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Mathematical Learning Difficulties among Indian Students: Evidence Review and Secondary Analysis of National Learning Data

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Abstract- Mathematical learning disability (MLD)- spanning from inability to achieve at an overall low level in basic numeracy up to a learning disability with disproportionate disadvantage in mathematics (which is frequently characterized as developmental dyscalculia) is a significant impediment to education in India. MLD is not one problem only but rather a continuum of difficulties related to number sense, fact recall, procedural fluency and mathematical thinking which are commonly exacerbated by attentional and linguistic requirements of classroom instruction (Geary, 2004, 2010). This paper is a synthesis of the evidence on the nature, correlates and educational implication of MLD in Indian students and triangulates the evidence with secondary national learning data. Findings on the cognitive and educational research on math anxiety and dyscalculia and Indian literature on the identification, prevalence, and school reaction to it were integrated using a narrative review approach (Ramaa and Gowramma, 2002; Mogasale et al., 2012; Scaria et al., 2023). Further, rural learning outcomes based on the ASER national results were examined as a secondary trend to define Grade 3, 5, and 8 foundational levels of arithmetic achievement (ASER Centre, 2022, 2024). On the national level, the percentage of Grade 3 children who were capable of performing at least subtraction increased to 33.7% (2024), and those who could do division to 30.7% (2024), which was a sign of post-pandemic recovery but still left a basement (ASER Centre, 2024). According to Indian clinical and school-based literature, establishing a valid prevalence of learning disorders with comorbidities with other learning and attention problems is needed due to the suggestion that the prevalence of learning disorders comorbid with dyscalculia are non-trivial and often under-identified (Karande & Kulkarni, 2005; Chacko & Vidhukumar, 2020). The paper suggests an India-relevant multi-tier system of early screening, classroom teaching in accordance with the foundations of numeracy, targeted remediation in the form of concrete-representational-abstract sequencing, and assessment accommodations, which are in line with disability rights and board regulations (Government of India, 2016; Ministry of Education, 2020, 2021).

Keywords- Mathematical learning difficulties, dyscalculia, India, foundational numeracy, ASER, math anxiety, specific learning disorder, remediation.

I. Introduction

Mathematical learning difficulties (MLD) are defined as problems in the ability to conceive and comprehend concepts about numbers, to learn arithmetic facts, to compute and do so with accuracy as well as efficiency, and to use mathematics in solving mathematical problems despite the children likely receiving enough schooling (Geary, 2004, 2010). On the extreme end of the spectrum, diagnostic conditions are Specific Learning Disorder with impairment in mathematics, which is a neurodevelopmental disorder in the presence of continuing learning and application of mathematical academic skills at a level significantly lower than age norms and not attributed to intellectual disability, uncompensated sensory issues, or an absence of an opportunity to learn (American Psychiatric Association, 2022). MLD is important in education systems since mathematics learning is cumulative: initial deficiencies in number sense, place value, and basic operations are likely to be manifested later in deficiencies in working with fractions, algebraic reasoning, measurement, and applied problem-solving (Geary, 2011). These challenges are not just academic problems, and persistent experience of failure may lead to avoidance, anxiety, and disengagement, decreased practice and increasing achievement gaps with time (Ashcraft, 2002; Carey et al., 2016).

The necessity to tackle MLD is especially strong in India because of the chronic foundational numeracy gaps that have been detected in large-scale surveys, even though the enrollment increased, and the foundational learning policy has become prioritized (ASER Centre, 2022, 2024). The Annual Status of Education Report (ASER), which is a rural household-level assessment, repeatedly revealed the fact that a significant number of children in primary classes are unable to solve grade-level calculations. ASER 2024 has shown an increase in the basic arithmetic indicators in comparison to 2022 and the overall levels are still low, indicating that a high percentage of learners continue to be at risk of long-term maths challenges (ASER Centre, 2024). This trend also goes together with the international data, which show that chronic low numeracy in the early grades predicts subsequent learning problems in mathematics, particularly those not remedied by the early number sense and operations gaps (Geary, 2010; Butterworth et al., 2011).

Politically, the National Education Policy 2020 of India recognizes foundational literacy and numeracy (FLN) as a deeply urgent and necessary requirement to further education and makes early-grade foundational skills the top priority of the school system (Ministry of Education, 2020). The NIPUN Bharat mission is a national guideline on enhancing FLN by strengthening pedagogy, assessment, and teacher capacity building, as well as community involvement (Ministry of Education, 2021). In the case of more persistent and severe difficulties of children, the rights-based framework is also present in India in the form of the right to an inclusive education and requirement of suitable arrangements to learners with benchmark disabilities under the Rights of Persons with Disabilities Act (RPwD), 2016 (Government of India, 2016). Although not necessarily identified consistently across environments, these policy and legal approaches go toward proving the thesis that universal

foundational strengthening and individualized support must be provided to both dyscalculia and specific learning disorder.
The current paper has three aims in this context, namely, first, the synthesis of evidence of cognitive, affective, and contextual predictors of MLD among Indian students; second, a quantification of recent national data on basic arithmetic achievement using ASER 2018/2022/2024 national results; and third, the suggestion of an India-based framework of identification, instruction, remediation, and accommodations. The research questions used to guide the research are as follows: What are the factors that are consistently related to MLD in the literature (e.g., number sense, working memory, anxiety, instructional quality)? What does national learning data tell us about the scale and direction of underlying arithmetic gaps? What are the possible answers to school level when it comes to normal classroom conditions in India?

II. Literature Review

Conceptualizing MLD and dyscalculia
MLD occurs as a continuum of low achievement due to holes in instruction and opportunity to neurodevelopmental dyscalculia in which individuals continue to have problems in processing number and learning arithmetic (Butterworth et al., 2011; Geary, 2011). One of the most common official early terms, developmental dyscalculia, lies in the fact that in some cases, children exhibit distinctive and persistent problems with mathematics that are not in line with overall intelligence and schooling experience (Kosc, 1974). Notably, children do not often have pure profiles: mathematics problems often accompany reading problems, attention problems, and more general executive functional problems, making it hard to identify and subsequently plan interventions (Geary, 2004; Swanson and Sachse-Lee, 2001). In practice, this comorbidity holds the center stage since often the interventions that lack attention, language, or working memory limitations tend to have minimal effects especially when it comes to word problems and multi-step activities (Geary, 2011).

Cognitive correlates of mathematical difficulties
Deficits in number sense have been found to be fundamental to cognitive research, such as the inability to comprehend numbers magnitude, the approximate quantity representations, and number-number relationships (Butterworth et al., 2011). With poor number sense, children find it hard to make sense of the numbers, compare the numbers and generate flexible strategies of mental calculation and thus difficult later operations and fractions (Geary, 2010). The executive functions and working memory are also important in mathematical activities especially when they have to hold and manipulate the intermediate results, to plan on how to proceed with solving a problem and inhibition of irrelevant information (Swanson and Sachse-Lee, 2001). These cognitive stresses are enhanced in school mathematics, where children are supposed to adhere to processes, match multi-digit operations, and word problems. The other pattern that is similar is inefficient retrieval of arithmetic facts; children with MLD might use slow counting strategies and when they error they do so consistently regardless of practice meaning that they have contravened with the development of automaticity (Geary, 2011). The interplay of these cognitive variables leads to the consideration that effective interventions must include a combination of conceptual

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instruction (meaning of operations and number relations) with guided practice which develops fluency without deteriorating the comprehension.

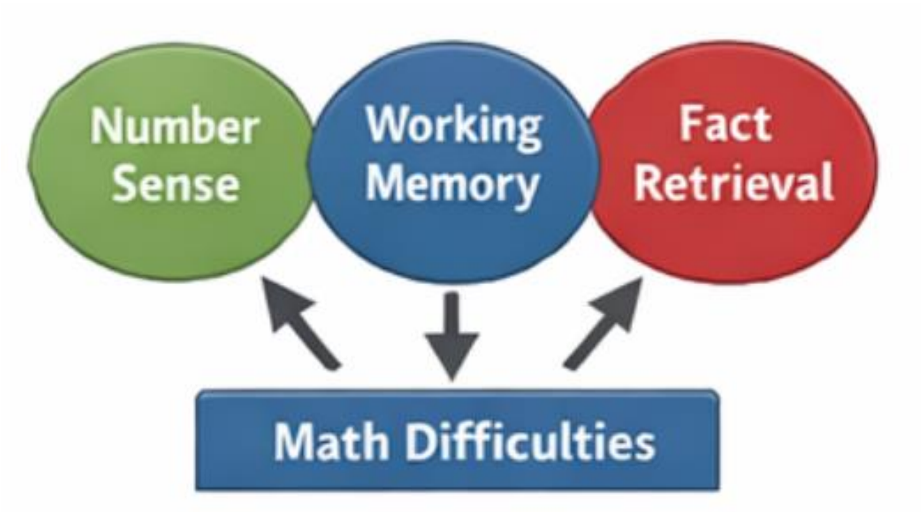

Figure 1. Cognitive Factors Contributing to MLD: Number Sense,

Affective correlates: mathematics anxiety and avoidance

In addition to cognition, affective issues, especially mathematics anxiety, have been found to be highly correlated with poorer performance and a lack of commitment to mathematics learning (Ashcraft, 2002; Dowker et al., 2016). Mathematics anxiety is not just discomfort, but it is also associated with cognitive interference, particularly working-memory depletion in solving problems, which directly may affect performance (Ashcraft, 2002). Longitudinal and meta-analytic data also suggest that anxiety and performance have a two-way relationship, with poor performance as a source of anxiety and anxiety as a source of poorer performance, which forms a negative feedback loop (Carey et al., 2016). With high stakes exams, social comparison, and classroom norms that encourage speed and accuracy but provide insufficient support, especially to students who are behind in foundational skills, this cycle can be fueled in Indian contexts. In turn, interventions that involve supportive classroom activities (low-stakes practice, error-friendly norms, strategy instruction) can be significant additions to cognitive remediation, especially in the case of students who have learned to be afraid of mathematics.

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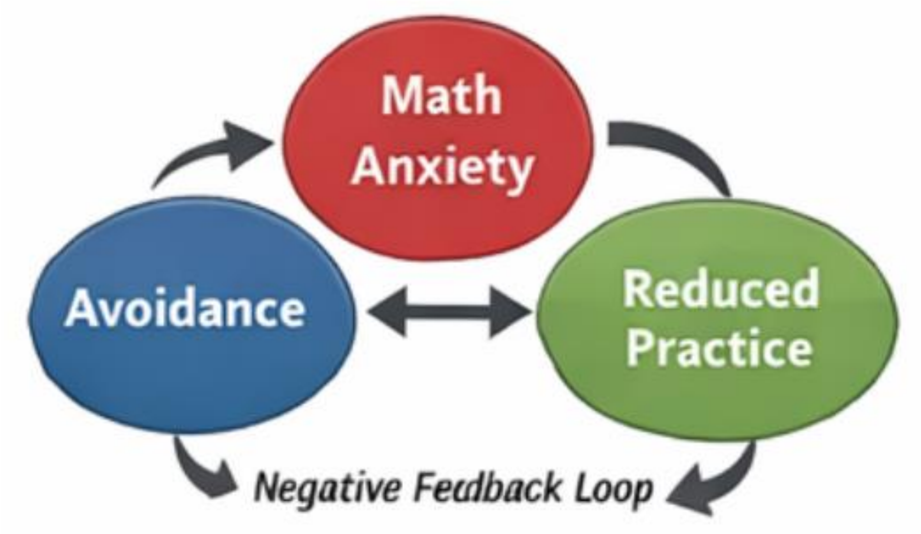

Figure 2. Affective Pathway Model: Math Anxiety → Avoidance → Reduced Practice → Lower Achievement (Feedback Loop)

Contextual and instructional factors in India

The characteristics of Indian instruction and context that can be identified are high classroom sizes, mixed learning levels in the same grade, imbalance in teacher preparation on math instruction, insufficient time to provide individual remediation, and language diversity that influences how children learn to access mathematical language (Ministry of Education, 2020, 2021). Although the policy frameworks focus on competency-based results and foundational learning, the implementation is highly diverse in different states and schools, and classroom translation is unequal (Ministry of Education, 2021). Curricular guidance and learning outcome frameworks are meant to help teachers to sequence competencies and make sure that conceptual learning is achieved, yet most schools stick to procedural teaching, rote and textbook completion, which are not enough to support students who have underlying gaps (NCERT, 2017). Moreover, children with socioeconomically disadvantaged backgrounds might experience less math-related interactions in their homes and might experience irregular attendance, which combines with the quality of instruction to exacerbate the learning problems.

Indian evidence on prevalence and identification gaps

Indian study provides valuable evidence on identifying and prevalence of dyscalculia. Ramaa and Gowramma (2002) presented a captive process of screening and sorting out dyscalculia in Indian primary school children and proved that it is possible to screen and sort out these in school setting. Non-trivial prevalence estimates of school-based studies on specific learning disabilities (SLD) in India have identified dyscalculia as one of the identified profiles (Mogasale et al., 2012). More recent literature also underlines the fact that the identification process is frequently late and many children have not been diagnosed because their teachers are unaware of its existence or because assessment is not always available and because of inconsistencies in certification routes and accommodation practices (Karande and

Kulkarni, 2005; Scaria et al., 2023). The variation in prevalence caused by the varied tools and sampling in a systematic review and meta-analysis of SLD in India have confirmed the necessity of early detection and school-based interventions over a severe failure or clinical referral (Scaria et al., 2023). There is also evidence that indicates a significant presence of an at-risk group in primary schools and this indicates that tiered screening models may be able to identify struggling learners at an earlier stage (Chordia et al., 2020).

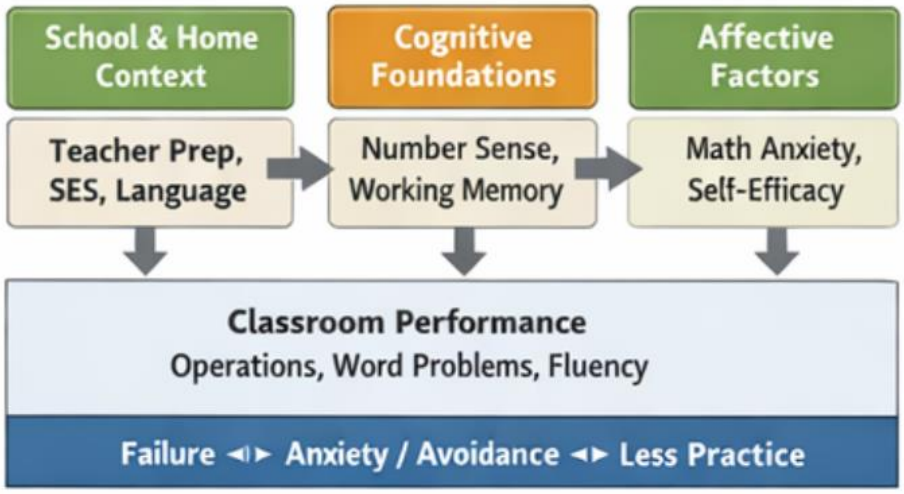

Figure 3 Conceptual Pathways to Mathematical Learning Difficulties

III. Methodology

Study design

The approach that is employed to tackle the issue in this paper is a mixed evidence approach based on (a) a narrative review of peer-reviewed articles and policy documents and (b) a secondary quantitative trend analysis of national learning indicators. And the narrative review combines India-specific literature on the identification of dyscalculia/SLD and dyscalculia/SLD educational responses with the world-wide foundational studies on cognitive and affective correlates of MLD (Geary, 2010; Butterworth et al., 2011; Ashcraft, 2002). The secondary analysis reviews the publicly reported national arithmetic attainment measures of the ASER national findings (2018, 2022, 2024) in order to put MLD into the context of the overall trends in foundational numeracy (ASER Centre, 2022, 2024). Moreover, NEP 2020, NIPUN Bharat guidelines, RPwD Act (2016) and board circulars pertaining to concessions and accommodation were used in conducting policy/document analysis.

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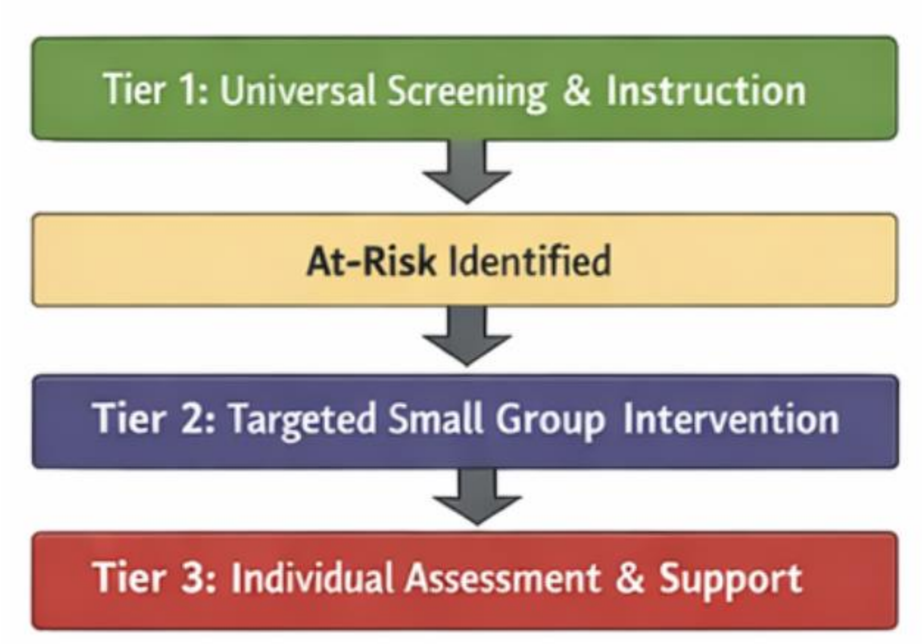

Figure 4. Screening-to-Support Flowchart for Identifying

Data sources (secondary)

ASER 2022 and ASER 2024 national findings on arithmetic indicators (Std III subtraction; Std V division; Std VIII division division) were considered secondary sources, as well as NAS 2021 report-card portal as background evidence on the prevalence of national assessment focus, NEP 2020 and NIPUN Bharat instructions on policy framing of FLN and legal/accommodation documents, such as RPwD Act (2016) (ASER Centre, 2022, 2).

Measures and analysis

ASER records the percentage of children able to accomplish arithmetic tasks of choice. In this paper, the researchers concentrate on three most prevalent indicators, which include Std III at least subtraction, Std V at least division, and Std VIII at least division (ASER Centre, 2024). To present changes percent point changes in the year 2018-2022-2024 were calculated to reflect the pre-pandemic baseline (2018), pandemic/ post-pandemic low point (2022), and recovery phase (2024). Since the analysis is secondary and descriptive, the analysis is not causal but aids in triangulation with research literature on the foundational numeracy gaps and MLD risk.

IV. Results

According to the secondary trend analysis, the rural India rural areas have made progress in the foundational levels of arithmetic between 2022 and 2024, though the attainments of primary levels are low. In particular, Std III subtraction increased by 25.9 (2022) per cent to 33.7 (2024), Std V division increased by 25.6 (2022) per cent to 30.7 (2024) and Std VIII division increased by 44.7 (2022) per cent to 45.8 (2024) (ASER Centre, 2024). These findings are an indicator of recovery following discontinuity due to the pandemic but also shows that a significant share of children are yet to achieve benchmarks, especially in the lower grades where the basics of success are to be solidified. The slight progress in Std VIII indicates that older groups might be compensating previous learning lapses and they might need alternative intervention plans such as bridging instruction, and applied numeracy activities that are in tandem with curriculum demands.

When these trends are viewed through the prism of MLD literature, it can be seen that a large portion of children can be facing mathematics challenges because of a combination of lost education in the early childhood and continued cognitive limitations. Those students who have severe and persistent and are likely to fall into the categories of dyscalculia/SLD may be a subset of the overall group of low performers. This interpretation is supported by Indian studies reporting non-trivial amounts and regular identification obstacles, that is, national low achievement ought not to be equated with in fullness with dyscalculia but should result in screening and special support pathways (Ramaa & Gowramma, 2002; Mogasale et al., 2012; Scaria et al., 2023).

A tiered model can be supported at the school response level by converging evidence. The idea of universal instructions should focus on the idea of conceptual knowledge and fluency growth in addition to FLN priorities (Ministry of Education, 2021). Individualized intervention should be used with persistent MLD and suspected dyscalculia and targeted small-group intervention with learners that do not reach benchmark but respond to intervention, and some accommodations and referrals may be necessary (Gersten et al., 2009; Karande and Kulkarni, 2005).

Table 1 — ASER national trends in arithmetic attainment

Grade & skill benchmark	2018 (%)	2022 (%)	2024 (%)	Change 2018→2024 (pp)	Change 2022→2024 (pp)
Std III: at least subtraction	28.2	25.9	33.7	+5.5	+7.8
Std V: at least division	27.9	25.6	30.7	+2.8	+5.1
Std VIII: at least division	44.1	44.7	45.8	+1.7	+1.1

ASER indicates that Grade 3 and Grade 5 arithmetic improved notably between 2022 and 2024, while Grade 8 division remained relatively stable.

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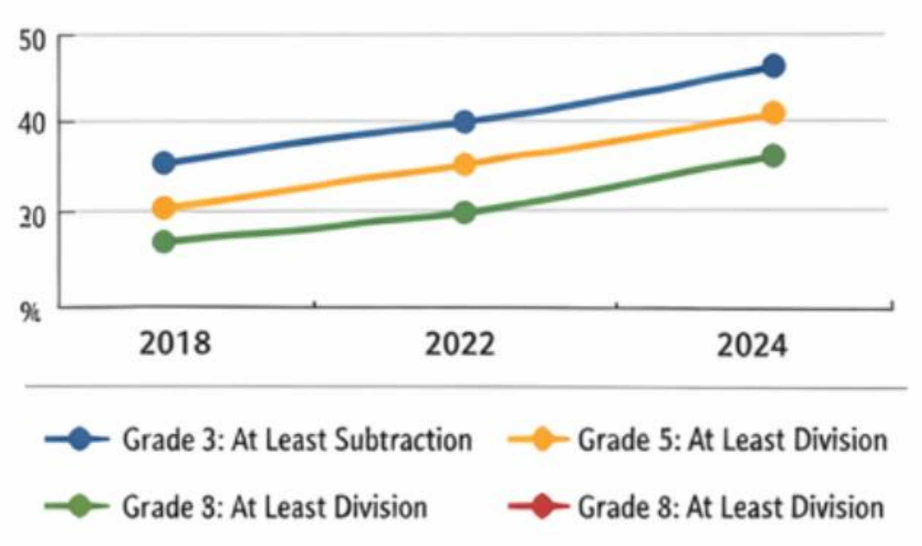

Figure 5. Trends in Basic Arithmetic Achievement in Rural India (ASER 2018, 2022, 2024)

Table 2 — Selected Indian prevalence evidence

Study	Setting	Focus	Key takeaway
Ramaa & Gowramma (2002)	Primary schools, India	Dyscalculia identification procedure	Demonstrated structured screening/diagnosis approach and non-trivial dyscalculia occurrence in samples
Mogasale et al. (2012)	Primary school children, South Indian city	Specific learning disabilities incl. dyscalculia	Reported notable SLD prevalence; dyscalculia present within identified SLD profiles
Chacko & Vidhukumar (2020)	School-going children, Kerala	SLD prevalence & determinants	Reported prevalence and emphasized need for awareness and support systems
Scaria et al. (2023)	Systematic review/meta-analysis	SLD prevalence in India	Prevalence varies by methods; supports scalable screening and school-based supports

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Table 3 — School response framework

Tier	Who it targets	What to do (math-specific)	Progress monitoring
Tier 1 (Universal)	All students	Explicit instruction, manipulatives, number talks, worked examples, daily practice aligned to FLN	Weekly quick checks (1–2 skills)
Tier 2 (Targeted)	Students below benchmark	Small-group remediation using Concrete–Representational–Abstract (CRA), error analysis, fluency + conceptual tasks	Fortnightly skill probes
Tier 3 (Intensive)	Persistent MLD / suspected dyscalculia	Individualized plan, structured intervention, accommodations, referral pathway	Individual goals + monthly review

Tier 3 (Intensive) Persistent MLD / suspected dyscalculia Individualized plan, structured intervention, accommodations, referral pathway Individual goals + monthly review

V. Discussion & Conclusion

Interpretation in the Indian context

The positive change in ASER 2024 as compared to 2022 indicates that the performance of children in arithmetic can be restored once schooling normalizes, and the emphasis on the foundational learning increases, which is in line with the change in the policy towards FLN (ASER Centre, 2024; Ministry of Education, 2021). Nevertheless, the overall low levels of Grade 3 and Grade 5 learners that can demonstrate basic operation standards suggest that the system remains miles off the target of guaranteeing universal foundational numeracy. In terms of MLD, this implies that a group of students is vulnerable to forming chronic mathematics problems because of the accumulation of learning disabilities, and a subgroup may be harboring neurodevelopmental dyscalculia that will need more vigorous intervention (Butterworth et al., 2011; Geary, 2011). The cumulative quality of learning math is that children who fail to achieve mastery of subtraction by Grade 3 might not achieve the levels of division, fractions, and algebraic reasoning in the future unless there is effective bridging and remediation done.

Why MLD persists

The phenomenon of persistence of MLD in the classrooms of India can be best described by an integrated model of a combination of cognitive, affective, and system level constraints. Child with a poor number sense and minimal working memory are put at a disadvantage in the normal instructional cycles where they are expected to acquire place value and operation quickly in their heads (Swanson and Sachse-Lee, 2001; Butterworth et al., 2011). The repeated failure experiences may cause anxiety and decrease confidence and avoidance behaviors that restrict practice and engagement (Ashcraft, 2002; Carey et al., 2016). On the system level, classrooms are usually diverse in terms of learners with vastly different levels of goals and do not have time to provide differentiated instructions and feedback. In pedagogy where procedural completion is prioritized over the creation of meaning, students with underlying gaps can learn steps out of context without underlying conceptualization building brittle knowledge that will fail when subjected to even a slightly different format of problems.

Policy and rights-based implications

The guidelines of NEP 2020 and NIPUN Bharat offer the enabling policy environment to the universal foundational strengthening of numeracy, which is provided by India (Ministry of Education, 2020, 2021). Meanwhile, the duty of inclusive education as stipulated by the RPwD Act (2016) helps to strengthen the need to offer reasonable accommodations and support services to learners with identified disabilities and learning disorders (Government of India, 2016). In the case of MLD, this means that the schooling systems are not to be based solely on overall reforms, but also institutionalize the process of screening, referral, certifying and accommodating where on the need basis. Boards-level circulars on concessions provide guidance at the operational level in the examination of accommodated in relation to the school-level awareness and implementation capacity are bottlenecks.

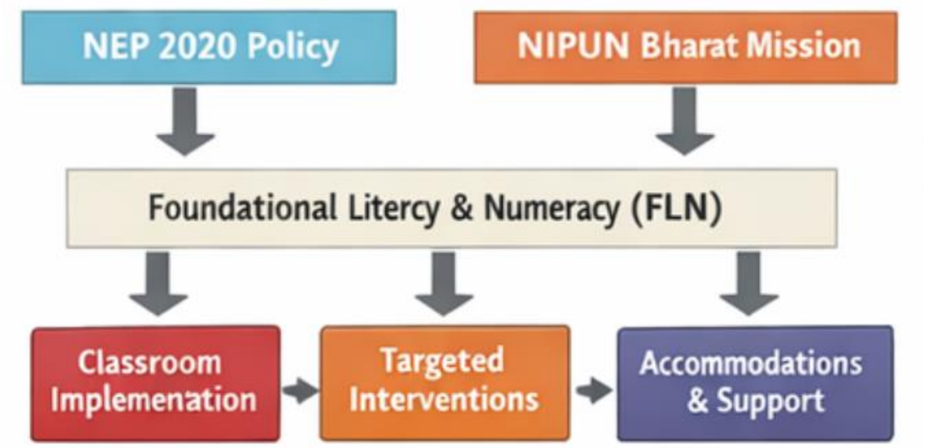

Figure 7. Policy-to-Practice Framework: NEP 2020 & NIPUN Bharat to Classroom FLN Implementation and Accommodations

Recommendations for practice

A response that is evidence-consistent and India-practical involves (1) early screening in Grades 13 with short numeracy screeners that measure number recognition, comparing magnitudes, and basic facts (2) reinforcing Tier 1 instruction in daily mental math, number lines, manipulatives, used examples, and multilingual scaffolds aligned with FLN (3) targeted remedially with concreterepresentationalabstractions sequences with hands-on materials to visual models and then symbolic forms (4) expressing anxiety-sensitive classroom practice, such as low-stakes.

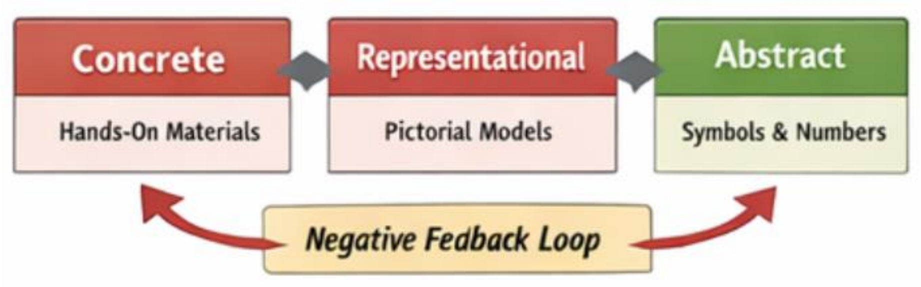

Figure 8. Classroom Intervention Model Using CRA Approach (Concrete → Representational → Abstract)

VI. Conclusion

The mathematical learning problem among Indian students not only indicates systemic-level underlying numeracy but it also indicates neurodevelopmental profiles like dyscalculia. Basic arithmetic levels improved between 2022 and 2024, but the data on national learning indicates that a significant portion of the learners continues to perform below major benchmarks in the primary grades, which means that many still require basic support (ASER Centre, 2024). It has been postulated in the literature that chronic MLD is defined by cognitive limitations in interaction with affective reactions like anxiousness, and contextual factors like instructional quality and resource shortage (Geary, 2011; Ashcraft, 2002). The most realistic solution to India is a mixed strategy based on universal FLN-aligned education, focused remediation, early identification, and rights-based accommodations as a means of minimizing mathematics failure in the long term and providing equitable educational achievement.

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