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From Nālandā to Neural Networks: Rethinking Multilingual Cognition and Adaptive Learning through a Translanguaging Pedagogical Lens under NEP 2020

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Abstract –

Cultivation of hybrid multilingual learning environments was the soul of ancient Nalanda Mahavihara and Takshashila. Then, concepts like dialogic pedagogy, multilayered linguistic exchange and holistic cognition were nonexistent theories. But, the emerging hybrid AI architectures progressively mirror the same intellectual spirit. NEP 2020's priority for mother-tongue instructions and AI-assisted educational reconfiguration display significant scope for strengthening and utilizing India's underlying multilingual cognition. Although the persistent layers of digital divide, social media and chatbot addiction stay counterproductive to the learning environments, sovereign projects like Bhashini, Anuvadini are creating new prospects for mono-English to multilingual regional transitions. By analyzing Cummins' Common Underlying Proficiency (CUP), García's Translanguaging, and the Zone of Proximal Development (ZPD), this paper explores the potential for AI-assisted sustainable cognitive agility and polylingual knowledge transfer.

Keywords: – *NEP 2020, Multilingual Cognition, Adaptive learning, Indian Educational Technology, Educational AI.*

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Introduction

The 1992 'Programme of Action' document confirmed that India, the linguistic mosaic, has 1,576 rationalized and 1,796 other mother-tongues[1]. Yet, for decades, institutional success has ignored the potential of multilingual cognition while promoting English-medium schooling. Although regional classrooms regularly operate through interlinguistic shifts among Bengali, Hindi, Tamil, and other languages, monolingual English instruction has become a pedagogical marker of economic and academic mobility. Interestingly, the historical linguistic tradition of Nalanda Mahavihara and Takshashila used to encourage code-switching between Sanskrit, Pali, Prakrit and other regional languages to spread knowledge[2]. The 'Dual Iceberg' metaphor of Cummins' CUP model suggests that this code-mixing tradition develops a shared cognitive engine spontaneously to dig deeper into linguistic emotion, reasoning and comprehension[3]. García's Translanguaging further complements this code-switching, by recognizing natural linguistic flow and applying the cognitive engine to combat linguistic anxiety organically[4].

AI-based adaptive learning can optimize this cognitive engine and its multilinguistic flow to a fuller extent. For instance, a student speaking English in class but Hindi in household and Bengali in station may provide Bhashini and other LLMs with a multi-lingual prompt. The LLMs' tendency to mimic would generate a response in code-mixed dialect without penalty. Such a learning environment could actively utilize the internal cognitive engine and reduce English-based monolinguistic isolation. Contextually, NEP 2020 also has actively advocated for an additive multilingual model in the classroom[5]. Focusing on the transition from monolinguistic, subtractive model to multilingual additive model, ZPD and Cognitive Flexibility Theory can develop an immersive learning environment with AI and LLM orchestration. This paper critically examines the application of these frameworks within India's multilingual educational environment and emerging AI usage. However, it also highlights the algorithmic bias and ecological costs of AI and recommends a holistic assimilation between historical multilingual traditions and modern AI-driven learning to shape the dynamic cognitive ecosystem of the subcontinent.

NEP 2020 and MOI

The National Education Policy (NEP) 2020 recommends mother tongue or the regional language as the medium of instruction "until Grade 5, and preferably until Grade 8," determining the multilingual pedagogical philosophy[6]. To eliminate the linguistic barrier, the policy also promotes a "flexible three-

1 https://www.education.gov.in/sites/upload_files/mhrd/files/upload_document/languagebr.pdf--Date:19/05/2025, Time:9:52 AM

2 https://blog.mygov.in/editorial/nalanda-how-it-changed-the-world/-Date:19/05/2025, Time:9:50 AM

3 Mabiletja, M., & Ngcobo, M, Language planning in the context of complex multilingual schools, ScienceRise, (4), 37-50, 2023.

4 Tapole, T. E, A qual-quantitative exploration of translanguaging impact of ESL teachers and learners' performance in three selected primary schools in Quthing District, Doctoral dissertation, National University of Lesotho, 2025.

5 https://www.education.gov.in/sites/upload_files/mhrd/files/nep/NEP_2020_Vision.pdf-Date:19/05/2025, Time:10:20 AM

6 https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1847066&reg=3&lang=2-Date:19/05/2025, Time:11:02 AM

language formula"[7] which closely aligns with Cummins' CUP framework in terms of multilingual cognitive skill transfer. However, in practice, there remains a significant implementation gap, further intensified by the stark urban-rural divide and infrastructural challenges. For example, rural students often benefit comparatively more from localized instruction, while urban students are frequently pushed toward English-medium instruction due to parental aspirations for socioeconomic mobility[8]. Moreover, trained multilingual teachers and educational resources in regional dialects remain adequate.

Teachers often observe that students who express themselves in their mother tongue engage with learning materials more effectively and create greater scope for reducing ethnocentric biases. However, state-wide preparedness is uneven. South Indian and North Indian states frequently conflict over each other's regional languages and curricular preferences[9]. Although teachers prefer code-mixing (English & regional languages) for a better learning environment, parental preference, peer influence and multiethnic households may resist the process. Even a linguistic erosional trend is observed where linguistic proximity is highly visible. For instance, Punjabi demonstrates such erosional tendencies because the dominance and structural similarity of Hindi often reduce the active use of Punjabi in everyday communication[10]. AI has the potential to resist such erosions and bridge infrastructural gaps through real-time transliteration and voice-based services. Tools like Bhashini and Anuvadini are already using users' perspectives to expand regional dialects and indigenous languages[11]. So, LLM-based networks may help address several pedagogical and linguistic challenges associated with NEP implementation.

The Scope of AI-integrated Multilingual Cognition

Key Structural Pain Points

Although the overall literacy rate of 80.9% indicates a strong upward trend, major structural divides such as the urban-rural gap, gender disparity, regional inequality, and foundational challenges continue to counterbalance this progress[12]. An 11.4% difference between urban and rural literacy rates indicates persistent systemic accessibility challenges. Moreover, the 87.2% male literacy rate significantly outpaces the 74.6% female literacy rate, while states such as Rajasthan demonstrate a gender gap of more than 20%[13]. State-wise educational attainment also varies widely. For instance, Mizoram demonstrates a high literacy rate of 98.2%, whereas Bihar records only 74.3%. Furthermore, the ASER

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7 https://www.iitms.co.in/blog/three-language-formula-in-nep-2020.html-Date:19/05/2025, Time:11:02 AM

8 Singh, A. K., Multilingual Education and NEP 2020: Challenges and Opportunities, Jindal Journal of Public Policy, 8(II), 1–23, 2025. https://doi.org/10.54945/jjpp.v8iII.277.

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2023 report highlights foundational learning concerns by stating that only 42.8% of Grade 5 students can read a Grade 2-level text[14].

AI tailored operation in the educational ecosystem

The pain points are parts of a one-sized-fits all approach which is further intensified by the English-based monolinguistic isolation. Contextually, the emerging AI toolkits and LLM orchestration models can transform this monolingual bottleneck with adaptive learning, Neural Machine Translation (NMT), and multilingual AI voices. AI-powered educational apps can analyze student interaction data in terms of response time, return rate, error traits and linguistic preferences to develop customized learning paths[15]. This forms a major layer of the adaptive learning model. So, a multilingual learner's struggle with Latin terminologies in Biology can be resolved with conceptual explanations in his/her regional preferences.

In terms of NMT, the neural networks of Bhashini and Anuvadini tools induce deep learning to transliterate academic texts maintaining semantic nuance andlinguistic intelligence[16]. Emerging multilingual chatbots also can promote the code-mixing learning model with 24 hours on-demand support while LLM orchestration can engage students in a dynamic learning environment combining different AI attributes. Students may even experiment with no-code open-source orchestration platforms to develop more immersive and interactive learning experiences.

Multilingual Cognition & Theoretical Applications

The Indian brain demonstrates a natural flair for cognitive flexibility due to its multilingual environment. AI models can further enhance this trait by reducing the biased linguistic separation embedded within existing educational systems. For instance, a student from rural Bengal struggling with Ohm's Law may receive support through their internal cognitive proficiency when the concept is explained in their mother tongue. Jim Cummins' theory of the "common cognitive substrate," where two surface-level languages share a deeper cognitive foundation, can help AI models activate the student's existing conceptual understanding[17]. In practice, an AI-driven platform may explain the concept in Bengali while encouraging the student to respond in their own linguistic style, thereby demonstrating the "Dual Iceberg" model.

Similarly, Lev Vygotsky's Zone of Proximal Development (ZPD) emphasizes the importance of capable guidance in learning[18]. Within a monolinguistic environment, a rural student may feel excluded

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[14] Jha, S., Niraj, K. C., Regmi, S., & Gupta, P, AI as a Global Equalizer: How NEP 2020 Can Leverage Artificial Intelligence to Bridge Educational Disparities, LTU Journal of Advanced Computing & Engineering, 1(1), 94-119, 2026.

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due to their strong dependence on regional language. Moreover, the dominance of English can create linguistic anxiety, further intensifying the outer layer of the ZPD framework. Contextually, AI-driven personal assistance already creates a more comfortable learning space by reducing linguistic anxiety, as students may ask questions without fear of judgment. Furthermore, AI-driven platforms can gradually introduce increasing layers of learning complexity and intervene adaptively to help students progress toward the inner zone (independent learning) of cognitive development.

Ofelia García's theory of translanguaging states that a multilingual environment creates an unified linguistic reserve that allows learners to spontaneously select linguistic paths for the best expressions[19]. So, languages become socio-political constructs to validate mixed natural phrases without strict mono boundaries. Emerging AI tools with Indian datasets can master this spontaneous code-mixing with its continuous learning feature and naturally validates learners' cognitive flow. As a result, memory blocking affective filters like linguistic anxiety reduces and students feel free from the pressure of a pure linguistic conversation. Moreover, cognitive flexibility theory demands information with multiple channels[20]. AI's multitasking environment achieves this easily, providing video, audio, sketchy notes and texts with bullet points. So, students get a dynamic environment to cultivate their memory hubs. It is quite similar to the Nalanda tradition where foreign language students were encouraged to translate texts in their languages[21].

Challenges, Limitations & Ethical Concerns

However, AI-engineered intelligent systems also tend to deepen systemic and ecological tensions through linguistic barriers, algorithmic bias, and cultural mismatches. These tensions further intensify the digital divide, as adaptive learning platforms and intelligent tutoring systems largely follow the technological and pedagogical attributes of developed countries. Notably, broadband subscriptions rate crossed 1 billion in 2025. However, the quality of digital engagement between urban and rural regions continues to demonstrate a stark disparity. A 2024 survey noted that 82.2% teenagers can use smartphones but only 57% use it for educational purposes[22]. Another recent study confirmed that 83.2% of rural students in Grades 8–10 experience excessive screen time primarily associated with social media consumption.

Interestingly, the digital divide is not limited to hardware accessibility but extends across three interrelated dimensions: access, skills, and outcomes. Beyond the first dimension of infrastructural access, the second dimension focuses on digital skills and meaningful engagement.

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19 García, O., & Kleyn, T, Translanguaging theory in education, In Translanguaging with multilingual students, 9-33. Routledge, 2018.

20 Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. K., Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains, In 10th Annual Conference Cognitive Science Society Pod, 375-383, Psychology Press, 2019, October.

21 Kumari, P., & Shi, W, Experience and enlightenment of the Indian Buddhist Education, In 3rd International Conference on Judicial, Administrative and Humanitarian Problems of State Structures and Economic Subjects (JAHP 2018), 870-872, 2018.

22 https://www.orfonline.org/expert-speak/students-screens-and-human-capital-formation-in-india- Date:20/05/2025, Time:8:02 AM

Constant dependence on general-purpose chatbots does not necessarily indicate learning. Rather, it may induce metacognitive laziness and disengagement from critical thinking. Therefore, teachers must differentiate between GenAI educational tools and generic conversational chatbots. Although 72% of lower-secondary teachers consider AI harmful to academic integrity, nearly 57% simultaneously use AI to improve lesson planning.[23] Another emerging skill issue is "TPACK divide" where teachers have resources but lack training or confidence to use them[24]. The final dimension, outcome, leads to the beneficiaries. Although varied academic advantages are present, the beneficiaries are mostly already-resourced, urban students. Additionally, LLMs are trained mostly by western datasets and Indian regional datasets cover only 1% of the global data[25]. So, the biased algorithms develop an "exclusion by design" scenario where regional datasets get generic feedback. The government and relevant research organizations are still not prepared with adoption policies and capacities. Also, the datacenters are supposed to grow five-fold by 2030, indicating major concerns for e-waste, water and energy consumption rate. GenAI alone would create 5 million metric tonnes of waste by 2030[26]. Therefore, sustainability and resource distribution should be major policy-focus areas.

Conclusion and Recommendations

Modern India should not forget the dynamic learning tradition of Nālandā and other Mahavihara. Therefore, human-centric AI must be a bridge instead of a major replacement. NEP and Indian schools cannot avoid the computational thinking and AI in pedagogical activities. So, the focus should be on meaningful, deep absorption, maintaining sociocultural, collective identities. The vision of NEP 2020 can be realized with an extended Sovereign AI initiative like Param-2, inclusive of all the indigenous and regional dialects. Moreover, multilayer language data trusts can increase regional accounts in the LLM environment and Community-in-the-Loop initiatives. Considering the AI literacy challenges for the teachers, a set of nation and state-wide AI training and audit programs are required. NISHTHA already is working on AI-based computational thinking but it needs more real-world simulation tools for practice[27]. A Sovereign AI Cloud to include rural schools can make the process holistic, reducing the digital divide traits. The focus is to apply ZPD to optimize learning environments while recognizing inherent multilingual cognition through the interconnected dimensions of skills, access, and educational outcomes. Therefore, AI-centric hybrid models should be integrated with ethical frameworks and regional knowledge traditions to cultivate a cognitively agile and linguistically inclusive India.

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