A Comparative Pilot Study of Curriculum-Based vs. Skill-Based Assessment for Dyslexia

Sushree Sahu[1], Vandana Shriharsh[1], Triptish Bhatia[1], Pragati Goel[2], Nandini C. Singh[2,3] , Smita N. Deshpande[1*]

1.   Atal Bihari Vajpayee Institute of Medical Sciences-Dr. Ram Manohar Lohia Hospital, New Delhi, India.
2.   National Brain Research Centre, Manesar, India.
3.   UNESCO-Mahatma Gandhi Institute of Education for Peace and Sustainable Development, New Delhi, India

Abstract

Introduction: *Specific Learning Disability (SLD) is a certifiable disability for benefits under the Rights of Persons with Disabilities Act in India (2016) for which the NIMHANS SLD index is the legally mandated standard for assessment. We evaluated the NIMHANS battery against Dyslexia Assessment for Languages of India (DALI), a skill-based objective assessment.* **Methods:** *School going children (17 consented, 15 included in final analysis) from ages 5-10 years, and with IQ more than 85 on Malin's Intelligence Scale for Indian Children, and standard score 70 and above on Colored Progressive Matrices were assessed using the NIMHANS SLD index, curriculum textbooks, and DALI at the Department of Psychiatry and Clinical Psychology of a tertiary care, free teaching hospital in New Delhi. Various domains/tests were evaluated and categorized as comparable or non-comparable. Concordance analysis (kappa) was used to test for agreement in comparable domains and Spearman's rank correlation was used to test for relationship between all domains of NIMHANS battery and DALI.* **Results:** *Significant concordance between curriculum textbooks and DALI was found on tests for English and Hindi Spelling, English Reading, and English Comprehension. Significant correlations were found on tests for Spelling (both languages), Reading (both languages), and Comprehension (English only) between curriculum textbooks and DALI.* **Conclusion:** *We found curriculum textbooks, NIMHANS SLD index and DALI comparable in English tests for dyslexia and Hindi Spelling test. Given the complex education system and disparate examination testing systems in India, it might be beneficial to incorporate skill-based tests for SLD evaluation.*

Keywords: Dyslexia, Curriculum, NIMHANS SLD index, DALI

*** Correspondence to: Dr. Smita N. Deshpande, Dept. of Psychiatry, De-addiction Services & Resource Center for Tobacco Control, Centre of Excellence in Mental Health, Atal Bihari Vajpayee Institute of Medical Sciences & Dr. Ram Manohar Lohia Hospital, Banga Bandhu Sheikh Mujib Road, New Delhi, India Email address: smitadeshp@gmail.com*

INTRODUCTION

Specific learning disabilities (SLD) are a heterogeneous group of disorders affecting school-going children manifesting as significant and persistent learning difficulties in literacy acquisition, specifically in reading, writing, listening, speaking and mathematics (Ahmad, 2015; Karande, Sholapurwala, & Kulkarni 2011). SLDs affect approximately 5-15% of school-going children and are attributed to dysfunction in the central nervous system (Karande & Kulkarni, 2005; Lagae, 2008). In a 5 year study of children reporting to the Learning Disability Centre in urban India, nearly 88% of children were diagnosed with dyslexia, dyscalculia and dysgraphia, and nearly 10% of children had dyslexia with dysgraphia (Singh et al., 2017). Children diagnosed with an SLD have adequate learning opportunity including the capacity and motivation for learning, as well as intact hearing and vision abilities (Karande & Venkataraman, 2012; Karande, Bhosrekar, Kulkarni, & Thakker, 2009).

Children with SLD have IQ of 85 and above (i.e. no intellectual impairment), but struggle with academic achievement expected of their chronological age, and need educational accommodations (John, Sadasivan, Sukumaran, District, & David, 2020). SLDs have been included in the disability category of the Rights of Persons with Disabilities (RPWD) Act in India (2016) necessitating the early identification, assessment, diagnosis and certification of vulnerable children (The Gazette of India Extraordinary, 2018) to enable early intervention. However, the certification of disability in SLD is often subjective and equivocal, creating confusion for clinicians and certifying boards (John, 2020). The most widely used battery for SLD assessment, diagnosis and certification in India is National Institute of Mental Health and Neurosciences (NIMHANS) index for SLD developed in 1992 (Kapur, John, Rozario, Oommen, & Uma, 2002). It is available for two levels- Level I for 5-7 years, and Level II for 8-12 years. The battery is available only in English, lacks objective and well-established norms for subtests across all the classes, is based on the Karnataka syllabus (considered to be easier than some other Indian boards) and lacks country-wide application (Kohli, Sharma & Padhy, 2018). For assessment and certification, the regular clinical practice has been to use the battery in conjunction with school-based curriculum textbooks in English and the respective regional language. Thus, the child is primarily assessed using school textbooks for domains like Reading, Writing, Dictation, Comprehension and Arithmetic. A child whose performance is two grades below the current grade is diagnosed with SLD. While the school curriculum is a criterion based assessment for SLD (Ahmad, 2015), it lacks standardization in the assessment of children (meaning two children of the same age and class might be assessed using different content and test items depending on the type of school, examination board, and the state they belong to). Moreover, it is difficult to ascertain the equivalence of the test items in English and the regional language, thereby creating an arbitrary assessment protocol. It is also unlikely that two assessors assessing the same child might assess him on the exact same items from the textbooks, adding to further assessment arbitrariness and reduced objectivity in SLD assessment.

In the light of these challenges, an objective standardized skill-based assessment with equivalent tests in English and the regional language becomes imperative. India is a multilingual and multicultural country wherein the three language formula is employed in teaching and academics in most states with the further complication of two types of schools: English-medium and the regional-medium which emphasize learning in different languages (Ramaa, 2000). To make standardized assessment available to all children with diverse backgrounds, DALI (Dyslexia Assessment for Languages of India) was developed as a skill-based assessment by the National Brain Research Centre, Government of India (NBRC, Singh, 2015) to be consonant with the Indian education policy that mandates the teaching of two or three languages in addition to English (Viswanatham, 2001). Thus, school children all over India learn to read and write in a minimum of two languages, one of which is typically English, and the other an Indian language (Koul & Devaki, 2001). Thus, children in India are biliterate and should be assessed in both the languages. Children's linguistic profiles in India also vary considerably due to differences in the sociocultural, economic and educational profiles of their families, complicating the task of assessing children's literacy skills (Jhingran, 2005). Since DALI allows independent, objective, skill-based assessment in different languages it allows for a fairer assessment of Indian students in both the regional language as well as in English. It is a standardised and validated battery for dyslexia assessment available in English, Hindi, Kannada, and Marathi using equivalent tests for classes 1-5. This allows for early, bilingual assessment of Indian students in English and the regional language.

Our study aimed at comparing curriculum-based assessments, the appropriate tests from NIMHANS SLD battery, and the skill-based DALI through an exploratory analysis on a small sample.

METHODS

Procedure

Children presenting for SLD assessment to the outpatient Child Guidance Clinic (CGC) at the Dept. of Psychiatry and Clinical Psychology of a tertiary care, free teaching hospital in Delhi were referred for study participation. Children (and their parents) who consented to participate were administered the Malin's Intelligence Scale for Indian Children (MISIC, Malin, 1969) and the Coloured Progressive Matrices (CPM, Raven, 1990) as tests of intellectual functioning before SLD assessment in order to exclude children with intellectual disability. NIMHANS SLD index, curriculum textbooks and DALI were thereafter administered by different psychologists who were blind to each other's assessment to prevent bias. All children were administered MISIC on day 1 (average of 1.5 hours per child), followed by 2 sessions (3 hours each) for testing on NIMHANS battery and curriculum-based assessments on two separate days: 1 session for English, another for Hindi. MISIC, NIMHANS battery and curriculum-based assessments were

administered by either VS or PG, both of whom are licensed clinical psychologists with extensive clinical experience in the assessment of SLD. After 2 weeks, CPM and DALI were administered in a single day by SS with a break of 20 minutes each between CPM and DALI, as well as between DALI English and DALI Hindi (total 3 hours). SS was trained in DALI administration by the test developers at NBRC. The entire assessment was carried out within a one-month period for each child. The study was approved by the Institution Ethics Committee of the hospital.

Sample

School going children from classes 1-5 were recruited in the study since norms for DALI are available for classes 1-5, while those for NIMHANS battery are available till class 7.

Children were enrolled in the study after written informed consent from the parents and assent from the children between August 2018 and September 2020. The inclusion criteria were school going children scoring 85 and above on MISIC, and standard score of 70 and above on CPM. Children with intellectual disability, epilepsy and/or neurological disorder were excluded from the study.

Instruments

Malin's Intelligence Scale for Indian Children (MISIC) (1969)

MISIC was developed in Nagpur by Dr. Arthur Malin as an intelligence test by adapting the Weshcler Intelligence Scale for Children (WISIC). It consists of 11 subsets of performance and verbal tests and takes about 2-2.5 hours to complete. The verbal scale includes the following tests: information, general comprehension, arithmetic, analogy and similarity, vocabulary and digit span. The performance scale includes the following tests: picture completion, block design, object assembly, coding and mazes. It is available in English, Hindi and Marathi. The children are tested depending on their regional language and the medium of instruction followed in their respective schools. However, since our sample consisted of children from English medium schools, they were tested in English. It is a reliable and valid test of intelligence for Indian children between 6 years to 15 years 11 months.

Coloured Progressive Matrices (CPM) (1990)

CPM is a non-verbal test of intelligence for children between 4-11 years (Raven, 1990). It uses visual patterns and shapes divided into three sets: A, AB, and B and takes approximately 15 minutes to administer. It contains 36 items (12 in each set) followed by 6 response options for each item. The assessee has to find the missing pattern by choosing one of 6 response choices. It is a culture free test and can be administered to children from diverse cultural and language backgrounds, and even to those with

language difficulties. CPM scores are converted into standard scores and percentile ranks.

NIMHANS Index for SLD (1991)

NIMHANS battery was developed by Kapur et al. (1992) on 100 children between 8-12 years of age (50 clinic children and 50 children with average to above average scholastic achievement) at the Department of Clinical Psychology at the National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore to assess SLD. It comprises of Level I (consisting of tests of Attention, Visual Language, Visuo-motor skills and Writing Skills), and Level II (consisting of tests of Attention, Language (i.e. Reading, Writing, Comprehension), Spelling, Perceptual Motor Abilities, Memory and Arithmetic). Norms have been developed for classes 1-7 and are used for SLD certification. Since the NIMHANS battery is available only in English till class 7, in prevalent clinical practice, sub tests of Language and Arithmetic (Literacy domains) are administered as curriculum-based assessments in English and in the regional language of the child (Hindi), while tests of Attention, Visuo-motor, Visual Memory, Visual Discrimination, Auditory Memory, and Auditory Discrimination are assessed from the NIMHANS battery in English only.

For clinical and certification purposes, children are diagnosed with SLD if they perform two grades below their current grade in both English and the regional language. Thus, the domains of Spelling, Reading, Writing and Comprehension in English and Hindi were assessed using current school textbooks of children in this study.

Dyslexia Assessment for Languages of India (DALI) (2015)

The Dyslexia Assessments for Languages of India (DALI) was developed by NBRC, Manesar as a 'skill-based' assessment for dyslexia in Indian students. It is a comprehensive assessment for children with or at risk for dyslexia in primary schools from classes 1-5 (Singh, 2015). It was standardized and validated in approximately 4000 children across the country and is available in English as well as in other regional languages (Hindi, Kannada, Marathi) with equivalent tests. DALI comprises of the following 10 equivalent tests in English and the native language that are administered by a trained psychologist: 'Picture Naming', 'Semantic Fluency', 'Verbal Fluency', 'Rhyming', 'Phoneme Replacement' (called 'Syllable Replacement' in the regional language), 'Letter Identification' (called 'Akshara Recognition' in the regional language), 'Word Reading', 'Nonword Reading', 'Reading Comprehension', 'Listening Comprehension' and Spelling/Dictation. They have been further classified into 3 domains: (a) Semantic Retrieval (Picture Naming, Semantic Verbal Fluency); (b) Phonological Processing (Rhyme and Phoneme replacement); and (3) Literacy (Word Reading, Letter Identification, Listening and Reading Comprehension, Nonword Reading and Spelling). The individual child is scored on each test, and the raw scores are converted into standardised scores for English and the native language respectively, and then plotted on a graph. This allows us to gauge the child's scores on each of the three domains. If the child scores 2 SDs

below average in 50% or more of the tests in each domain, then he/she is considered to have performed 2 SDs below average in that particular domain. If the child scores 2 SDs below average in at least two out of the three domains in both English and the native language, then he/she is diagnosed with dyslexia. If the child scores 2 SD below average in at least two domains in only one language, then it is assumed that the child may have performed poorly due to lack of exposure to that language, and may not have dyslexia.

DALI is a dyslexia assessment battery and does not include tests for dyscalculia and dysgraphia.

Administration and Scoring

For the curriculum-based assessments as well as the NIMHANS battery, the performance of each child was assessed grade wise, wherein the child was assessed on his current grade/class, one grade below the current grade and 2 grades below the current grade. If the child performed with at least 40% accuracy in current grade in each individual domain, the performance was considered 'adequate'. If the child performed at less than 40% accuracy in one grade below the current grade (but performed with at least 40% accuracy in two grades below the current grade) in each individual domain, the performance was considered 'difficulty'. If the child performed with less than 40% accuracy in two grades below the current grade (after being assessed on the current grade, one grade below as well as 2 grades below) in each individual domain, then the performance was considered 'disability'.

DALI scores are not based on school grade/class but instead on standard scores. Raw scores on DALI were converted into standard scores provided in the manual. The scores were operationalized viz: 85–115 (i.e. average or above average) as *'adequate'*, 78-84 as *'difficulty'* (between 1 and 1.5SD), below 78 (i.e.1.5 SD below) as *'disability'*, on each individual domain to make them comparable to NIMHANS battery.

Data Analysis

To compare NIMHANS battery and DALI, the authors evaluated subtests in NIMHANS battery that were similar to those in DALI *('comparable domains')*. Subtests within NIMHANS battery and DALI that were distinct and could not be compared with each other were considered *'non-comparable domains'*.

Comparable domains between NIMHANS battery and DALI included Spelling, Reading, and Comprehension in English language as given in their respective manuals. However, the NIMHANS battery was developed using the Karnataka Board syllabus in 1990s, it is not strictly applicable to the Central Board of Secondary Education syllabus for current times. Hence, the child was tested using the school curriculum textbooks in English and

Hindi instead of the NIMHANS manualised for comparable/literacy domains of Spelling, Reading and Comprehension.

Non-comparable/non-literacy domains included tests of Attention, Visual Perception, Visual Memory and Auditory Memory (from NIMHANS battery manual) vs. Picture Naming, Verbal Fluency, Semantic Fluency, Rhyme and Phoneme (from DALI manual).

We excluded arithmetic and writing in NIMHANS battery from the final analysis since the current version of the DALI battery lacks tests for dyscalculia and dysgraphia.

For the purpose of comparison, the operationalised terms of 'adequate', 'difficulty' and 'disability' on each domain in NIMHANS battery, curriculum assessments and DALI were converted into ordinal data for analysis using SPSS version 23 (IBM SPSS Inc., 2016). Cohen's kappa (Cohen, 1960) was used to estimate agreement/concordance between the comparable/literacy domains of curriculum-based assessments and skill-based DALI. Kappa value is considered moderate in the range of $0.41 \le \kappa \le 0.60$ and substantial in the range of $0.61 \le \kappa \le 0.80$ (Landis & Koch, 1977). Significance was reported at threshold p <0.05.

Spearman's rank order correlation (Spearman, 1904) was used to check for relationship between:

a) curriculum-based 'literacy' assessments with skill-based 'literacy' domains of DALI;
b) curriculum-based 'literacy' assessments with skill-based 'non-literacy' domains of DALI
c) 'Non-literacy' domains of NIMHANS battery with skill-based 'literacy' domains of DALI.
d) 'Non-literacy' domains in NIMHANS battery with skill-based 'non-literacy' domains of DALI.

Two tailed test of significance was reported at threshold p<0.05.

RESULTS

Sample Sociodemographic

A total of 17 children between 5-10 years agreed to participate in the study (males=15; females=2); refusals were due to the time, repeated visits and effort involved. Two children, both males, were excluded after the initial IQ assessment due to IQ score of less than 85 on MISIC and standard score of less than 70 on CPM respectively. Finally, 15 children meeting the inclusion criteria were enrolled (mean age= 8.4, SD=1.28) using convenience sampling method.

All children were studying in private Central Board of Secondary Education (CBSE) affiliated schools of Delhi with English as the medium of instruction. Hindi was the mother tongue of all children as well as the second language taught in school. All children were accompanied by their parents, but were not assisted by them during test administration. All children were referred for assessment by their teachers due to their academic difficulties. Out of these, 9 children out of 15 were diagnosed as SLD by psychiatrists in the OPD. Our sample children did not have any other co-morbidity as reported in their referrals to the clinical psychology team.

Concordance

Significant agreement was seen between curriculum-based assessments and skill-based DALI in English Spelling (κ=0.69), English Reading (κ=0.5), English Comprehension (κ=0.63) and Hindi Spelling (κ=0.49) (Table 1).

Table 1: Concordance for comparable domains between curriculum-based (school textbooks) and skill-based assessments (DALI) for dyslexia

Domain	Concordant (N)	Discordant (N)	Missing	Kappa coefficient	Significance
English Spelling	13 (86.67%)	2	0	0.69	0.000**
English Reading	11 (66.67%)	4	0	0.5	0.008**
English Comprehension	11 (80%)	3	1	0.63	0.004**
Hindi Spelling	12 (80%)	3	0	0.49	0.006**
Hindi Reading	*08 (53.33%)*	*7*	*0*	*0.22*	*0.17*
Hindi Comprehension	*08 (46.67%)*	*7*	*0*	*0.19*	*0.36*

** $p < 0.01$

Correlations

Significant correlations were found between curriculum-based assessments and DALI literacy domains in Spelling (both languages), English Reading and English Comprehension.

We checked for correlations across languages for each domain (e.g. curriculum-based English Spelling with DALI Hindi Spelling) to check for generalization of learning across

languages. Significant correlation was found in this small sample between (i) curriculum-based Hindi Spelling and DALI English Spelling; (ii) curriculum-based Hindi Comprehension and DALI English Comprehension; (iii) curriculum-based Hindi Reading and DALI English Reading; (iv) curriculum-based English Spelling and DALI Hindi Spelling (v) curriculum-based English Reading and DALI Hindi Reading. Curriculum-based Comprehension in neither Hindi nor English correlated significantly with DALI Hindi Comprehension (Table 2a).

Table 2a: Spearman's rank correlation between curriculum-based (school textbooks) and skill-based assessments (DALI) for dyslexia: Spelling, Reading and Comprehension

	School-Curriculum SpEng	School-Curriculum CompEng	School-Curriculum ReadEng	School-Curriculum SpHin	School-Curriculum CompHin	School-Curriculum ReadHin
DALI SpEng	0.83**	0.56*	0.64**	0.83**	NS	0.63*
DALI ComEng	0.63*	0.77**	NS	0.63*	0.55*	NS
DALI ReadEng	0.91**	0.67**	0.77**	0.91**	0.54*	0.75**
DALI SpHin	0.65**	NS	NS	0.65**	NS	NS
DALI CompHin	NS	NS	NS	NS	NS	NS
DALI ReadHin	0.9**	0.69**	0.77**	0.9**	0.54*	0.75**

** $p < 0.01$; * $p < 0.05$; NS= non-significant
E-English, H-Hindi; Sp=Spelling; Read=reading; Comp=Comprehension; SF=Semantic Fluency, VF=Verbal Fluency, PN=Picture Naming; VP=Visual Perceptual

Among the non-comparable/non-literacy domains of NIMHANS battery and non-comparable/non-literacy domains of DALI, significant correlation was found between NIMHANS Visual Perception and DALI Picture Naming (both languages), NIMHANS Auditory Memory with DALI Phoneme English, and NIMHANS Visual Memory with DALI Verbal Fluency English (Table 2b).

Curriculum-based English Comprehension correlated with DALI Semantic and Verbal Fluency. Curriculum-based Hindi Comprehension correlated with DALI Picture Naming

Table 2b: . Spearman's rank correlation between Non-Literacy Domains of NIMHANS battery vs DALI

	School-Curriculum SpEng	School-Curriculum CompEng	School-Curriculum ReadEng	School-Curriculum SpHin	School-Curriculum CompHin	School-Curriculum ReadHin	NIMHANS VP Eng	NIMHANS AM Eng	NIMHANS VM Eng
DALI SFEng	NS	0.62*	NS	NS	NS	NS	NS	NS	NS
DALI VFEng	NS	0.59*	NS	NS	NS	NS	NS	NS	0.56*
DALI PNEng	NS	NS	0.52*	NS	0.56*	0.52*	0.61*	NS	NS
DALI PNHin	NS	NS	NS	NS	NS	NS	0.57*	NS	NS
DALI RhyEng	NS	NS	0.60*	NS	NS	0.60*	NS	NS	NS
DALI RhyHin	NS	NS	0.56*	NS	NS	0.56*	NS	NS	NS
DALI PhonEng	NS	NS	NS	NS	NS	NS	NS	0.58*	NS

** p < 0.01; * p < 0.05; NS= non-significant

E-English, H-Hindi; Sp=Spelling; Read=reading; Comp=Comprehension; SF=Semantic Fluency, VF=Verbal Fluency, PN=Picture Naming; VP=Visual Perceptual

English. Curriculum-based Reading in English and Hindi correlated with DALI Rhyme (both languages) and DALI Picture Naming English (Table 2b).

DISCUSSION

NIMHANS SLD index is mandated as the only tool for SLD certification by the Government of India (Gazette of India 2018). However, it is a battery that was developed in 1991 on a smaller sample of clinic children and is available in English alone. As per Kishore et al. (2021), the RPWD Act has no standards for evaluating learning disabilities in vernacular languages, we feel that DALI may partially address this gap as it was developed and validated in Hindi, Marathi and Kannada as well (Singh 2015). We compared NIMHANS battery, and certain curriculum-based assessments in English and Hindi, with the DALI battery developed in 2015, which is an objective and a skill-based dyslexia assessment. This is the first pilot study to compare NIMHANS battery with a newer and more objective assessment tool DALI.

Our results showed significant agreement between curriculum-based assessment and skill-based DALI tests for English Spelling, Reading and Comprehension (termed 'Literacy' domains). Thus, objective skill-based assessments like DALI can be used as a measure of English Literacy for children of varied backgrounds in a multicultural set up like India. DALI's availability in different languages is an added advantage for Indian children who are typically taught three languages in school (Ramaa, 2000), making it necessary for Literacy to be assessed in all the languages the child learns in school.

In Hindi language tests, agreement was seen in Spelling alone for curriculum-based evaluation vs. skill-based DALI. The lack of agreement in Hindi Reading and Comprehension between curriculum and DALI assessments may be attributed to the difference in the nature of the test items. DALI assesses Reading through an objective measure of 'Word Reading' consisting of 50 words that should be readable by children of the same age across the country. But, in curriculum-based assessments, the children were assessed on reading through 'Paragraph Reading' from familiar school textbooks. This creates bias, either through possible familiarity due to repeated classroom exposure to textbook material or the inability to learn the specific text involved despite repeated exposure in class. DALI assesses comprehension for classes 1-2 on the one hand, and classes 3-5 on the other hand, through different test items. While classes 1-2 undergo assessment of comprehension through 'listening', classes 3-5 are assessed on 'reading' comprehension. This does not hold true for curriculum-based assessments, wherein Comprehension is assessed uniformly across all classes through 'Reading Comprehension'.

DALI does not have reading comprehension for classes 1-2 as it is assumed that such young children may not have developed skills for reading passages or long texts. Further, an extensive body of research shows that listening comprehension skills directly

influence reading comprehension (Catts, Fey, Zhang, & Tomblin, 1999; Hoover & Gough, 1990; Nation, Cocksey, Taylor, & Bishop, 2010; Rost & Hartmann, 1992; Sears & Keogh, 1993) and indirectly impact oral language and reading development (Kendeou, Van den Broek, White, & Lynch, 2009). Thus, listening comprehension has been well established as a requisite for literacy acquisition. Thus for children in classes 1 and 2, DALI includes listening comprehension as a necessary skill for evaluation. Curriculum-based assessments, however, test comprehension through reading passages only. This limitation primarily exists because NIMHANS battery and assessments for dyslexia are not typically conducted on young children of classes 1 and 2 in clinical settings. Most of the children who are referred for dyslexia testing are in the higher classes, and thus reading comprehension is given as one of the tests. However, research has shown both listening comprehension and reading comprehension correlate with each other, suggesting an overlap between the two apparently distinct constructs in students speaking more than one language (Schroeders, Wilhelm, & Bucholtz, 2010). Schroeders et al. (2010) suggest that while listening comprehension and reading comprehension may imply stimuli processing through different routes, the individual differences in these routes may also be correlated.

Another possible explanation for the lack of agreement in Hindi language tests may be due to forces of globalization that have made learning English a necessity (De Bree & Unsworth, 2014), resulting in an increased desire among Indians for English language acquisition to meet the demands of the globalized economy. Indians with knowledge of the English language have better income compared to those lacking it (Chakraborty & Bakshi, 2016). This translates as an overemphasis on English learning in Indian schools, often at the cost of reading and writing in the native language. All subjects, except the second or the third language are taught and assessed in English (e.g. Social Studies, Science). Thus, it is very likely that children may have acquired familiarity with only those Hindi texts taught in the classroom. This would mean limited familiarity and difficulty in reading in Hindi outside the classroom. Since DALI is curriculum-free, lack of concordance in Hindi Comprehension and Reading could be due to reading a familiar passage in the curriculum textbook versus reading an unfamiliar passage in DALI.

The Literacy domains in English and Hindi were significantly correlated in the curriculum-based assessments and skill-based DALI, the only exception being DALI Hindi Comprehension. The lack of relationship in Hindi Comprehension may again be attributed to the reasons mentioned above i.e., the difference in the nature of the test items between the two types of assessments, as well as the difference in the nature of test items in DALI between classes 1-2 and classes 3-5 respectively.

We found, in our small sample, that curriculum-based Comprehension in English correlated with DALI Semantic and Verbal Fluency in English. Curriculum-based Reading correlated with DALI 'Rhyme' in both English and Hindi. A significant relationship was also found between curriculum-based Reading and Comprehension on the one hand,

and DALI Picture Naming on the other hand. The results provide evidence for the role played by underlying cognitive processes measured by the non-literacy tests like phonological processing (i.e., making use of the sound structure of oral language when learning how to decode written language (Adams, 1990)) and fluency in Reading and Spelling (Caravolas, Volín, & Hulme, 2005; Gallagher Frith, & Snowling, 2000; Georgiou, Torppa, Manolitsis, Lyytinen, & Parrila, 2012).

Fluency tests tap into a child's semantic and lexical knowledge through the processes of search and retrieval (Sauzéon, Lestage, Raboutet, N'Kaoua, & Claverie, 2004) and are associated with measures of accuracy (i.e. errors and rule violations). Fluency is regarded as an essential skill in the classroom that may generalize across different classroom tasks including Spelling and language learning (Henry, Messer, & Nash, 2012; Unsworth, Spillers, & Brewer, 2011). Phonological abilities have been well-established primary skills that predict secondary comprehension and reading through impact on decoding abilities. Reading is a multifaceted process that draws on phonology (sound), semantics (meaning), orthography (spelling) and morphology (structure and relationship between words) (Ziegler & Goswami, 2005). Rhyme Test is a test of phonological awareness that has been found to predict reading through its impact on working memory (Knoop-van Campen, Segers, & Verhoeven, 2018) and is a predictor of poor reading in children with dyslexia (Boets et al., 2010; Gathercole & Baddeley, 2014). Stronger phonological skill enables children to decode words better by breaking down words into individual sounds, thereby enhancing reading ability (Grizzle & Simms, 2005). Thus, dyslexia batteries should incorporate tests that predict Spelling, Reading and Comprehension, in order to provide a holistic assessment of the child's Literacy profile.

The purpose of curriculum-based assessments is to provide educators with class' average academic performance which is available also through a school report card. Skill-based assessments on the other hand are designed to measure the knowledge, skills, and judgment required for competency in a given domain and provide information against norm-referenced tests. Reading, writing, and numeracy are basic literacy skills and are now regarded as basic life skills (UNESCO). When taught to learn to read and write, a child must learn rules and patterns that allow the application of these rules to any context and not just to familiar curricula. It is thus crucial that assessment of SLD assess the skill and its associated domains to enable diagnosis and effective remediation.

Indian education policy mandates the teaching of two or three languages in addition to English (Viswanatham, 2001), and schoolchildren learn to read and write in a minimum of two languages, one of which is typically English, and the other an Indian language (Koul & Devaki, 2001). The sequence and manner in which languages are taught, nevertheless, varies greatly (Meganathan, 2011; Viswanatham, 2001). An additional factor shaping literacy acquisition is the medium of instruction, which refers to the language through which children receive instruction in other school subjects. Children naturally receive several hours of exposure daily to the language that is the medium of

instruction, whereas other language(s) may be taught for an hour or less per day. Besides these variables within the school system, children's linguistic profiles vary considerably due to differences in the sociocultural, economic and educational profiles of their families, further complicating the task of assessing children's literacy skills (Jhingran, 2005). Finally, the greatest problem faced by educators and education support personnel has been the scarcity of assessment tools developed within and for the Indian context. As seen from the discussions above, information necessary to screen children in the classroom for dyslexia includes measures of letter-sound knowledge, word decoding, reading fluency, spelling and oral language. Teachers and educators are the best equipped to answer these, but there is a paucity of tests to screen children for dyslexia that can be completed by educators. To date, the only available tests are the DST-J in English normed on 450 children between 6.5 – 11.5 years (Fawcett and Nicolson, 2012) and the JST and MST which are part of DALI, normed on 4400 children available in four Indian languages English, Hindi, Marathi and Kannada (http://pib.nic.in/newsite/ PrintRelease.aspx?relid=128722, http://14.139.62.11/DALI/details.php). Given the complicated multilingual-multiliterate scenario, more tests are urgently needed to be developed and normed to meet the needs of all children in India.

The need of the hour is to either upgrade the existing tools or develop new tools (with periodic review) for assessing SLD among multilingual Indian children (Kishore et al., 2021). We submit that SLD assessment should begin as early as possible in schools so that remedies can be instituted early. DALI presents a useful tool for the assessment of early literacy and related cognitive skills in the bilingual-biliterate context of Indian schools starting from age 5. It also provides norms and standards for the identification of children who might be at risk for dyslexia. Tests in the revised DALI-iLAB can be used to create a comprehensive profile of a bilingual-biliterate child in both languages enabling remediation to focus on building skills in the child's area(s) of weakness, while fostering the child's strengths. For the assessment of dyslexia alone, which is currently believed to be 80% of all SLD cases, it is possible to use DALI as an alternative to NIMHANS SLD battery. Since DALI does not have tests on dyscalculia and dysgraphia, a complete SLD assessment may not be possible. However, just like the NIMHANS battery, DALI is being upgraded for use till class 12 (for students upto 17 years of age) along with incorporating tests on dyscalculia and dysgraphia.

On the other hand, NIMHANS battery too is limited in its availability of norms: available till class 7 in English only. Currently, children of up to class 12 are assessed using the school textbooks of current grade, one grade below and two grades below in dyslexia, dyscalculia and dysgraphia for disability certification. However, the NIMHANS battery is now being upgraded for use in children upto 13 years of age with domains focusing on literacy as well as cognition that predict academic skills acquisition (eg planning, attention, etc.). The upgraded NIMHANS battery may have wider applicability than its predecessor since it is based on tests from different education boards of India (Kishore et al., 2021).

LIMITATIONS

A major limitation of the current study is its very small sample size and those only from English medium schools of Delhi affiliated to the CBSE board. However, it was difficult to recruit a larger sample due to the cumbersome process of lengthy and frequent assessment. Every child was required to come for three different sittings for the textbook assessment, NIMHANS battery, and one sitting for DALI, with each sitting ranging from 1.5-3 hours, and assessors being blind to each other. Moreover, it was difficult to recruit children from classes 1-5 as most children presenting for dyslexia assessment in our department were older and studying in higher classes. Curriculum-based tests are not only familiar to children but are provide information already available through school report cards. They are therefore limited in their ability to provide new information or information remediation. Skill-based assessments on the other hand, evaluate cognitive processes necessary for literacy development but also provide insights on sub-processes necessary for reading and thereby   also inform the design of remedial intervention in the case of deficits.

CONCLUSION

Given the complex education system and disparate examination testing systems in India, it might be beneficial to have both skill and curriculum-based tests for SLD evaluation. DALI may be an objective, holistic and multilingual alternative battery to the NIMHANS SLD index as well as for curriculum-based assessments for dyslexia.

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CONFLICT OF INTEREST

The authors do not have any conflict of interest to declare.

Table comparing standard scores on DALI with curriculum-based assessments/NIMHANS categorizations into: adequate, difficulty, disability. *(Note: Table is cut over two pages)*

*NA- Since the participant was in class 1 and could not be assessed on arithmetic for two grades below. EWR-English Word Reading, HWR-Hindi Word Reading, ENWR-English non-word reading, HNWR-Hindi Non-word reading

Note: The table depicts standard scores on all DALI tests. For curriculum-based tests and NIMHANS tests, scoring was done based on three grades, i.e. current grade and two grades below. If the child performed with at least 40% accuracy in current grade in each individual domain, the performance was considered '*adequate*'. If the child performed at less than 40% accuracy in one grade below the current grade (but performed with at least 40% accuracy in two grades below the current grade) in each individual domain, the performance was considered '*difficulty*'. If the child performed with less than 40% accuracy in two grades below the current grade (after being assessed on the current grade, one grade below as well as 2 grades below) in each individual domain, then the performance was considered '*disability*'. Very often, the subjective impressions and the clinical judgement of the psychologist determines the category of performance of the child, making curriculum based assessments clinically subjective. For the purpose of the study, in order to make DALI comparable, the scores on DALI were operationalized viz: 85–115 (i.e. average or above average) as '*adequate*', 78-84 as

'*difficulty*' (between 1 and 1.5SD), below 78 (i.e.1.5 SD below) as '*disability*', on each individual domain.

Partic-ipants	Age (yrs)	SPELLINGS		COMPREHENSION		READING	
		DALI	Curriculum-based	DALI	Curriculum-based	DALI	Curriculum-based
S1	9	Eng-69 Hin-69	Eng- Disability Hin- Disability	Eng- 69 Hin- 70	Eng- Disabilty Hin- Adeqaute	EWR- 69 ENWR-69 HWR- 73 HNWR-78	Eng- Disability Hin- Disability
S2	6	Eng-69 Hin-69	Eng-Difficulty Hin-Difficulty	Eng- 115 Hin- 115	Eng- Adequate Hin- Adequate	Eng- 80 Hin- 81	Eng-Adequate Hin- Adequate
S3	7	Eng-69 Hin-74	Eng- Disability Hin- Disability	Eng- 70 Hin- 115	Eng- problem Hin- Problem	Eng-69 Hin-69	Eng- Difficulty Hin-Difficulty
S4	10	Eng-69 Hin-69	Eng- Disability Hin- Disability	Eng-69 Hin-69	Eng- Difficulty Hin- Adequate	EWR- 69 ENWR-79 HWR- 70 HNWR-74	Eng- Disability Hin- Disability
S5	6	Eng-69 Hin-69	Eng-N Hin-NA	Eng- Missing Hin- 85	Eng- Difficulty Hin- Difficulty	Eng-69 Hin-69	Eng- Disability Hin- Difficulty
S6	8	Eng- 115 Hin- 110	Eng- Adequate Hin- Adequate	Eng- 100 Hin- 85	Eng- Adequate Hin- Adequate	EWR- 108 ENWR-106 HWR- 105 HNWR- 111	Eng- Adequate Hin- Adequate
S7	9	Eng- 100 Hin- 110	Eng- Adequate Hin- Adequate	Eng- 100 Hin- 70	Eng- Adequate Hin- Adequate	EWR- 93 ENWR- 85 HWR- 78 HNWR- 89	Eng- Adequate Hin- Adequate
S8	9	Eng-69 Hin-69	Eng- Disability Hin- Disability	Eng-69 Hin-69	Eng- Disability Hin- Disability	EWR- 69 ENWR-69 HWR- 69 HNWR-69	Eng- Disability Hin- Disability
S9	10	Eng-69 Hin-69	Eng- Disability Hin- Disability	Eng- 100 Hin- 69	Eng- Adequate Hin- Adequate	EWR- 69 ENWR-69 HWR- 69 HNWR-69	Eng- Disability Hin- Disability
S10	9	Eng-108 Hin-75	Eng- Adequate Hin- Adequate	Eng-100 Hin-85	Eng- Adequate Hin- Adequate	EWR- 104 ENWR-106 HWR- 81 HNWR-89	Eng- Adequate Hin- Adequate
S11	10	Eng-69 Hin-69	Eng- Disability Hin- Disability	Eng-69 Hin-69	Eng- Disability Hin- Disability	EWR- 69 ENWR-69 HWR- 70 HNWR-69	Eng- Disability Hin- Disability
S12	8	Eng-69 Hin-69	Eng- Disability Hin- Disability	Eng-100 Hin-115	Eng- Disability Hin- Disability	Eng- 69 Hin- 69	Eng- Disability Hin- Disability
S13	9	Eng-69 Hin-69	Eng- Disability Hin- Disability	Eng-100 Hin-100	Eng- Adequate Hin- Adequate	EWR- 70 ENWR-69 HWR- 69 HNWR-69	Eng- Difficulty Hin- Difficulty
S14	8	Eng-69 Hin-69	Eng-Disability Hin-Disability	Eng-69 Hin-69	Eng-Disability Hin-Disability	EWR- 69 ENWR-69 HWR- 69 HNWR-69	Eng-Disability Hin-Disability
S15	8	Eng-69 Hin-69	Eng-Disability Hin-Disability	Eng-69 Hin-69	Eng-Disability Hin-Disability	EWR- 69 ENWR-69 HWR- 70 HNWR-78	Eng- Adequate Hin- Adequate

Table comparing standard scores on DALI with curriculum-based assessments/NIMHANS categorizations into: adequate, difficulty, disability. *(Note: Table is cut over two pages)*

Partic-ipants	Age (yrs)	Semantic fluency DALI	Verbal fluency DALI	Picture Naming DALI	Rhyme DALI	Pho-neme DALI	Attention NIMHANS	Visual perceptual NIMHANS	Visual Memory NIMHANS	Auditory Memory NIMHANS	Copying NIMHANS	Expressive Writing NIMHANS	Arithmetic NIMHANS
S1	9	Eng- 70 Hin- 94	Eng- 83 Hin- 69	Eng- 88 Hin- 74	Eng- 69 Hin- 70	Eng- 93 Hin- 93	Difficulty	Adequate	Difficulty	Adequate	Eng- Disability Hin- Difficulty	Eng- Disability Hin- Disability	Disability
S2	6	Eng- 90 Hin- 100	Eng- 85 Hin- 70	Eng- 89 Hin- 99	Eng- 85 Hin- 100	Eng- 69 Hin- 69	Missing	Adequate	Adequate	Difficulty	Eng-Difficulty	Eng-Difficulty	NA*
S3	7	Eng- 75 Hin- 93	Eng- 95 Hin- 74	Eng- 93 Hin- 99	Eng-108 Hin- 100	Eng- 78 Hin- 93	Difficulty	Adequate	Adequate	Adequate	Eng-Adequate Hin- Adequate	Eng-Adequate Hin- Adequate	Disability
S4	10	Eng- 78 Hin- 88	Eng- 80 Hin- 69	Eng- 69 Hin- 75	Eng- 70 Hin- 70	Eng-108 Hin- 100	Difficulty	Inadequate	Adequate	Adequate	Eng- Difficulty Hin- Difficulty	Eng- Disability Hin- Disability	Disability
S5	6	Eng-82 Hin-70	Eng- 76 Hin- 69	Eng- 82 Hin- 86	Missing	Missing	Missing	Adequate	Difficulty	Adequate	Eng-Adequate	Eng-Difficulty	Adequate
S6	8	Eng-108 Hin- 118	Eng-108 Hin- 91	Eng-84 Hin- 75	Eng-115 Hin- 100	Eng-115 Hin- 108	Difficulty	Difficulty	Missing	Adequate	Adequate	Eng-Adequate Hin- Adequate	Adequate
S7	9	Eng-88 Hin- 121	Eng-87 Hin- 69	Eng-92 Hin- 85	Eng-100 Hin- 78	Eng-100 Hin- 115	Difficulty	Adequate	Adequate	Adequate	Eng-Adequate Hin- Adequate	Eng-Adequate Hin- Adequate	Adequate
S8	9	Eng-69 Hin- 106	Eng-69 Hin- 69	Eng-71 Hin- 90	Eng-69 Hin- 78	Eng-69 Hin- 69	Difficulty	Difficulty	Adequate	Adequate	Eng-Adequate Hin- Adequate	Eng- Disability Hin- Disability	Difficulty
S9	10	Eng-85 Hin- 106	Eng-91 Hin- 70	Eng-75 Hin- 69	Eng-100 Hin- 78	Eng-108 Hin- 85	Difficulty	Difficulty	Adequate	Adequate	Eng-Adequate Hin- Adequate	Eng- Disability Hin- Disability	Adequate
S10	9	Eng-100 Hin- 94	Eng-85 Hin- 69	Eng-96 Hin- 69	Eng-115 Hin- 108	Eng-115 Hin- 115	Difficulty	Severe Difficulty	Adequate	Adequate	Eng- Disability Hin- Disability	Eng- Disability Hin- Disability	Adequate
S11	10	Eng-81 Hin- 79	Eng-85 Hin- 69	Eng-69 Hin- 79	Eng-70 Hin- 69	Eng-100 Hin- 78	Difficulty	Difficulty	Adequate	Adequate	Eng- Disability Hin- Disability	Eng- Disability Hin- Disability	Difficulty
S12	8	Eng-85 Hin- 108	Eng-91 Hin- 73	Eng-82 Hin- 86	Eng-93 Hin- 100	Eng-115 Hin- 85	Adequate	Adequate	Adequate	Adequate	Eng- Disability Hin- Disability	Eng- Disability Hin- Disability	Disability
S13	9	Eng-106 Hin- 97	Eng-111 Hin- 76	Eng-101 Hin- 87	Eng-100 Hin- 100	Eng-93 Hin- 69	Difficulty	Severe Difficulty	Adequate	Adequate	Eng- Difficulty Hin- Difficulty	Eng- Disability Hin- Disability	Difficulty
S14	8	Eng-85 Hin- 112	Eng-75 Hin- 73	Eng-71 Hin- 84	Eng-85 Hin- 100	Eng-70 Hin- 85	Difficulty	Missing	Missing	Missing	Missing	Missing	Missing
S15	8	Eng-70 Hin- 103	Eng-84 Hin- 78	Eng-71 Hin- 69	Eng-85 Hin- 93	Eng-100 Hin- 70	Difficulty	Severe Difficulty	Adequate	Adequate	Eng- Difficulty Hin- Difficulty	Eng- Disability Hin- Disability	Adequate

Non Comparable Domains (spanning header above all assessment columns)

Table comparing DALI with curriculum-based assessments.

Partici pants	Age (in years)	SPELLINGS		COMPREHENSION		READING		SPELLINGS		COMPREHENSION		READING	
		DALI Eng	Curriculum-based Eng	DALI Eng	Curriculum-based Eng	DALI Eng	Curriculum-based Eng	DALI Hin	Curriculum-based Hin	DALI Hin	Curriculum-based Hin	DALI Hin	Curriculum-based Hin
S1	9	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Adequate*	Disability	Disability
S2	6	Disability	Difficulty*	Adequate	Adequate	Difficulty	Adequate*	Disability	Difficulty*	Adequate	Adequate	Difficulty	Adequate*
S3	7	Disability	Disability	Disability	Difficulty*	Disability	Difficulty*	Disability	Disability	Adequate	Difficulty	Disability	Difficulty*
S4	10	Disability	Disability	Missing	Difficulty*	Disability	Disability	Disability	Disability	Disability	Adequate*	Disability	Disability
S5	6	Disability	Difficulty*	Difficulty	Difficulty	Disability	Disability	Disability	Difficulty	Adequate	Difficulty	Disability	Difficulty*
S6	8	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
S7	9	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Disability	Adequate*	Difficulty	Adequate*
S8	9	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability
S9	10	Disability	Disability	Adequate	Adequate	Disability	Disability	Disability	Disability*	Disability	Adequate*	Disability	Disability
S10	9	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Disability	Adequate*	Adequate	Adequate	Disability	Adequate*
S11	10	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability
S12	8	Disability	Disability	Adequate	Disability	Disability	Disability	Disability	Disability	Adequate	Disability	Disability	Disability
S13	9	Disability	Disability	Adequate	Adequate	Disability	Difficulty*	Disability	Disability	Adequate	Adequate	Disability	Difficulty*
S14	8	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability
S15	8	Disability	Disability	Disability	Disability	Disability	Adequate*	Disability	Disability	Disability	Disability	Disability	Adequate*

In order to make comparisons between DALI and curriculum-based assessments, DALI standard scores were operational-ized into adequate (85-115), difficulty (78-84), and disability (<78).
*Test domains where scores were higher on curriculum-based assessments when compared with DALI.

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