

A Culturally Responsive and Affect-Aware Conceptual Framework for AI-Assisted Learning in India's Multilingual Classrooms

Nikita Srivastava

nikita2013@bhu.ac.in

Deepa Mehta

Perspective

Keywords: culturally responsive AI, multilingual education, translanguaging, affective computing, ethical AI, educational technology

Posted Date: August 20th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10424388/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Artificial intelligence has expanded the reach of personalised learning, yet the dominant generation of intelligent tutoring systems treats culture and language as background noise rather than as the medium through which learning happens. This conceptual paper proposes SETU—a Socio-culturally Embedded Tutoring framework whose name, echoing the Sanskrit word for a bridge, signals its central purpose: to connect a learner’s cultural and linguistic world with formal curricular knowledge. SETU integrates six interacting components: a Linguistic Repertoire Engine, a Funds-of-Knowledge Mapper, an Affect and Context Sensor, an Adaptive Pedagogy Orchestrator, a Dialogic Feedback Composer, and an Equity and Ethics Guardrail (EEG) around a continuously updated Learner Culture Profile and an explicit teacher-in-the-loop provision. Grounded in sociocultural and situated theories of learning, in culturally responsive and culturally sustaining pedagogy, and in international AI-ethics guidance, the framework is situated within India’s policy turn toward multilingualism and rootedness under the National Education Policy 2020 and the National Curriculum Framework for School Education 2023. Systematic data on India’s linguistic diversity and on foundational and digital learning are used to motivate the design. Rather than replacing the teacher as cultural mediator, SETU is designed to augment that role. The paper provides architectural diagrams, a comparison to traditional tutoring, and a multifaceted framework to make this kind of learning equitable and context-aware.

Introduction

Artificial intelligence has moved over the past decade from the fringes of education research to the core of discussions around learning design, delivery, and assessment. With adaptive platforms, generative tools, and intelligent tutors, we now have the potential for teaching that is responsive, scalable, and data-rich (Zawacki-Richter et al., 2019). Yet, the potential is incomplete. Many of today’s applied systems use shallow data to parse student-answered items, time spent, and earned scores, and then rearrange the order of learning materials.

What they miss in the process is the learner as a cultural and linguistic agent who thinks, not in an assumed monolingual space, but within a community language, brings cultural capital, and interprets all tasks from a specific vantage point. This gap is experienced acutely in the context of highly plural communities, nowhere more vividly than in the Indian landscape, with its plethora of languages and schooling communities whose ways of knowing don’t always align with the language of the textbook. The import of technology without attending to such diversity can end up amplifying and embedding the very inequities it claims to address (Selwyn, 2019; Williamson & Eynon, 2020). The notion of personalisation without regard for such nuances delivers, at best, a form of deep learning on superficially diverse paths-deep for all, but deeply culturally insular for many. However, long-standing work in the learning sciences has offered a more fertile starting point for innovation. Since Vygotsky (1978), learning has come to be seen as mediated by the tools of culture and social interaction rather than transmitted in static chunks between teachers and students. This naturally leads to culturally responsive and culturally relevant pedagogies, an entire branch of practice research that argues for culturally grounded learning

that enhances both engagement and achievement (Gay, 2018; Ladson-Billings, 1995a). If that be true of teaching in a room, it ought to be true also of teaching on a machine. Thus, instead of asking whether AI can learn to individualise, this paper addresses whether it can learn to mediate culture instead.

To do so, we propose SETU, an AI-Assisted Learning Framework for Socio-culturally Embedded Tutoring in Multilingual settings. SETU is an apt choice in more than one way: The word in Indian languages meaning “bridge”, it represents the central premise and organising commitment of the proposed framework - building a bridge between the learner’s worlds of culture and language, and the worlds of the curriculum and institutionally sanctioned knowledge, as a skilled educator does. SETU should be viewed not as a finalised product but as a conceptual architecture or blueprint designed to guide designers, developers and policymakers across subjects and in diverse contexts.

Research Questions

1. How can an AI tutoring architecture treat language and culture as central resources rather than incidental variables, so as to overcome the shallow personalisation of existing systems?
2. What components and interconnections are required to interpret a learner’s cognitive, linguistic, affective, and cultural signals while remaining aligned with international AI-ethics guidance and India’s curricular policy?
3. How does such a structure retain and enhance the position of the teacher as a human mediating culture, instead of replacing it?
4. How does the proposed framework address the persistent challenges of linguistic disadvantage, the digital divide, and algorithmic bias in diverse educational settings?

Background

With the explosion of intelligent technology in Education comes a rapidly expanding knowledge base, but the field is characterised by a lack of agreement on what ‘learner’ means. Some intelligent systems have offered complex models of the brain, yet cast students only as owners of skill proficiencies. Contemporary learning analytic platforms and generative models offer a wider sensory field and greater productive capacity, while several reviews note that designers pay little heed to the role of the teacher and the wider culture of language and learning (Zawacki-Richter et al., 2019; Holmes et al., 2019). SETU engages directly with this research agenda: culture and language are treated as central to the design from the start.

Culturally Responsive Pedagogy and Computing

The pedagogy is sound. Ladson-Billings (1995a; 1995b) defined teaching as involving academic success, cultural competence, and socio-critical consciousness. Gay (2018) moved that posture to the

micro-level of classroom operations, choices about what materials they bring, how they interact, and the types of examples they give all carry cultural significance that are crucial for engagement.

Paris (2012) recast the endeavour in his concept of culturally sustaining pedagogy, calling for schools to sustain rather than erase student language and cultural repertoires. Among technologies, specifically, Scott, Sheridan, and Clark (2015) theorised culturally responsive computing, proving that asset-based design grounded in community know-how boosts student performance and participation among those historically relegated to the margins. SETU brings this thread from pedagogy to architecture.

Sociocultural and Situated Theories of Learning

At the core of these pedagogies is a theory of mind. Vygotsky (1978) thought that higher-order thought processes are constructed through mediated tools, especially language, within the zone of proximal development, where the learning partner scaffolds skills that the novice has yet to perform independently. Lave and Wenger (1991) reoriented our views from isolated cognitive mechanisms to learning in the world, where learning is understood as participation in communities of practice that generate social and individual meaning and identity. And Rogoff (2003) illustrated that the ways in which competence is instantiated may vary across cultural contexts. Taken together, this set of arguments suggests that removing a learner's context as a cultural agent would run contrary to how people learn in practice.

Multilingualism, Funds of Knowledge, and Translanguaging

A further two constructs influence its design. The Moll, Amanti, Neff and Gonzalez (1992) study proved that homes are repositories of a culturally varied fund of knowledge that teachers can utilise for linking the world at home to the world at school. The work of Garcia and Wei (2014) defines translanguaging as the agile use of multilingual pupils' full linguistic abilities to resist artificial boundaries erected between named languages, viewing it as a resource rather than a deficit. In an Indian context, mother-tongue-based multilingual education is Mohanty's prerequisite for equality (2019). Two components of SETU are directly inspired by these constructs.

Ethical and Responsible AI in Education

The integration of AI into teaching decision-making inevitably raises issues of fairness, transparency, privacy, and learner autonomy. A common set of ethical principles is emerging worldwide (Jobin et al., 2019; Floridi & Cowls, 2019), with the UNESCO Recommendation on the Ethics of Artificial Intelligence prioritising inclusion, human autonomy and non-discrimination (UNESCO, 2021). Concurrently, a body of literature highlights the need to create AI that facilitates teacher-AI complementarity rather than replacing teachers, while ensuring that humans make all key decisions (Holstein et al., 2019; Selwyn,

2019). SETU builds these considerations into the design, rather than treating ethics as an addition required to demonstrate compliance.

The Indian Policy Context

Finally, the framework is located within a particular policy moment. Schooling is steered towards conceptual learning and student-centric pedagogical methods in NEP 2020, which recommends, where feasible, the use of the home language/mother tongue as the medium of instruction for children up to class 5. The National Curriculum Framework for School Education 2023 translates this aspiration into implementation by positioning Indian knowledge, multilingualism, and equity at the content, pedagogical, and cultural levels (NCERT, 2023). It is possible to understand SETU as a technological expression of these intentions. Table 1 summarises how the framework departs from conventional AI tutoring systems.

Table 1
Comparative orientation of conventional AI tutoring systems and the SETU framework

Criterion	Conventional AI tutoring systems	SETU framework
Personalisation basis	Prior scores, item responses, rules	Cognitive, linguistic, affective, and cultural signals combined
Language	Single instructional language assumed	Multilingual repertoire and translanguaging are supported
Learner’s culture	Treated as background or noise	Treated as an asset via funds-of-knowledge mapping
Affect and context	Absent or rudimentary	Integral, through an effect and context sensor
Role of the teacher	Often bypassed	Teacher-in-the-loop as human cultural mediator
Ethics and equity	Addressed post hoc, if at all	Built-in guardrail aligned with UNESCO and NEP
Theoretical grounding	Behaviourist or cognitivist	Sociocultural, situated, and culturally responsive

The SETU Conceptual Framework

SETU is proposed as a modular, ethically grounded, and culturally responsive architecture for AI-assisted learning. Its premise is that effective AI-supported instruction must interpret not only what a learner knows and does, but the linguistic and cultural world in which that knowing is situated. The framework was developed through an iterative synthesis of the literature reviewed above, identifying gaps in linguistic exclusion, cultural invisibility, weak affective awareness, and ethics treated as an appendage

whose components are designed to close. The architecture is presented through two complementary diagrams: a layered view of the components (Fig. 1) and a data-flow view of their interaction (Fig. 2).

Note

Multilingual and multimodal inputs feed a sensing layer (LRE, FKM, ACS) that updates a Learner Culture Profile; the Adaptive Pedagogy Orchestrator and Dialogic Feedback Composer act on that profile, with the teacher-in-the-loop and the Equity and Ethics Guardrail governing the cycle. At a high level, SETU comprises six interdependent components organised around a shared Learner–Culture Profile Repository. Each performs a distinct function while communicating continuously with the others.

1. Linguistic Repertoire Engine (LRE)

The LRE regards the whole of the learner's linguistic resources as an asset, not a deficit. It facilitates interaction in the home language and across languages to encourage translanguaging, in which learners draw on linguistic resources from their entire repertoire to make meaning (Garcia & Wei, 2014). For learners who are learning in a medium of instruction that is not their own language, the engine offers their mother tongue as a scaffolding resource—a facility which glosses the key vocabulary items, which accepts answers in the home language, and bridges toward the language of instruction. In situations where, for many, learning takes place through a medium of instruction that is not their home language, the engine helps overcome a structural source of inequality (Mohanty, 2019).

2. Funds-of-Knowledge Mapper (FKM)

The FKM elicits and represents the cultural and community knowledge that learners bring with them—agricultural, artisanal, narrative, mathematical, and moral. Drawing on the funds-of-knowledge tradition (Moll et al., 1992), it tags curricular concepts with culturally proximate analogues, so that a new idea can be introduced through a familiar practice rather than an alien example. Over time, the mapper builds an asset profile that the orchestrator can use to select examples and tasks that resonate with the learner's lived experience.

3. Affect and Context Sensor (ACS)

Cognitive learning, however, does not exist in an emotionless, circumstance-free vacuum. It is mediated as well as supported by them, as in our ACS that fuses multimodal cues - the expressed sentiments of the learner (in answer expressions), affect signatures such as engagement/fatigue signals, but also external influences such as time-of-day or learning environment constraints - to create an estimate of the current emotional state of the learner and their prevailing circumstances. The system adapts the level and nature of the adaptive responses to increase, decrease, or temporarily delay instruction, based on the inferred situation and the learner's inferred emotions (frustration, boredom or distraction), following the principles of affect-aware educational technology (e.g., D'Mello and Graesser, 2005). As in previous systems of affect inference, all inferred effect information passes through an ethical filter and is perceived as hypothesis-generating rather than fact-establishing.

4. Adaptive Pedagogy Orchestrator (APO)

The APO is the pedagogical orchestrator. Upon review of the Learner-Culture Profile, the APO orchestrates, prioritises, paces, and schedules instruction to keep the learner in the Zone of Proximal Development (Vygotsky, 1978) with a predisposition for learner-favoured cultural resources surfaced by the FKM and provided by the LRE. Instead of dictating a linear progression, the orchestrator constructs learners' paths, adjusting pacing, delivery modality and example type as the profile unfolds in response to changes to the learner, and transitioning the learning environment from reactive feedback to culturally informed, anticipatory scaffolding.

5. Dialogic Feedback Composer (DFC)

For many, learning is cemented by feedback, and the way it is given can be as important as the feedback itself. The DFC is able to deliver formative feedback at any of the levels advocated by Hattie and Timperley (2007), task process and self-regulation, adapting its language, tone and the level of directiveness based on the student's skill level and cultural sensitivities (Shute, 2008). The feedback could be in the learner's mother tongue, relate to something the learner is familiar with, or even be presented as a dialogue rather than a judgment, turning your correction into a conversation and therefore protecting your learner's sense of efficacy.

6. Equity and Ethics Guardrail (EEG)

Rather than a to-do list, the EEG functions as the system's conscience, auditing components for biases, checking the system against principles of transparency and consent, monitoring moments of significant decision-making, and ensuring that students and instructors have a voice in overseeing and challenging its output. More than a task list, the EEG serves as the framework's conscience, implementing bias tests across its components and ensuring the framework continues to be assessed against transparency and consent standards. It can also track when critical, consequence-affecting decisions are being made and provides students and teachers with a mechanism to scrutinise and dispute the system's output. In designing the safeguard architecture we implement real world recommendations for inclusion, consent and human control into code (UNESCO, 2021; Floridi & Cowls, 2019). In the EEG, we actualise our primary concern; that the teacher is still front and centre, acting as a human mediator of exceptions, adding nuance, co-creation, and ultimately acting with an augmentative rather than replacing role (Holstein et al., 2019).

Integration Logic and Data Flow

SETU's components are constructed not as a pipeline but as an integrated cycle. A learning interaction results in the generation of multimodalities, which the sensing components, namely LRE (linguistic repertoire engine), ACS (affect and context sensor), and FKM (funds of knowledge mapper), use to independently (in parallel) interpret the language and effect on the one hand, and cultural assets on the other. These are used to update the Learner-Culture Profile Repository, an explainable and longitudinal

account that incorporates the cognitive, lingual, affective, and contextual elements of a Learner’s experience. The Adaptive Pedagogy Orchestrator then uses the standards-aligned knowledge base to devise a culturally mediated learning move. This is formatted by the Dialogic Feedback Composer into the correct language and register. Every critical action is subject to a check and may be modified/stalled by the Equity and Ethics Guardrail if its execution could be harmful and unfair. Parallel is a thread supplying observations to a teacher interface dashboard. Figure 2 depicts this flow.

Note

The cycle is bidirectional: outputs return as adjusted, culturally situated content, and the Equity and Ethics Guardrail gates decisions before they reach the learner.

Two aspects differentiate this flow from traditional ones: First, cultural/linguistic interpretation happens at the point of sensing, not as a superficial decoration, ensuring culture dictates what and how the teaching material will be prepared and presented, instead of simply “ dressing up the material with local culture”; Second, the teacher plays a dynamic part of the feedback cycle as opposed to merely being an end recipient of final outcome reporting to ensure the mutually enhancing complementarity between human teachers and AI the framework advocates for as a cornerstone principle. Table 2 lists the role of each component and the corresponding contribution to equity and personalisation.

Table 2
SETU components, core functions, and contributions to equity and personalisation

Component	Core function	Contribution to equity/personalisation
Linguistic Repertoire Engine	Supports home-language and cross-language interaction	Reduces linguistic disadvantage; validates learner identity
Funds-of-Knowledge Mapper	Represents community knowledge as curricular assets	Makes content culturally resonant and meaningful
Affect and Context Sensor	Interprets emotion, fatigue, and setting	Times and tunes instruction to learner well-being
Adaptive Pedagogy Orchestrator	Sequences ZPD-aligned, culturally relevant tasks	Delivers deep, not shallow, personalisation
Dialogic Feedback Composer	Generates multi-level, language-aware feedback	Sustains motivation; improves receptivity
Equity and Ethics Guardrail	Audits bias; ensures transparency and oversight	Protects fairness, agency, and teacher authority

The Current Scenario: Evidence from Authentic Data

A case for culturally and linguistically responsive design. The case for cultural and linguistically responsible design is not simply based on ideology; it’s inscribed in the demographics of Indian schooling. According to the 2011 census, 19,569 mother-tongue returns were made which were

subsequently reduced to 1,369; while 121 are reported to be spoken by over 10,000 individuals each, and only 22 are listed under the constitutional scheduled languages, the number of actual mediums of instruction are limited to few tens which leaves the majority of school children to be taught in a language other than their home language.

(Mohanty, 2019). Figure 3 visualises this funnel from spoken diversity to the languages of schooling.

Note

Counts shown on a logarithmic scale. Source: Census of India (2011); medium-of-instruction figure after Mohanty (2019).

As a result of this deficit, there are clearly documented disadvantages to children being taught in an unknown language, and these costs are largely shouldered by tribal, minority, and indigenous-language speaking populations (Mohanty, 2019). Therefore, a framework capable of “meeting learners where they are” has the potential to mitigate an inherent structural inequity.

Foundational learning data sharpen the picture. The Annual Status of Education Report 2024, a household survey of 649,491 children across 17,997 villages in 605 rural districts, found that the share of Standard III children in government schools able to read a Standard II level text recovered to 23.4% in 2024, up from 16.3% in 2022, while the corresponding figure for Standard V rose to 44.8% (ASER Centre, 2025). The recovery is encouraging, yet it also shows that most children remain below the competencies expected of them several grades earlier. Figure 4 traces this decline and rebound.

Note

Percentage of children able to read a Standard II-level text. Source: ASER Centre (2025).

Lastly, the digital arena discourages hope that digital access will automatically solve the divides. ASER 2024 is the first ASER year to study rural 14–16-year-olds’ digital preparedness and found that about 90% of students reported having access to smartphones at home, while 82% could operate a device. The percentage of persons who had used phones to participate in learning in the last week was, however, low-57 per cent compared to their reported usage of smartphones for social media of 76 per cent (ASER Centre, 2025). This discrepancy between the availability of access and the utilisation of phones for learning can be illustrated in Fig. 5 below:

Note

Self-reported figures, rounded. Source: ASER Centre (2025). Put all these data pieces together, and you have a coherent story. Cross-lingual disparities hinder learning; the impact of foundational deficiencies endures even during learning and catch-up; and internet access doesn’t magically “educate” users. Such a solution, one that is multilingual, linguistically authentic, affect-aware, and ethical (i.e., it scaffolds

learning to support users across devices, using the languages and idioms they understand best), directly addresses each of these issues.

Evaluation and Validation Framework

SETU, as a conceptual architecture, is calling out for verification, not for declaration of verification. A sound programme of verification could take a design-based approach, iterating the architecture across actual classrooms and against comparison controls, which might include traditional tutoring methods, within a quasi-experimental context. There are five dimensions proposed as benchmarks for success: cognitive effectiveness-do students understand, retain, and transfer knowledge? Cultural and linguistic relevance: Can students learn and express themselves in their native languages and identify their experiences within curriculum materials? Emotional and situational awareness-does the instruction adapt correctly to emotional tone and environmental cues? Ethical principles-is the interaction equitable, transparent, and is there scope for student agency, with the teacher still present? And trust and satisfaction, do the students and teacher find the experience appropriate and respectful? Each of these points refers to tangible measures, ranging from gains on pre and post-tests to the incidence of native language use to patterns of successful emotion inference across different ethnic and cultural groups, to system log reports of overriding an inferred student emotion or language, all of which could be mapped to an information display dashboard for evaluation.

The language and emotion models, in particular require careful consideration, due to differences in predictive capabilities across different population groups: in the same way, localisation testing across languages, and cultural and geographical boundaries would need to occur before deployment rather than be treated as an add-on; this reflects the central argument of this approach that responsiveness, while ideally it could be presumed, must always be verified and measured, in the context.

Discussion and Implications

SETU thus shifts educational AI away from a content-serving machine to a mediating machine for language, knowledge and culture, with strong policy, practice and teacher-education implications. For policy, SETU provides a model to support the work of designing educational technologies that will meet the multilingual and equity aspirations of NEP 2020 and NCFSE 2023, insofar as it suggests procurement and design guidelines that are guided not by whether a system customises but by how accountably and responsively it does so. For practice, SETU's reliance on the human-in-the-loop provision is a philosophical choice.

It does not view AI as a substitute for the scarcity of teachers, but as a tool to increase teachers' reach as culture brokers, taking on routine scaffolding while allowing the human to own the interpretation, translation, and relationship.

For teacher preparation policy, this calls for the development of educators to codevelop, manage and scrutinise the AI with the help of expertise in AI and data Literacy as a part of the already demanded multilingual and culturally responsive teachers. For inclusion, the framework is a conscious choice to adapt to low-resource and linguistically diverse contexts. By foregrounding the role of home language, community knowledge and oversight, SETU outlines how tech can complement rather than supersede local educational practices and beliefs. The strengths of SETU to support India's multilingual classrooms thus make it adaptable to other culturally and linguistically diverse settings.

Conclusion

This paper has argued that the next generation of educational AI should be built to mediate culture and language rather than to ignore them. Drawing on sociocultural and situated theories of learning, on culturally responsive and sustaining pedagogy, and on international AI-ethics guidance, it proposed SETU, a Socio-culturally Embedded Tutoring framework whose six components are organised around a Learner–Culture Profile and an explicit teacher-in-the-loop provision. Authentic data on India's linguistic diversity and on foundational and digital learning were used to show why such a design is needed, not merely desirable.

SETU exists as an aspiration – a named concept, both structurally and functionally, of both linking learners 'cultural worlds with 'knowledge' and serving to guide the integration of artificial intelligence within schools in a manner that strengthens pluralism and equity and respects teachers' irreplaceable labour. Such a vision will ultimately depend, at its core, on empirical evaluation, sustained engagement with teachers, and the cultural lives of those whom they teach.

Declarations

Funding: This research received no specific grant or funding from any funding agency in the public, commercial, or not-for-profit sectors.

Ethics approval: Not applicable.

Consent to participate: Not applicable. As no human participants were involved in this study, informed consent to participate was not required.

Consent to publish: Not applicable. This manuscript does not contain any individual person's data in any form (images, videos, identifiable details, etc.), so consent to publish was not required.

Clinical trial Number -Not applicable

References

1. Annual Status of Education Report Centre. Annual status of education report (rural) 2024. Pratham; 2025.
2. Aronson B, Laughter JC. The theory and practice of culturally relevant education: A synthesis of research across content areas. *Rev Educ Res*. 2016;86(1):163–206. <https://doi.org/10.3102/0034654315582066>.
3. Baker RS. Stupid tutoring systems, intelligent humans. *Int J Artif Intell Educ*. 2016;26(2):600–14. <https://doi.org/10.1007/s40593-016-0105-0>.
4. Bruner JS. The culture of education. Harvard University Press; 1996.
5. Census of India. Language: India, states and union territories (Table C-16). India: Office of the Registrar General & Census Commissioner; 2011.
6. Eglash R, Bennett A, O'Donnell C, Jennings S, Cintonino M. Culturally situated design tools: Ethnocomputing from field site to classroom. *Am Anthropol*. 2006;108(2):347–62. <https://doi.org/10.1525/aa.2006.108.2.347>.
7. Floridi L, Cowls J. A unified framework of five principles for AI in society. *Harv Data Sci Rev*. 2019;1(1). <https://doi.org/10.1162/99608f92.8cd550d1>.
8. García O, Wei L. Translanguaging: Language, bilingualism and education. Palgrave Macmillan. 2014. <https://doi.org/10.1057/9781137385765>.
9. Gay G. Culturally responsive teaching: Theory, research, and practice. 3rd ed. Teachers College; 2018.
10. Hattie J, Timperley H. The power of feedback. *Rev Educ Res*. 2007;77(1):81–112. <https://doi.org/10.3102/003465430298487>.
11. Holmes W, Bialik M, Fadel C. Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign; 2019.
12. Holstein K, McLaren BM, Alevan V. Co-designing a real-time classroom orchestration tool to support teacher–AI complementarity. *J Learn Analytics*. 2019;6(2):27–52. <https://doi.org/10.18608/jla.2019.62.3>.
13. Jobin A, Ienca M, Vayena E. The global landscape of AI ethics guidelines. *Nat Mach Intell*. 2019;1(9):389–99. <https://doi.org/10.1038/s42256-019-0088-2>.
14. Ladson-Billings G. Toward a theory of culturally relevant pedagogy. *Am Educ Res J*. 1995a;32(3):465–91. <https://doi.org/10.3102/00028312032003465>.
15. Ladson-Billings G. But that's just good teaching! The case for culturally relevant pedagogy. *Theory Into Pract*. 1995b;34(3):159–65. <https://doi.org/10.1080/00405849509543675>.
16. Lave J, Wenger E. Situated learning: Legitimate peripheral participation. Cambridge University Press; 1991. <https://doi.org/10.1017/CBO9780511815355>.
17. Luckin R, Holmes W, Griffiths M, Forcier LB. Intelligence unleashed: An argument for AI in education. Pearson; 2016.

18. Ministry of Human Resource Development. National education policy 2020. Government of India; 2020.
19. Mohanty AK. The multilingual reality: Living with languages. Multilingual Matters; 2019.
20. Moll LC, Amanti C, Neff D, González N. Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory Into Pract.* 1992;31(2):132–41. <https://doi.org/10.1080/00405849209543534>.
21. National Council of Educational Research and Training. National curriculum framework for school education 2023. Government of India; 2023.
22. Paris D. Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher.* 2012;41(3):93–7. <https://doi.org/10.3102/0013189X12441244>.
23. Pekrun R. The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychol Rev.* 2006;18(4):315–41. <https://doi.org/10.1007/s10648-006-9029-9>.
24. Rogoff B. The cultural nature of human development. Oxford University Press; 2003.
25. Scott KA, Sheridan KM, Clark K. Culturally responsive computing: A theory revisited. *Learn Media Technol.* 2015;40(4):412–36. <https://doi.org/10.1080/17439884.2014.924966>.
26. Selwyn N. Should robots replace teachers? AI and the future of education. Polity; 2019.
27. Shute VJ. Focus on formative feedback. *Rev Educ Res.* 2008;78(1):153–89. <https://doi.org/10.3102/0034654307313795>.
28. Sleeter CE. Confronting the marginalization of culturally responsive pedagogy. *Urban Educ.* 2012;47(3):562–84. <https://doi.org/10.1177/0042085911431472>.
29. UNESCO. Recommendation on the ethics of artificial intelligence. United Nations Educational, Scientific and Cultural Organization; 2021.
30. Vygotsky LS. Mind in society: The development of higher psychological processes. Harvard University Press; 1978.
31. Williamson B, Eynon R. Historical threads, missing links, and future directions in AI in education. *Learn Media Technol.* 2020;45(3):223–35. <https://doi.org/10.1080/17439884.2020.1798995>.
32. Zawacki-Richter O, Marín VI, Bond M, Gouverneur F. Systematic review of research on artificial intelligence applications in higher education – Where are the educators? *Int J Educational Technol High Educ.* 2019;16:39. <https://doi.org/10.1186/s41239-019-0171-0>.

Figures

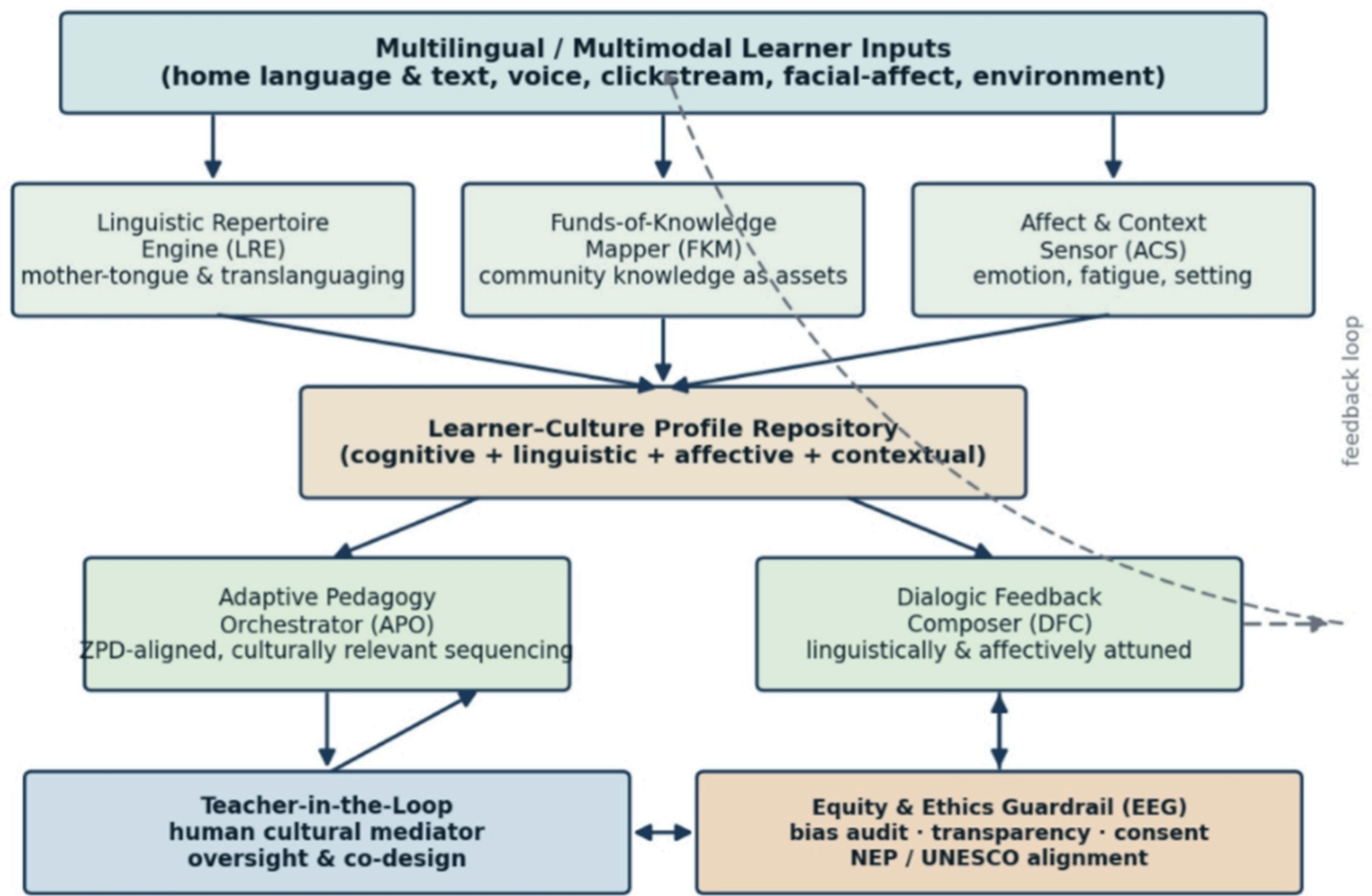


Figure 1

Layered architecture of the SETU framework.

Note. Multilingual and multimodal inputs feed a sensing layer (LRE, FKM, ACS) that updates a Learner Culture Profile; the Adaptive Pedagogy Orchestrator and Dialogic Feedback Composer act on that profile, with the teacher-in-the-loop and the Equity and Ethics Guardrail governing the cycle. At a high level, SETU comprises six interdependent components organised around a shared Learner–Culture Profile Repository. Each performs a distinct function while communicating continuously with the others.

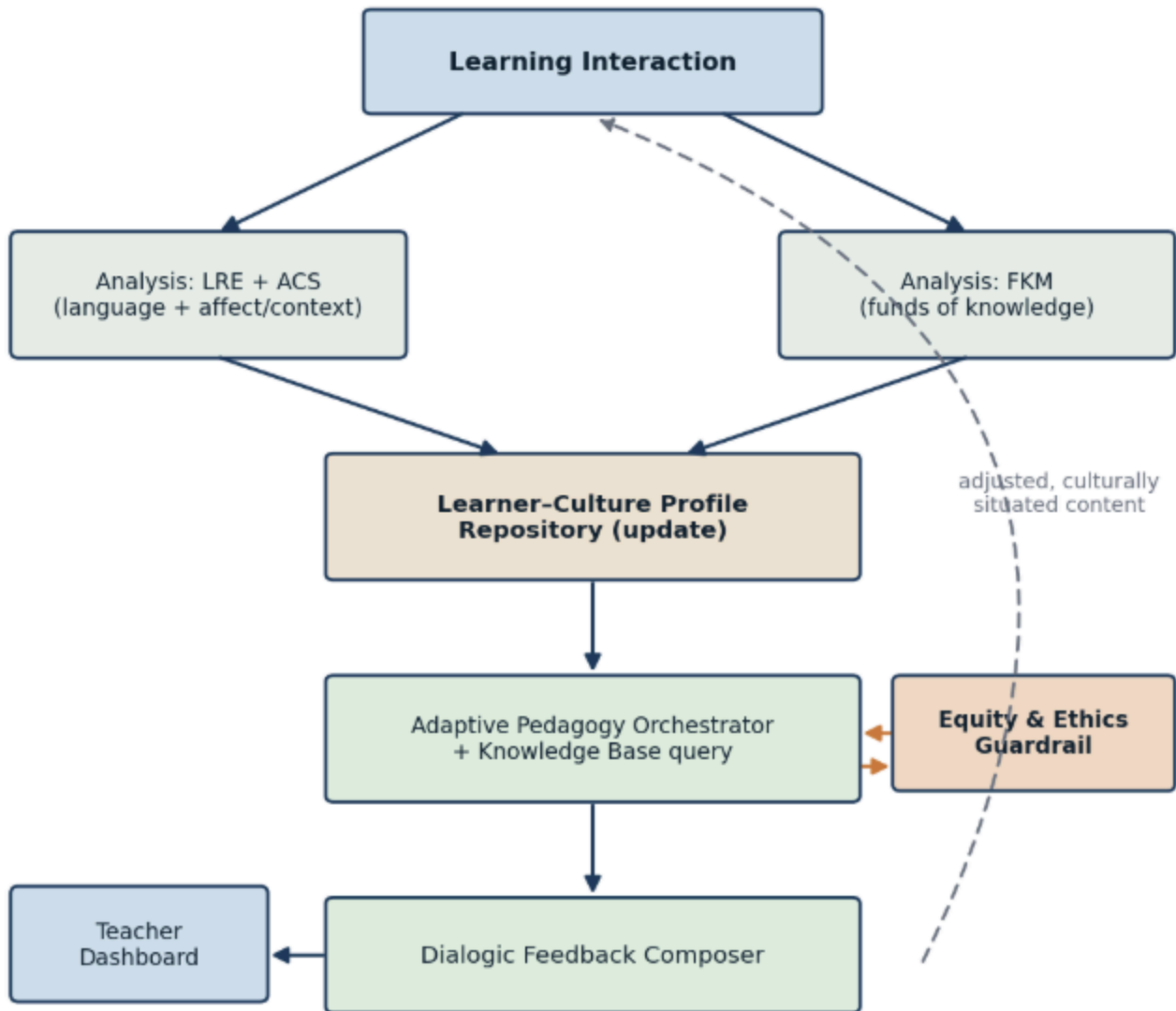


Figure 2

Data flow and decision cycle in the SETU framework.

Note. The cycle is bidirectional: outputs return as adjusted, culturally situated content, and the Equity and Ethics Guardrail gates decisions before they reach the learner.

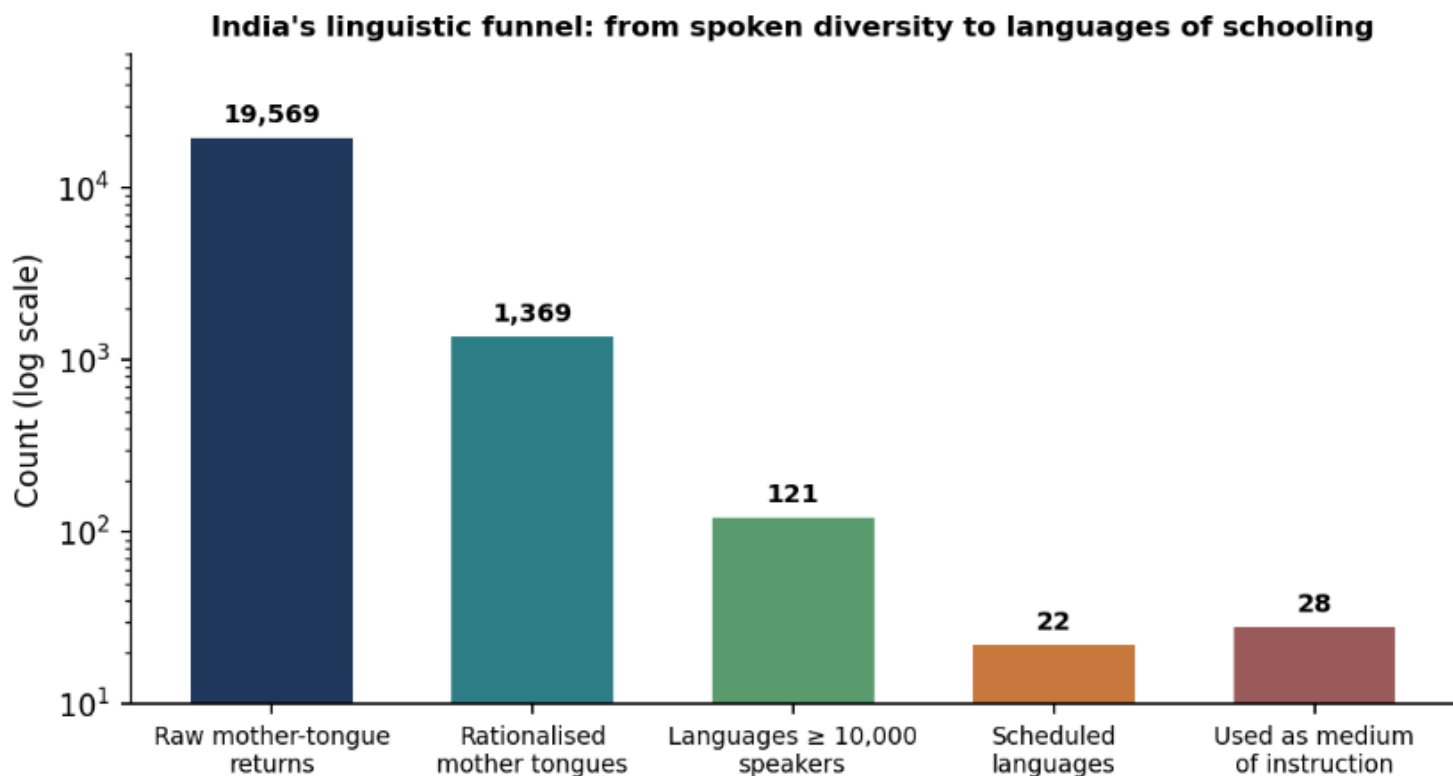


Figure 3

India's linguistic funnel, from spoken diversity to languages of schooling.

Note. Counts shown on a logarithmic scale. Source: Census of India (2011); medium-of-instruction figure after Mohanty (2019).

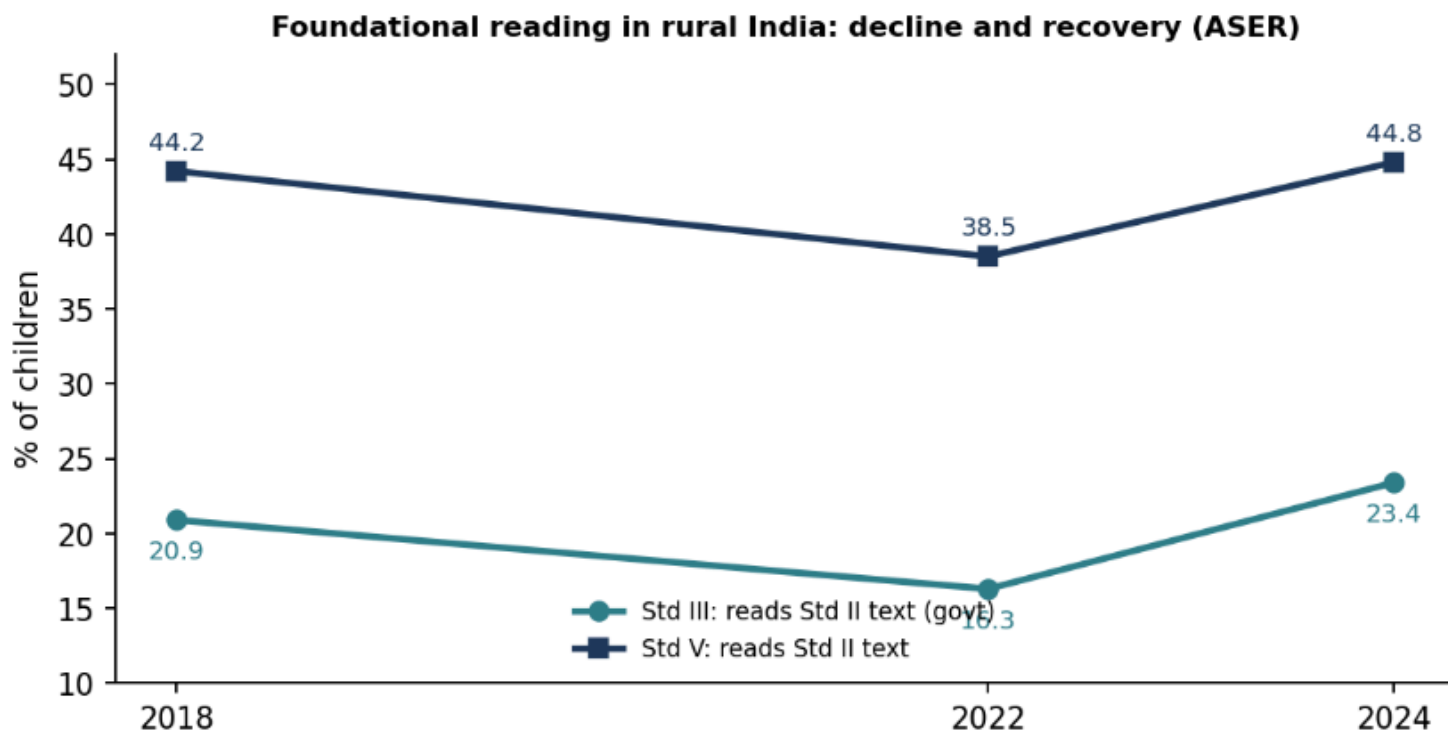


Figure 4

Foundational reading in rural India: decline and post-pandemic recovery.

Note. Percentage of children able to read a Standard II-level text. Source: ASER Centre (2025).

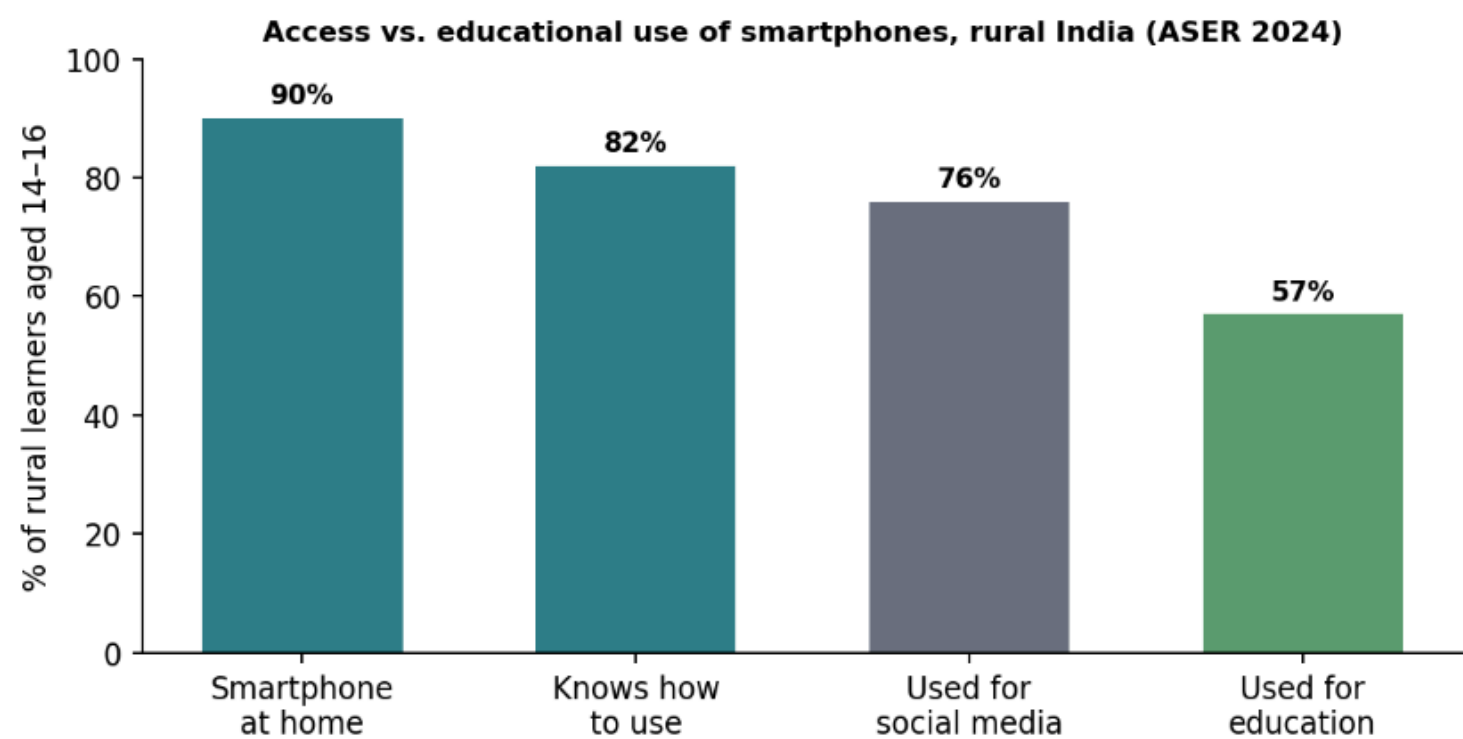


Figure 5

Access versus educational use of smartphones among rural learners aged 14–16.

Note. Self-reported figures, rounded. Source: ASER Centre (2025). Put all these data pieces together, and you have a coherent story. Cross-lingual disparities hinder learning; the impact of foundational deficiencies endures even during learning and catch-up; and internet access doesn’t magically “educate” users. Such a solution, one that is multilingual, linguistically authentic, affect-aware, and ethical (i.e., it scaffolds learning to support users across devices, using the languages and idioms they understand best), directly addresses each of these issues.