own construction, after Sweller (1988) and Sweller et al. (1998).

4.2 Translanguaging: the pedagogical legitimacy of the mother tongue

Where Cognitive Load Theory supplies mechanism, translanguaging theory supplies legitimacy. García and Wei (2014, 2015) claim that the languages of a bilingual are neither two parallel monolingual systems, nor are they a set of semiotic repertoires, but rather a single integrated repertoire; and that the pedagogies that encourage learners to exercise that repertoire are more effective than those that enforce monolingualism. Practically, the traditional Anglophone digital library enforces monolingual borders: not only does it accept only English queries, but also provides only English documents, but it also implicitly frames the first language of the student as something to be transcended. AMAE reframes AI translation and multilingual conversation

as translanguaging technologies — tools that allow the learner to think in Hindi, ask questions in a code-switched register, read in translation, and check the reading against the English original, seamlessly and without embarrassment. The mother tongue is thereby converted from an obstacle into a cognitive resource, which is precisely the conversion the phrase from friction to equity denotes.

4.3 Technology acceptance: UTAUT as the adoption boundary condition

A framework that equalises accessibility in principle achieves nothing if the tools go unused. The Unified Theory of Acceptance and Use of Technology consolidated eight prior models — including the Technology Acceptance Model's perceived usefulness and perceived ease of use (Davis, 1989) — into four determinants of behavioural intention: performance expectancy, effort expectancy, social influence, and facilitating conditions, explaining approximately seventy per cent of variance in intention against the seventeen to fifty-three per cent of its predecessors (Venkatesh et al., 2003, 2012). Within AMAE, these constructs operate as moderators: AI equalisation tools will translate capability into behaviour only where students expect them to improve academic performance, find them effortless in low-bandwidth and shared-device conditions, perceive normative approval from teachers and librarians, and enjoy facilitating infrastructure. UTAUT thereby disciplines AMAE against technological determinism.

4.4 The multi-level digital divide: language as a cross-cutting stratum

Digital divide scholarship distinguishes a first-level divide of physical and material access, a second-level divide of skills and usage, and a third-level divide of tangible outcomes (Scheerder et al., 2017; van Deursen & van Dijk, 2011, 2019; van Dijk, 2005). All three can be found in India. By the end of March 2026 the country had about 1,092.79 million internet subscribers, 440.87 million rural and 651.93 million urban; which is 48.31 subscribers per 100 population in the rural areas and 126.80 subscribers per 100 in the urban areas, a national average of 76.59 per 100 (Telecom Regulatory Authority of India, 2026). Rural penetration is therefore close to one-third of the urban rate. AMAE's theoretical contribution to this tradition is to propose language as a cross-cutting stratum that modulates all three levels simultaneously (Figure 3): a learner may possess devices at the first level and operational skills at the second, yet be excluded from outcomes at the third purely because the content layer speaks a language she does not. Linguistic equalisation is therefore not a courtesy feature but a precondition of third-level equity.



Figure 3. Language as a cross-cutting stratum in the multi-level digital divide. LCAF operates orthogonally to the conventional three levels, so that gains in access and skills need not translate into outcome equity. Source: Authors' own construction, extending van Deursen and van Dijk (2019) and Scheerder et al. (2017).

4.5 Information poverty: from outsider to insider

Chatman (1996) theorised information poverty through the lived experience of outsiders — individuals who mistrust the information world confronting them and respond with secrecy and non-seeking. Her constructs predict the reference-desk avoidance and silent attrition that Indian librarians observe among vernacular-medium students, and they align with the library anxiety findings reported for non-native English speakers by Sinnasamy and Abdul Karim (2016). AMAE's dialogic dimension operationalises the outsider-to-insider transition: a conversational agent that greets the student in her own language performs, at scale, the welcoming function that determines whether a learner ever crosses the threshold of professional help-seeking.

4.6 Linguistic imperialism: the critical frame

Finally, Phillipson's (1992) account of linguistic imperialism — the structural and ideological maintenance of English dominance — together with contemporary analyses of English hegemony across economic, governance, and scientific domains (Zeng & Yang, 2024), situates AMAE politically. The Anglophone character of scholarly infrastructure is not a natural fact but an accumulated asymmetry. A framework that equips a college library in eastern Uttar Pradesh to serve its Bhojpuri- and Hindi-speaking readers in their own languages is, modestly but concretely, a counter-hegemonic intervention. This critical frame also guards AMAE against a subtle failure mode: equalisation must augment the learner's linguistic repertoire, never excuse institutions from developing genuine multilingual collections or learners from acquiring English where they wish to. The protest ought to be made full blooded. Even the achievement of English proficiency itself is a product of material value in Indian graduate labour markets and a library providing a consistent supply of mother-tongue translation itself may face the criticism of diminishing the incentive and the incidental exposure via which that proficiency is gained - replacing short-term understanding with long-term employability. The charge is answered by three considerations which do not reject it. First, the evidence provided by English-medium instruction studies is that understanding deficits and language acquisition are not actually traded off as the objection presupposes, Macaro et al. (2018) report weak evidence that content teaching in English is a reliable way to gain English proficiency, therefore, the trade in which the sacrifice is being sought might buy little. Second, the theory of translanguaging believes that scaffolding in the first language will not displace second-language growth, since the conceptual knowledge acquired in one language will be transferred to the second language. Third, and most importantly, in the design, the Adaptive Personalisation dimension of AMAE is constructed, so that the extent of equalisation is under the control of the learner: the support of bilingual parallel display and vernacular glossary does not deny the learner the exposure to the English original but rather eliminates the comprehension penalty. Proposition 2, however, does not assume that longer term English proficiency is a result that has to be assumed but measured by a piece of empirical work.

5. The AMAE Framework

5.1 Definition and scope

This is what is termed AI-Mediated Accessibility Equalisation: the systematic use of artificial intelligence abilities, i.e., translation, summarisation, dialogue, speech, and adaptive personalisation, at the consumption point of academic library services, under explicit equity protections, to reduce Linguistic-Cognitive Accessibility Friction so that learning outcomes are not dictated by the language in which resources are fortuitously packaged. The resulting end-state is cognitive equity: an equal cognitive opportunity to comprehend, evaluate, and apply academic material, irrespective of the medium of prior instruction. The boundary conditions of the framework are deliberate. It addresses academic and college libraries rather than public or school libraries; it addresses linguistic friction rather than disciplinary difficulty, so that intrinsic load is respected rather than evaded; and it assumes the Indian public AI infrastructure described in Section 3.3, while remaining in principle portable to comparable multilingual settings. A further boundary condition is legal rather than technical, and it is the most consequential constraint on implementation. Machine translation and summarisation of a licensed full text produce a derivative work, and the standard subscription and consortium agreements under which Indian academic libraries acquire electronic resources rarely grant the right to create, store, or redistribute such derivatives. AMAE is therefore immediately implementable across the layers a library controls or that carry permissive terms — catalogue and discovery metadata, open-access and institutional-repository holdings, government and public-domain material, library-authored instructional content, and the abstracts that most publishers permit to be displayed — while extension to licensed full text requires either explicit contractual permission or ephemeral, user-initiated, non-retained translation performed at the point of reading. Section 6.2 and Section 6.3 treat the negotiation and policy implications; the framework should be read as specifying what a library ought to provide once the rights position permits it, not as an assertion that the rights position is already settled.

5.2 Dimensions

AMAE comprises five intervention dimensions and one cross-cutting governance layer, presented in Figure 4 and detailed in Table 3.

Dimension 1: Linguistic Translation Equalisation. Neural machine translation embedded in discovery layers, e-resource viewers, and repository interfaces, rendering metadata, abstracts, and full texts into the reader's preferred scheduled language on demand. The theoretical warrant is extraneous-load reduction combined with translanguaging legitimacy; the enabling infrastructure is IndicTrans2-class models delivered through Bhashini application programming interfaces.

Dimension 2: Cognitive Simplification Equalisation. Large-language-model summarisation, explanation, and register simplification in the mother tongue — a Hindi plain-language précis of an English research article, worked examples, and glossary generation. Where Dimension 1 changes the language of the text, Dimension

2 additionally manages its cognitive density, protecting germane load for schema construction.

Dimension 3: Interactive Dialogic Equalisation. Multilingual conversational agents for reference, instruction, and wayfinding, able to sustain code-switched dialogue. The warrant is Chatman's outsider construct together with UTAUT effort expectancy: dialogue in one's own language collapses the social cost of asking.

Dimension 4: Modality Equalisation. Speech-to-text query input and text-to-speech resource delivery in Indian languages, addressing uneven text literacy, shared-device usage, and low-bandwidth realities documented in the rural-urban divide statistics; theoretically anchored in the material-access stratum of the first-level divide.

Dimension 5: Adaptive Personalisation Equalisation. Interfaces that detect or elicit language preference and proficiency and calibrate equalisation intensity accordingly — full translation for one reader, bilingual parallel display for another, English with vernacular glossary support for a third — operationalising UTAUT facilitating conditions at the individual level and honouring translanguaging's insistence on fluid repertoire use.

The Equity-Safeguard Layer (cross-cutting). This layer is not a sixth intervention but the governance condition on the five above. It comprises bias auditing across languages and dialects; hallucination control with source-linked verification for translated and summarised content; privacy protection for query and language-preference data; transparent AI labelling; human librarian oversight with defined escalation paths; licence compliance review, so that equalisation is applied only to content the library is entitled to transform; and terminological control. The last of these deserves emphasis. Academic subject vocabulary frequently lacks stable equivalents across Indian languages, and this is precisely where general-purpose machine translation is least reliable: a discipline term rendered inconsistently across sessions, or rendered into an unfamiliar coinage, can impose fresh extraneous load in place of the load removed. The layer therefore requires a curated bilingual glossary of discipline terms, aligned where possible with existing controlled vocabularies and subject headings, together with a convention of displaying the English term alongside its vernacular rendering on first occurrence. The detector-bias discovery of Liang et al. (2023) is a red flag in itself: when systems are constructed based on Anglophone standards, non-native users were incorrectly identified more than two-thirds of the time, and an equalisation architecture that lacks this aspect poses a threat to undermine the entire purpose of its creation (UNESCO, 2021).

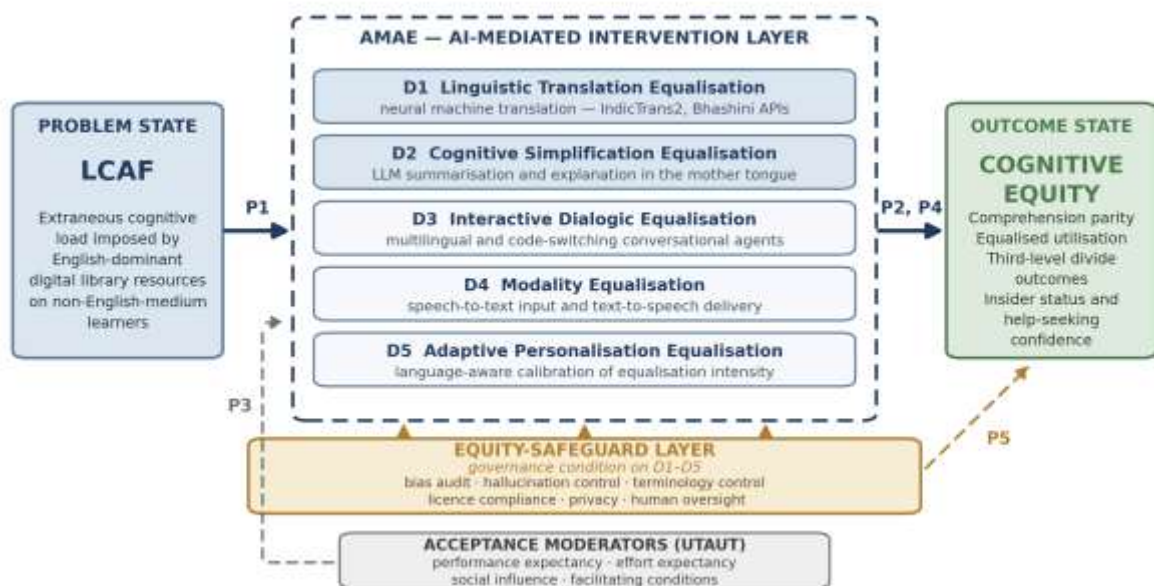


Figure 4. The AI-Mediated Accessibility Equalisation (AMAE) model: five dimensions of interventions and a cross-cutting Equity-Safeguard Layer transforms the state of the LCAF problem into cognitive equity results, mediated by UTAUT acceptance constructs. Origin: Self-construction on the part of the authors.

Table 3. Dimensions of the AMAE framework with enabling tools and theoretical warrants

Dimension	AI capability and exemplar tools	Primary theoretical warrant	DURA dimension acted upon
D1 Linguistic Translation	Neural machine translation (IndicTrans2, Bhashini APIs) in	Extraneous-load reduction;	Resource Relevance and Quality

Dimension	AI capability and exemplar tools	Primary theoretical warrant	DURA dimension acted upon
Equalisation	discovery layers and viewers	translanguaging	
D2 Cognitive Simplification Equalisation	LLM summarisation, explanation, and register simplification in mother tongue	Germane-load protection	Resource Relevance and Quality
D3 Interactive Dialogic Equalisation	Multilingual and code-switching conversational agents; AI reference support	Information poverty; UTAUT effort expectancy	Awareness and Motivational Factors
D4 Modality Equalisation	Speech-to-text query input; text-to-speech delivery in Indian languages	First-level divide (material access)	Digital Infrastructure Accessibility
D5 Adaptive Personalisation Equalisation	Language-preference detection; calibrated bilingual parallel display	UTAUT facilitating conditions; translanguaging	User Digital Competency
Equity-Safeguard Layer (cross-cutting)	Bias audits, hallucination control, privacy protection, human oversight	Responsible AI ethics (UNESCO, 2021); Liang et al. (2023)	All dimensions (governance)

Source: Authors' own construction.

5.3 Propositions

The framework is falsifiable in principle, with five propositions. Two qualifications apply. The propositions are expressed in directional, but not in effect-size, terms, as no previous literature sets a size of linguistic equalisation in a library context; and Propositions 1 and 2 assume an instrument of LCAF has been constructed, the first activity of the research agenda in Section 7. Until that instrument exists, the propositions are testable through established proxies — subjective workload scales, comprehension assessment, and logged resource utilisation — rather than through direct measurement of the construct itself.

Proposition 1 (baseline friction). The greater a learner's dependence on a regional-language medium of prior instruction, the higher the baseline LCAF experienced in English-dominant digital library environments, independent of digital skills and device access.

Proposition 2 (load offloading). Exposure to Translation and Simplification Equalisation reduces measured extraneous cognitive load and increases comprehension and resource utilisation among non-English-medium learners, advancing them toward third-level digital divide outcomes.

Proposition 3 (acceptance moderation). The effect of AMAE tool availability on actual use is moderated by UTAUT constructs, such that performance expectancy, effort expectancy, and facilitating conditions strengthen — and their absence attenuates — the conversion of capability into behaviour.

Proposition 4 (insider transition). Dialogic and Modality Equalisation reduce outsider self-perception and library anxiety, increasing help-seeking frequency and reference-service engagement relative to English-only service points.

Proposition 5 (safeguard dependency). In the absence of an operative Equity-Safeguard Layer, AI deployment can reproduce or amplify linguistic inequity — through translation error, hallucinated vernacular content, or biased assessment of non-native output — partially or wholly reversing the gains predicted in Proposition 2.

5.4 Positioning AMAE within the LCAF–DURA research programme

AMAE constitutes the third movement of a cumulative research programme (Figure 5). The diagnostic construct is LCAF: it recognises and conceptualises the latent load. The descriptive model is DURA: four dimensions are used to chart the breakdown of accessibility in terms of infrastructure, competency, quality of resources and motivation (Dheeraj & Sharma, 2026). The prescriptive framework is AMAE: it describes the AI-based intervention that should be used in each of the DURA dimensions to decrease LCAF. Translation and Simplification Equalisation act principally on Resource Relevance and Quality, converting linguistically inaccessible holdings into usable ones; Modality Equalisation acts on Digital Infrastructure Accessibility, accommodating shared devices and oral interaction; Dialogic Equalisation acts on Awareness and Motivational Factors, reducing the affective cost of engagement; and Adaptive Personalisation acts on User Digital Competency, meeting each learner at her actual proficiency frontier. The programme thus moves from naming the problem, through mapping its landscape, to prescribing its remedy.

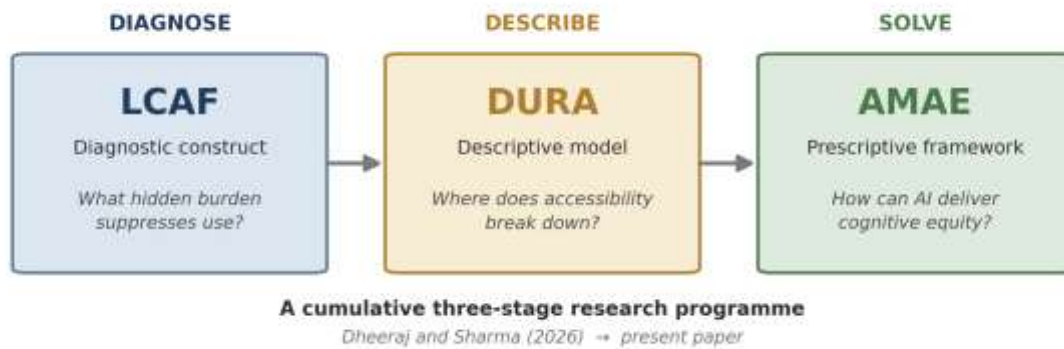


Figure 5. The LCAF–DURA–AMAE research programme as a cumulative diagnose–describe–solve arc. Source: Authors' own construction.

5.5 Differentiation from existing approaches

Because AMAE claims originality, it must be distinguished from the nearest existing alternatives (Table 4). Four are relevant. First, technology acceptance studies of library systems explain adoption but treat the resource itself as a fixed English-language object; they predict who will use a database, not whether its language renders it comprehensible. Second, cross-language information retrieval solves the matching problem — connecting a vernacular query to an English document — but stops at retrieval, leaving the retrieved document as cognitively inaccessible as before. Third, digital divide frameworks diagnose structural inequality with great sophistication but treat language as a contextual variable rather than an intervention target, and offer no service-design prescriptions. Fourth, the emerging library chatbot literature is prescriptive and service-oriented but framed around efficiency and availability rather than equity, and is overwhelmingly Anglophone in its assumptions. AMAE's distinctive contribution is to combine the load mechanism, the equity objective, the service prescription, and the safeguard architecture in a single model calibrated to a multilingual Global South context.

Table 4. Differentiation of AMAE from the nearest existing approaches

Approach	What it explains well	What it leaves unaddressed	AMAE's advance
Technology acceptance studies of library systems	Who adopts a system and why	Treats the resource as a fixed English object; silent on comprehension	Retains UTAUT as moderator but targets the resource itself
Cross-language information retrieval	Matching vernacular queries to English documents	Stops at retrieval; retrieved document remains inaccessible	Extends intervention from retrieval to comprehension and use
Multi-level digital divide frameworks	Structural inequality in access, skills, outcomes	Language treated as context, not intervention target; no service prescriptions	Formalises language as a cross-cutting stratum and prescribes remedies
Library chatbot and generative AI literature	Service efficiency, availability, professional competencies	Framed around efficiency not equity; Anglophone assumptions	Reframes AI deployment as an equity intervention with safeguards

Source: Authors' own construction.

6. Implications

6.1 Implications for theory

AMAE makes three theoretical contributions. First, it extends multi-level digital divide theory by formalising language as a cross-cutting stratum modulating access, skills, and outcomes simultaneously — a stratum the divide literature has acknowledged anecdotally but not modelled architecturally. Second, it imports Cognitive Load Theory into library and information science as a causal mechanism for a familiar but under-theorised phenomenon, giving user studies a measurable mediating variable, namely extraneous load of linguistic origin, between resource provision and learning outcome. Third, it repositions translanguaging — hitherto a classroom pedagogy construct — as a design principle for information systems, opening a conversation between applied linguistics and information science that both fields have largely deferred.

6.2 Implications for practice

For practising librarians the framework converts an amorphous aspiration — inclusive service — into an implementable service stack. College libraries can begin at Dimension 1 by surfacing Bhashini-powered translation of catalogue metadata and abstracts; progress to Dimension 3 by deploying a Hindi–English conversational agent for directional and ready-reference queries; and mature toward Dimensions 2, 4, and 5 as capacity grows. Because the underlying models and application programming interfaces are public digital infrastructure, the marginal cost of entry is organisational rather than financial — an important consideration for the state and affiliated colleges that educate the majority of Indian undergraduates. Sequencing should follow the rights position as much as the technical one: metadata, abstracts, open-access holdings, institutional repository content, and library-authored guides can be equalised immediately, whereas licensed full text requires prior negotiation. Consortium-level bargaining is the efficient instrument here, and e-ShodhSindhu is well placed to seek a standard translation-and-summarisation clause on behalf of its member institutions rather than leaving each library to negotiate alone. The Equity-Safeguard Layer translates into concrete operating policy: displaying source originals alongside translations, conducting regular accuracy audits on a sample of languages, maintaining a bilingual glossary of discipline terms, labelling AI-generated content explicitly, recording the licence basis on which each collection is equalised, and defining escalation paths from the conversational agent to a librarian. The concept of multilingual AI service design ought to be instead viewed as a fundamental professional skill in library and information science, as opposed to an added value (Cox, 2023).

6.3 Implications for policy

AMAE is in line with the National Education Policy 2020, which at the same time encourages mother-tongue education and infrastructure of digital education (Ministry of Education, 2020). If the policy succeeds, the cohort of non-English-medium entrants to higher education will expand at precisely the moment when their dependence on Anglophone academic resources deepens; AMAE supplies the bridging mechanism. Four policy recommendations follow. First, translation and summarisation equalisation should be embedded in the national platforms — the National Digital Library of India, SWAYAM, and e-ShodhSindhu — rather than left to piecemeal implementation by individual institutions. Second, the University Grants Commission and the National Assessment and Accreditation Council should recognise linguistic accessibility provision as a quality indicator within library assessment. Third, the Bhashini mandate should name higher-education libraries explicitly as a served sector, with service-level commitments appropriate to academic use, and should support a shared multilingual glossary of academic subject terminology as a public good. A fourth recommendation follows from the licensing constraint identified in Section 5.1: national consortium negotiators should seek a standard clause permitting machine translation and summarisation of licensed content for registered users of the subscribing institution, on the model of the text- and data-mining clauses that have become routine in recent agreements. Without such a clause, the most substantial category of library content remains outside the reach of equalisation whatever the technology permits.

7. Future Research Agenda

The next stage of the programme is empirical, and the agenda comprises four tracks. Track one operationalises LCAF as a psychometrically valid scale, drawing on cognitive load instrumentation and on established library anxiety instruments such as the Library Anxiety Scale (Bostick, 1992). Track two tests Propositions 1 to 4 through quasi-experimental designs in Indian college libraries, comparing comprehension, usage, and subjective workload — measured, for instance, with the NASA Task Load Index — under translated as against original-language resource conditions. Track three examines Proposition 5 through adversarial audit studies of translation accuracy, hallucination incidence, and bias across scheduled languages in live library deployments. Track four pursues replication in other multilingual contexts, beginning with linguistically comparable settings in South and South-East Asia and sub-Saharan Africa, in order to convert asserted portability into demonstrated generality. The findings of these tracks should feed back into revision of the framework itself.

8. Conclusion

Indian academic libraries have assembled the knowledge of the world and delivered it in a language that most of their readers do not command. For decades the resulting friction has been misread as a shortfall of skills, of motivation, or of infrastructure, rather than as a cognitive load created by linguistic packaging. Artificial intelligence has, for the first time, made the equalisation of that load technically feasible at the point of use and affordable through public infrastructure. What feasibility alone cannot supply, the AMAE framework provides: a theoretically grounded, ethically safeguarded, falsifiable architecture specifying how translation, simplification, dialogue, modality, and personalisation convert linguistic friction into cognitive equity — subject, as Section 5.1 makes clear, to a licensing position that the profession must negotiate rather than assume. Where LCAF diagnosed the problem and the DURA model mapped its landscape, AMAE now

prescribes the remedy. The value of the framework will be settled empirically, and the agenda for doing so is set out above; the direction of obligation, however, is already clear. In a country of a hundred and twenty-one languages, served by an education policy that acknowledges them, the academic library can no longer devolve its equity obligations to the licence agreement.

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