Research in Social Sciences
Volume 8, Issue 4, pp. 51-61
2025

Relations between Reading Fluency and Reading Comprehension for L2 English Readers in Grades 3 and 5 in India

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ABSTRACT: *We report on a study that was conducted in an urban city center, Bangalore, India. This study was conducted to observe the relations between fluency and comprehension for L2 English Learners in this context. The participants included 688 students from Grades 3 and 5, who came from different home language backgrounds and attended schools where the language of instruction was English. We used a structural equation modeling (SEM) technique to compare the relationship between L2 English oral reading fluency and silent reading fluency on comprehension. Our findings suggested that oral reading is more predictive of reading comprehension than silent reading across the two grade levels. Implication for reading assessment and intervention practices within the Indian context will be discussed.*

Key words: *Comprehension, Indian context, oral reading fluency, silent reading fluency, structural equation modeling.*

1. Introduction

There are 122 recognized languages in India and schools face a constant dilemma of synchronizing the language of instruction with students' home languages. According to the National Curriculum Framework 2005 (Ramachandran et al., 2005), schools typically follow a three-language formula (Aggarwal, 1991). The first language is the language of instruction (one of the official languages, English or Hindi); the second is the official language that is not the language of instruction (English or Hindi), which is introduced by Grade 5, and the third language is the state language, which is introduced by Grade 7 (Ramachandran et al., 2005). Unfortunately, measuring students' proficiency in these languages is a difficult task, given the inconsistent time frames in which schools opt to introduce these languages. An additional complexity is that in most urban centers, a child's home language may differ from the national or state languages introduced in school. "A typical child in India is exposed to at least four languages from ages 0-13 years: a home language (L1); school language 1 (L2)-- which is the language of instruction (English, in our sample); school language 2 (L3) which is the national language Hindi; and school language 3 (L4) which is the state language (Kannada, in our sample)" (Shenoy et al., 2020, p. 2).

80% of Indian schools are government schools, but because of the poor quality of education, 27% of Indian children are privately educated (Annual Status of Education Report, 2016, p. 122). In urban centers, more than 50% of children (27 million) attend private schools (Annual Status of Education Report, 2016, p. 122). These private schools follow a state, national or international standardized curriculum, and the language of instruction is English (Kurrien, 2005). Government schools on the other hand follow a state-level curriculum and the language of instruction is the State language. There is a push towards English medium instruction in the private schools in order to promote social and economic mobility for students attending these schools. According to Kalyanpur (2020), this is creating a new group of marginalized students in India;

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DOI: *10.53935/26415305.v8i4.456*
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a group that attends low-cost private schools and for whom English still seems inaccessible because of the poor quality of instruction in these schools.

In schools where English is the language of instruction, "In a typical seven-hour school day, a student is exposed to six hours of instruction in English, and one hour of instruction in Hindi and/or the state language" (Shenoy et al., 2020, p. 2). By middle or high school, a larger number of students are proficient in all domains of speaking, listening, reading and writing in English. These students consider the English language to be their dominant language since they have been exposed to it more than the other languages, and it is pervasive across academic content areas. Therefore, in our study, we focused on measuring students' L2 English reading skills because for our sample of students in Bangalore, it was the language of instruction and it represents their access to literacy.

The predominant method used to teach reading in India is the "Alphabet-Spelling Method" (Gupta, 2014, p. 3911). Students are taught letter names and how to spell out words; therefore, they bypass the sound structure of the language and acquire new words by sight word recognition instead. It is very common for teachers in Indian classrooms to teach reading by focusing on written products, such as copying from the board and choral recitation, rather than comprehension. One teacher in Gupta's (2014) study reported: "These children are not reading because they are not copying the letters." In class, teachers used terms that are central to initial reading---picture, word, letter, sound and spelling---interchangeably" (Gupta, 2014, p. 3912). Recently, Dixon et al (2011) and Gupta (2014) attempted to introduce Phonics-Based Instruction in Indian schools. Their findings suggested that students from the slums, who did not have English support at home and were first generation school-goers, performed better on reading acquisition tasks if they were instructed in Phonics-Based programs rather than the Alphabet-Spelling method (Dixon et al, 2011). Similar findings were reported for students attending rural schools in India (Gupta, 2014).

Students in India are typically assessed only on their written content area skills, with the assumption that these assessments indirectly measure students' reading abilities. The predominant format for testing is targeted at students producing short answers and essays, and it taps into their rote-memorization skills (Ramanathan, 2008). Questions are limited to those that have been extensively covered in class and for which teachers have given students appropriate responses. Linguistic creativity is restricted to the teacher's interpretation of the textbook, and students are not directly tested on other aspects of the language, such as speaking, listening and reading in the elementary grades. Given the context, we were interested in assessing reading skills and possibly introducing reading assessments and progress-monitoring tools that could not only keep track of student progress but also help guide instruction for teachers.

1.1. Latent Structure of Reading Skills in L1 and L2

The following studies report on the latent structure of reading skills for monolingual English readers. Norwalk et al. (2013) conducted a confirmatory factor analysis of the Early Arithmetic, Reading and Learning Indicators (EARLI) on a group of students in pre-school, and found that phonological awareness was an important early literacy skill that accounted for the most variance in their model. Oslund et al. (2002) used subtests from the Comprehensive Test of Phonological Processing (Wagner, Torgessen & Rashotte, 2003), DIBELS and Woodcock Reading Mastery Test (WRMT, 1998) to observe kindergarten predictors of Grade 1 reading outcomes and found that last sound phoneme segmentation, letter sound production and whole word segmentation was positively linked to later reading outcomes. Tannenbaum et al. (2009) used multiple measures to look at the relationship between word knowledge and reading comprehension in third grade students and found that breadth of word knowledge was most highly related to performance on reading comprehension and breadth and depth of word knowledge are distinguishable but highly related. Kim, Wagner & Foster (2011) used multiple subtests to measure the relations between oral reading fluency, silent reading fluency and reading comprehension in first grade students and found that silent and oral reading fluency were related but distinct forms of reading fluency, and that reading fluency predicted reading comprehension better for average readers than skilled readers. Kim & Wagner (2015) found that in Grade 1 reading comprehension was largely explained by word reading fluency but not by text reading fluency; in Grade 2, listening comprehension was more related to reading comprehension and text reading fluency was independently related to reading comprehension; and in Grade 3-4, listening comprehension became more strongly related to reading comprehension.

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We found a limited number of studies that explored the latent structure of reading skills in L2 English. Kim (2012) measured the predictive validity of literacy measures from the DIBELS for Spanish-speaking ELs and found that Oral Reading Fluency was a better predictor of California Standards Test (CST) than DAZE and language proficiency levels did not change this finding. Adams et al (2020) studied the reading achievement among Spanish-speaking ELs and found that the Oral Reading Fluency subtest predicted a large proportion of the variance and retell and language were significant predictors above and beyond ORF. Our study fills this gap by looking at the latent structure of L2 English reading skills for a sample of students in India.

1.2. Progress-Monitoring Measures

The Dynamic Indicators of Basic Early Literacy Skills-Next Edition (DIBELSNext, Good, Kaminski & Cummings, 2011) is a widely used tool to measure reading and literacy skills in the United States (US). Measuring students' reading skills is an important component that educators consider while making intervention decisions for their students.

Researchers at the University of Oregon developed and revised the easyCBM measures (Anderson et al, 2014). The focus has been to facilitate "data-driven instructional decision making through enhanced reporting options" (Anderson, et al., 2014, p.4), in order to promote progress-monitoring and universal screening in schools (Deno, 2003; Keller-Margulis et al, 2008).

These progress-monitoring tools were adapted for our current study, in order to measure reading trajectories in L2 English in our sample of students in India. Our rationale for using these measures were as follows: (a) We wanted to provide teachers with reading assessments that would complement their writing assessments of content area skills; (b) Even though our sample of students was bilingual, they were not bi-literate; they were only literate in English and not in their native languages; (c) Even though students spoke different languages at home, English was their link language in the classroom, and they used it to communicate with their teachers and peers.

Additionally, we wanted to explore how they would perform on fluency and comprehension measures and whether the reading instruction they were currently receiving—namely the Alphabet-Spelling Method (Gupta, 2014) --- would impact their scores. Our rationale for utilizing both the DIBELS Next and easyCBM measures was to be able to capture a wide variety of subtests that measured reading in elementary grades, as well as to observe their efficacy and reliability as assessments of L2 English reading development within the Indian context.

For consistency, we maintained the content and administration procedures, employed in the US. For the comprehension measures, we selected culture-free passages which discussed generic themes such as taking care of a pet dog, trees and plants and going to the market. For example, a passage titled "Parts of a Tree" was chosen instead of "The Cocoa Stand" as the latter was not relevant to the Indian context. The passages were modified to reflect names that are common within the Indian context (e.g. "Abby" was replaced with "Asha") and some words were changed to reflect common usage in the culture (e.g. "jump rope" was replaced with "skipping rope"), but the essence of the passages in terms of meaning and comprehension were not changed.

1.3. Context and Research Questions

We were interested in studying the reading development of L2 English in elementary grades for students attending private schools in the Indian context. We were particularly interested in the differences between the causal roles of silent reading and oral reading on comprehension. We wanted to measure this given the backdrop of using the alphabet-spelling method for reading instruction that is unique to the Indian context. We believe the following research question is an important contribution to the reading literature:

How are oral reading and silent reading fluency related to reading comprehension for L2 English readers in Grades 3 and 5 in Bangalore, India?

2. Method

2.1. Participants

The sample consisted of 688 students from Grades 3 (n=345) and 5 (n=343). Students came from different home language backgrounds and were enrolled in English-medium schools. They did not receive any

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additional bilingual support for the development of their home languages and were not expected to be bi-literate in both languages. The demographic information of the students is presented in Table 1.

2.2. School Setting

Students were recruited from six different school sites, all located in an urban city center, Bangalore. Two of these schools were low-cost schools, two were middle-cost schools and two were high-cost schools. Since all the schools were private schools, the students that attended these schools typically came from low-income, middle-income and high-income socio-economic backgrounds respectively. Both low-cost schools followed a State Board Curriculum that is prescribed by the state of Karnataka; both middle-cost schools followed a National Board Curriculum that is prescribed by the Central Board of Education in India; one high-cost school followed the National Board Curriculum and the other followed a Montessori Curriculum. The State Board Curriculum is less rigorous than the National Board Curriculum, and the main goal for students graduating from the State Board Curriculum is to find jobs within the state of Karnataka. In comparison, the National Board Curriculum is more rigorous and is followed throughout India, preparing students for national and international jobs. The school characteristics are presented in Table 1.

Table 1. Demographic Data for the Students in the Sample.

			Grade Three		**Grade Five**	
			Frequency	**Percentage**	**Frequency**	**Percentage**
Individual Characteristics	Gender	Male	187	53.89	199	57.18
		Female	160	46.11	149	42.82
	SES	Low-Income	43	12.39	48	13.79
		Middle-Income	223	64.27	217	62.36
		High-Income	81	23.34	83	23.85
School Characteristics	School Type	Low-Cost 1	39	11.24	40	11.49
		Low-Cost 2	4	1.15	8	2.3
		Middle-Cost 1	85	24.5	83	23.85
		Middle Cost 2	138	39.77	134	38.51
		High Cost 1	62	17.87	80	22.99
		High Cost 2	19	5.48	3	0.86
	Curriculum	State	43	12.39	48	13.79
		National	285	82.13	297	85.34
		Montessori	19	5.48	3	0.86

2.3. Measures

The reading measures were administered across three phases during the 2021-22 academic year. The academic year in India is from June-March, so the reading measures were administered during three time periods: July-August, October-November and January-February to correspond with benchmark assessments that are administered in Fall, Winter and Spring in the US. The total individual administration time was approximately 30 minutes per student. For the purposes of this study however, we only analyzed data from the beginning of year and end of the year datasets.

2.4. DIBELS Next Subtests

The following subtests were administered for students in Grades 3 and 5:

1. Oral Reading Fluency: The ORF subtest was used to measure the ability to accurately read an unknown passage, and the student earned 1 point for each word that was read correctly. It was a timed test administered for 1 minute.
2. DAZE Comprehension: DIBELS Daze is a cloze comprehension measure, which measures the students' understanding of the meaning of a word within the context of a sentence. It was individually administered and students were given 3 minutes to complete the test. They were asked to silently read a passage and circle their word choices. According to the authors, approximately every seventh word was replaced by a box containing the correct word and two distractor words. The scores represented the

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number of correct and incorrect words, and an adjusted score that compensates for guessing is calculated based on the number of correct and incorrect responses.

2.5. Easy CBM Subtests

The following subtests were administered for students in both Grades 3 and 5, except Word Reading Fluency that was only administered to students in Grade 3:

1. Multiple Choice Reading Comprehension: Students were instructed to silently read a comprehension passage and answer twenty multiple choice comprehension questions that followed. This subtest was group-administered by class sections in the schools, and typically took 30 minutes to complete. Scores were calculated as number of correct responses out of the twenty questions.

2.6. Test of Silent Reading Efficiency and Comprehension (TOSREC)

We chose the TOSREC (Wagner et al., 2010) as an added progress-monitoring measure was because the DIBELSNext and easyCBM had a reading fluency subtest but not a comprehension test for Grade 1. Students were expected to read various statements and conclude if they were true or false. For example, they read a statement such as "A lion can fly" and checked a box labeled "yes" or "no". The test was timed for 3 minutes, and raw scores were calculated by subtracting incorrect responses from correct ones. Some words that were written in American English were changed to Indian English so that students would comprehend them in this context (e.g. The word "cookies" was changed to "biscuits"). But the meaning of the text was retained in all instances. We found that out of all the fluency and comprehension measures, the TOSREC represented a somewhat culture-free test, because of the generic statements which were either true or false, rather than a passage or story that had many more cultural references. It seemed to be a preferred test for this context and captured comprehension at a sentence level.

2.7. Ethics Statement

We received informed consent from parents whose children were recruited for our study. We also received assent from students participating in out study. Our ethics proposal was approved by the University's Institutional Review Board before the study was conducted.

3. Data Analyses

The primary purpose of this study is to understand the causal factors that are most relevant for reading comprehension among third and fifth grade L2 English language learners. We employ over three hundred observations of student test scores for a series of reading subtests measured at the beginning and end of the third (N = 345) and fifth (N = 343) grade years, respectively. Multivariate regression techniques provide a simplistic way of analyzing causality among a range of independent variables that contribute to a univariate outcome. Although linear modeling techniques are straightforward to implement, the relative simplicity of these models offers limited utility for the type of causal relationships that we wish to analyze.

Instead, we employ a structural equation model (SEM) technique that permits us to simultaneously analyze more than one dependent variable, as well as its lagged values, in the full model (Kline 2015; Ullman and Bentler 2003). SEMs represent an added benefit over ordinary least squares insofar as they may be used to analyze latent variables as well as nonlinear relationships within the data. "When the phenomena of interest are complex and multidimensional, SEM is the only analysis that allows complete and simultaneous tests of all the relationships (Ullman and Bentler 2003)." Here, our concern is primarily nonlinearity.

We employ *path diagrams* to depict our systems of structural equations (Figures 2 and 3). We assume that each of the observed variables are measured with error. Unidirectional arrows represent a causal path extending from an independent variable to a dependent variable, while bidirectional arrows represent covariance between measures without any implied directionality (Ullman and Bentler 2003). The path diagrams represent our proposed covariance structure for the data; we test whether this proposed structure – as illustrated in the path diagrams – adequately represents the true population covariance (Bollen 2005). Articulated another way, "…The major question asked by SEM is, "Does the model produce an estimated population covariance matrix that is consistent with the sample (observed) covariance matrix? (Ullman and Bentler 2003)." Our goal is to select the model that best reflects the patterns observed in our sample.

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This is a comparative project in the sense that we are interested in the lower-level skill sets that are most predictive of reading comprehension during the end of the third and fifth grade years. Our dataset includes student test scores situated approximately ten months apart and we want to analyze the impact of specific subtests on comprehension at both of these intervals. We are primarily interested in test score outcomes, yet our data are drawn from a population of students situated across different school settings with varying degrees of resources. Examples of these resources in the aggregate include the type of school curriculum as well as the overall income-level of the schools. We also include gender as an individual measure of variability in the data. Each of these indicators – (1) curriculum, (2) income, and (3) gender – have the potential to confound our results. Additionally, we chose not to include these measures in the SEM models due to limited sample size (and degrees of freedom). Instead, we simply regressed each test score on our three confounder variables, and calculated the residuals in terms of the difference between the actual and predicted test score values. After controlling for the marginal effect of each confounder -- and reducing the data down to only the unexplained variance -- we created the SEM model from residuals on each individual test score.

Combining results, we created a cross-lag model of comprehension influenced by both (1) oral reading fluency (ORAL) and (2) silent reading fluency (SLNT). To operationalize comprehension, we employed the aggregate sum of the DIBELS Daze and the Multiple-Choice Test of Reading Comprehension (MCRC) subtests. ORF served as our measure of oral reading fluency and TOSREC served as our measure of silent reading fluency. Within each model we analyzed comprehension at zero and ten months as well as the subtests, ORAL and SLNT, respectively, at months zero and ten. Inherent in the cross-lag model are several possible paths. Figure 1 presents the proposed structural equation model. Here, we permit comprehension in the final time period ($COMP_2$) to be influenced by (1) comprehension in the initial period ($COMP_1$) as well as (2) the contemporaneous ($ORAL_2$, $SLNT_2$) and (3) lagged values of each subtest ($ORAL_1$, $SLNT_1$). All of contemporaneous values covary with one another ($ORAL_1 \leftrightarrow SLNT_1 \leftrightarrow COMP_1$). Additionally, the lagged value of each measure influences the same measure in the final period ($ORAL_1 \rightarrow ORAL_2$). Finally, we permit comprehension in the first period to have a top-down influence on subskills in the final period ($COMP1 \rightarrow ORAL_2$, $COMP_1 \rightarrow SLNT_2$). We set cross-lagged paths between subtests, e.g., $ORAL_1$ and $SLNT_2$, to be zero so that we are able to retain two degrees of freedom in the full model. We exploit the SEM modeling process to test which lower-level skill, oral reading or silent reading, is more predictive of reading comprehension. Model fit statistics and standardized coefficients permit us to identify the foundational skills that are most predictive of future comprehension. In the structural equation model, we observe these influences through direct and indirect effects.

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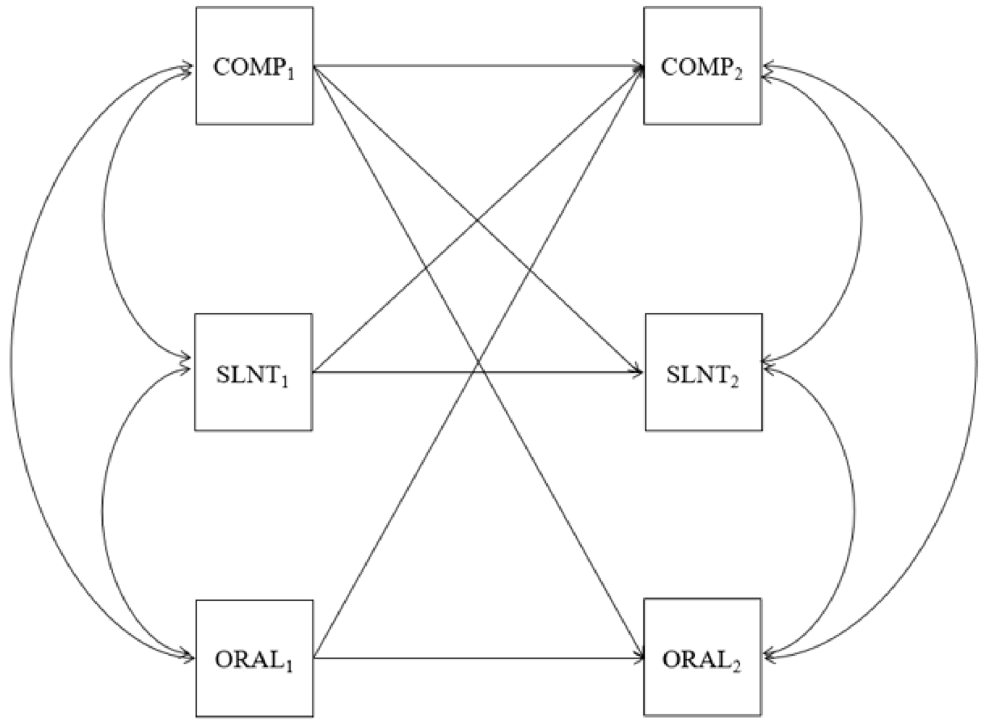

Figure 1. Proposed structural equation model of reading skills.

4. Results

The summary statistics for Grade 3 and Grade 5 are represented in Tables 2 and 3 respectively.

Table 2. Summary Statistics for Reading Subtests for Students in Grade 3.

		Month Zero; N = 328		Month Ten; N = 345	
		Mean	**Min.**	**Mean**	**Min.**
		(SD)	**Max.**	**(SD)**	**Max.**
TOSREC		12.51	0	13.18	0
		(7.48)	48	(8.24)	51
DIBELS	ORF	58.80	0	69.27	0
		(39.54)	249	(38.99)	205
	RF	9.84	0	5.94	0
		(14.60)	94	(7.50)	55
	DAZE	3.35	0	8.34	0
		(4.53)	36	(8.09)	45
EasyCBM	WRF	36.19	0	47.56	0
		(23.64)	115	(26.41)	144
	PRF	66.06	0	79.07	0
		(42.10)	207	41.23	236
	MCRC	5.70	0	7.45	0
		(3.27)	18	(3.09)	17

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Table 3. Summary Statistics for Reading Subtests for Students in Grade 5.

		Month Zero; N = 329		Month Ten; N = 343	
		Mean	**Min.**	**Mean**	**Min.**
		(SD)	**Max.**	**(SD)**	**Max.**
TOSREC		11.52	0	16.76	0
		(7.61)	36	(8.07)	56
DIBELS	ORF	83.00	0	92.53	0
		(40.55)	206	(40.77)	193
	RF	17.84	0	11.89	0
		(18.14)	90	(11.54)	70
	DAZE	9.25	0	13.01	0
		(8.20)	51	(8.89)	45
EasyCBM	PRF	104.56	0	120.11	1
		(44.51)	241	(45.90)	248
	MCRC	10.64	0	10.02	0
		(3.50)	20	(3.45)	19

Substantial growth was recorded on most subtests in both grade levels. In Figures 2 and 3, we present the cross-lag panel models of reading comprehension for grades three and five, respectively. We standardized the coefficients in each model. Below are the model coefficients (Tables 4 and 5) and fit statistics (Table 6) for each grade level. From these statistics we observe relationships among the subtests and comprehension measures for each set of students. Consider the structural equation model for grade three (Figure 2; statistically significant paths only). The fit statistics demonstrate that this is an appropriate structural equation for our data. The chi-squared value is not statistically significant (χ^2 value = 4.053, p-value 0.1318, 2 degrees of freedom). In addition, the comparative fit index (CFI = 0.999) is greater than 0.95. Finally, the standardized root mean square residual (SRMR 0.016) is less than 0.08. Collectively, these measures internally validate our selection criteria.

Table 4. Grade 3 structural equation model.

Variable		**Standardized path estimate**	**Standard error**	**Two-tailed p-value**
COMP3	on			
	COMP1	0.216	0.05	0.000
	SLNT1	-0.192	0.041	0.000
	ORAL1	0.576	0.044	0.000
SLNT3	on			
	SLNT1	0.949	0.007	0.000
	COMP1	0.017	0.017	0.318
ORAL3	on			
	ORAL1	0.818	0.03	0.000
	COMP1	0.012	0.039	0.763
COMP1	with			
	SLNT1	0.309	0.05	0.000
	ORAL1	0.609	0.035	0.000
SLNT1	with			
	ORAL1	0.213	0.053	0.000
COMP3	with			
	SLNT3	0.101	0.055	0.066
	ORAL3	0.122	0.055	0.026
SLNT3	with			
	ORAL3	0.131	0.055	0.016

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Means				
	COMP1	-0.691	0.061	0.000
	SLNT1	-2.61	0.116	0.000
	ORAL1	-0.142	0.055	0.011
Intercepts				
	COMP3	0.101	0.111	0.366
	SLNT3	-0.17	0.049	0.000
	ORAL3	0.351	0.041	0.000
Variances				
	COMP1	1	0	999.000
	SLNT1	1	0	999.000
	ORAL1	1	0	999.000
Residual variances				
	COMP3	0.506	0.039	0.000
	SLNT3	0.089	0.009	0.000
	ORAL3	0.32	0.029	0.000

Table 5. Grade 5 structural equation model.

Variable		Standardized path estimate	Standard error	Two-tailed p-value
COMP3	on			
	COMP1	0.293	0.05	0.000
	SLNT1	-0.153	0.04	0.000
	ORAL1	0.513	0.045	0.000
SLNT3	on			
	SLNT1	0.945	0.008	0.000
	COMP1	0.007	0.019	0.696
ORAL3	on			
	ORAL1	0.697	0.035	0.000
	COMP1	0.145	0.042	0.001
COMP1	with			
	SLNT1	0.331	0.049	0.000
	ORAL1	0.606	0.035	0.000
SLNT1	with			
	ORAL1	0.204	0.053	0.000
COMP3	with			
	SLNT3	0.136	0.054	0.012
	ORAL3	0.33	0.049	0.000
SLNT3	with			
	ORAL3	0.118	0.055	0.031
Means				
	COMP1	-0.077	0.055	0.163
	SLNT1	-3.918	0.162	0.000
	ORAL1	-0.32	0.057	0.000
Intercepts				
	COMP3	-0.162	0.159	0.308
	SLNT3	-0.026	0.075	0.735
	ORAL3	0.226	0.035	0.000
Variances				
	COMP1	1	0	999.000
	SLNT1	1	0	999.000

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	ORAL1	1	0	999.000
Residual variances				
	COMP3	0.508	0.039	0.000
	SLNT3	0.103	0.011	0.000
	ORAL3	0.371	0.032	0.000

Table 6. Grade 3 and 5 structural equation model fit statistics.

Model fit statistics	**Grade 3**	**Grade 5**
Number of free parameters	25	25
Loglikelihood		
H_0 value	-7435.858	-7807.002
H_1 value	-7433.832	-7805.53
Information criteria		
Akaike (AIC)	14921.717	15664.004
Bayesian (BIC)	15016.542	15758.905
Sample-Size Adjusted BIC	14937.243	15679.605
(n* = (n + 2) / 24)		
Chi-Square test of model fit		
Value	4.053	2.944
Degrees of freedom	2	2
p-Value	0.1318	0.2294
RMSEA (Root mean square error of approximation)		
Estimate	0.056	0.038
90% confidence interval (p-value)	0.000 (0.135)	0.000 (0.122)
Probability RMSEA ≤ 0.05	0.345	0.475
CFI/TLI		
CFI	0.999	0.999
TLI	0.991	0.996
Chi-Square test of model fit for the baseline model		
Value	1403.816	1344.585
Degrees of freedom	12	12
p-Value	0.000	0.000
SRMR (Standardized root mean square residual)		
Value	0.016	0.016

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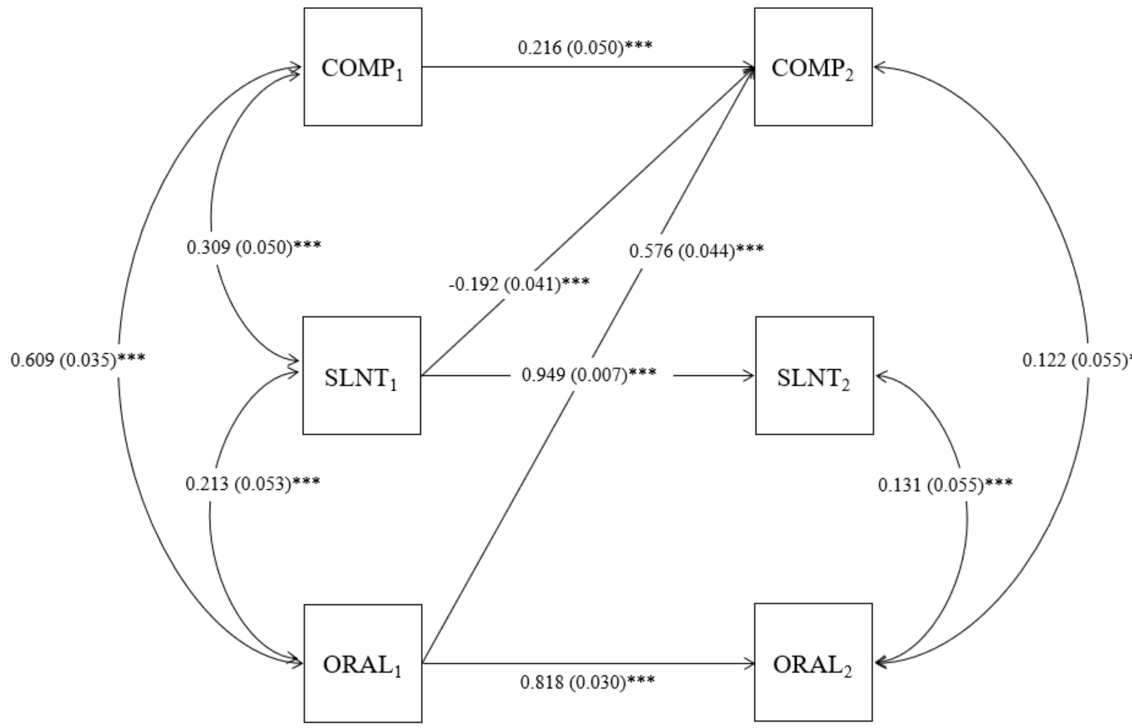

Figure 2. Grade 3 structural equation model†.

Note: †Significant pathways only
Statistical significance: *** p-value < 0.001, ** p-value < 0.01, * p-value < 0.05.

The structural equation model permits us to create numerous relationships within and across the contemporaneous and lagged values of the higher order (*reading comprehension*: COMP$_1$, COMP$_2$) and lower order (*oral reading*: ORAL$_1$, ORAL$_2$, *silent reading*: SLNT$_1$ and SLNT$_2$) variables. Here, we observe that comprehension in the first period covaries significantly with oral reading (ORAL$_1$ $\leftrightarrow$ COMP$_1$, *covariance* = 0.609, p-value < 0.001), whereas the covariance with silent reading is not as strong (SLNT$_1$ $\leftrightarrow$ COMP$_1$, *cov.* = 0.309, p < 0.001). This suggests that the variance in comprehension at the beginning of grade three is more closely related to students' oral reading skills at that time. We also observe that each variable in time two is a function of its own lagged value. For instance, comprehension at the end of the year is related to its lagged value (e.g., COMP$_1$ $\rightarrow$ COMP$_2$, *coefficient* = 0.216, p < 0.001). However, the relation between comprehension during successive periods is much more tenuous than the relations between subtests. As demonstrated in Figure 2, oral reading during time one explains a large part of the oral reading skills at time two (ORAL$_1$ $\rightarrow$ ORAL$_2$, *coef.* = 0.818, p-value < 0.001). Similar correlations exist between silent reading at times one and two (SLNT$_1$ $\rightarrow$ SLNT$_2$, *coef.* = 0.949, p < 0.001). This finding is consistent with our theoretical understanding of higher order and lower levels skill sets. It follows intuitively that lower levels skills, such as oral or silent reading, would be closely correlated over time. In contrast, we observe that comprehension is much more complex; comprehension at the end of the year is less closely related to its lagged value (COMP$_1$ $\rightarrow$ COMP$_2$, *coef.* = 0.216, p < 0.001) than similar relations within subtests.

Most notably, the standardized coefficients in this model permit us to analyze the relative contribution of each subtest at the beginning of the school year (ORAL$_1$, SLNT$_1$) to comprehension in the final time period (COMP$_2$) for grade three students. Here, the data suggests that oral reading at the beginning of the year contributes positively and significantly to comprehension in the final time period (ORAL$_1$ $\rightarrow$ COMP$_2$, *coef.* = 0.576, p < 0.001). This is its direct effect. We can also calculate the indirect effect of the oral reading subtest by analyzing the coefficients associated with the indirect paths that incorporate oral reading at time two (ORAL$_1$ $\rightarrow$ ORAL$_2$ $\rightarrow$ COMP$_2$). We are able to perform this calculation because oral reading at time two is a function of oral reading at time one. To calculate the indirect effect of oral reading on comprehension, we multiply the coefficients for these paths (ORAL$_1$ $\rightarrow$ ORAL$_2$ $\rightarrow$ COMP$_2$). As a result, the indirect effect of

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oral reading on comprehension is 0.818 * 0.122 = 0.0998. We calculate the total effect of oral reading on comprehension to be 0.576 + 0.0998 = 0.676.

Additionally, observe the difference in coefficients for the effects of oral reading at times one ($ORAL_1$ → $COMP_2$, *coef.* = 0.576, $p < 0.001$) and two ($ORAL_2$ → $COMP_2$, *coef.* = 0.122, $p < 0.05$), respectively, on comprehension in the final time period. These results suggest that students' oral reading at the *beginning* of the school year is a better predictor of comprehension at the end of third grade than students' oral reading skills in the final period. Not only are lower-level, oral reading skills at the beginning of the year good indicators of current comprehension ($ORAL_1$ ←→ $COMP_1$, *cov.* = 0.609, $p < 0.001$), but the adequacy of these skills is also a strong predictor of future comprehension ($ORAL_1$ → $COMP_2$, *coef.* = 0.576, $p < 0.001$).

However, many of the effects that we observe with respect to oral reading cannot be applied to silent reading skills among third grade students. In Figure 2, we observe a negative direct effect ($SLNT_1$ → $COMP_2$, *coef.* = -0.192, $p < 0.001$) and zero indirect effects of silent reading on reading comprehension in the final period. Similarly, we observe that oral reading at time two contributes significantly to comprehension in the final time period ($ORAL_2$ → $COMP_2$, *coef.* = 0.122; $p < 0.05$), whereas there are zero contemporaneous effects for silent reading ($SLNT_2$). Each of these results reinforce the finding that oral reading is a strong correlate of *contemporaneous* comprehension as well as strong predictor of *future* reading comprehension; we cannot draw similar conclusions with respect to silent reading from within our third-grade sample.

The structural equation model for grade three (Figure 2) also suggests important inferences regarding the relationships between higher and lower order skills sets. Observe that there is a clear bottom-up, forward relationship between oral reading at time one and comprehension at time two ($ORAL_1$ → $COMP_2$, *coef.* = 0.576, $p < 0.001$). This suggests bottom-up processes at work. In other words, lower-level skills affect higher order skill sets within future time periods. We do not draw similar conclusions regarding top-down processes. Notice in Figure 2, that there are not significant paths stemming from comprehension in time one to lower-level skill sets in time two, i.e., oral or silent readings skills. This suggests that students who may struggle with reading comprehension at the beginning of the school year are not being comparatively 'held-back' or disadvantaged by poor mastery. Poor comprehension skills at time one do not hamper the acquisition of lower-level skill sets throughout the year.

We compare and contrast the results for reading comprehension measures of third grades learners with students in grade five (Figure 3, statistically significant paths only). Fit statistics demonstrate that this is an appropriate structural equation model for the fifth grade data. The chi-squared value is statistically insignificant (χ^2 value = 2.944, p-value 0.2294, 2 degrees of freedom), which is appropriate for a correctly specified model. In addition, the comparative fit index (CFI = 0.999) is greater than 0.95. Finally, the standardized root mean square residual (SRMR 0.016) is less than 0.08. Similar to our depiction of third grade students, the model associated with fifth graders learners is internally valid.

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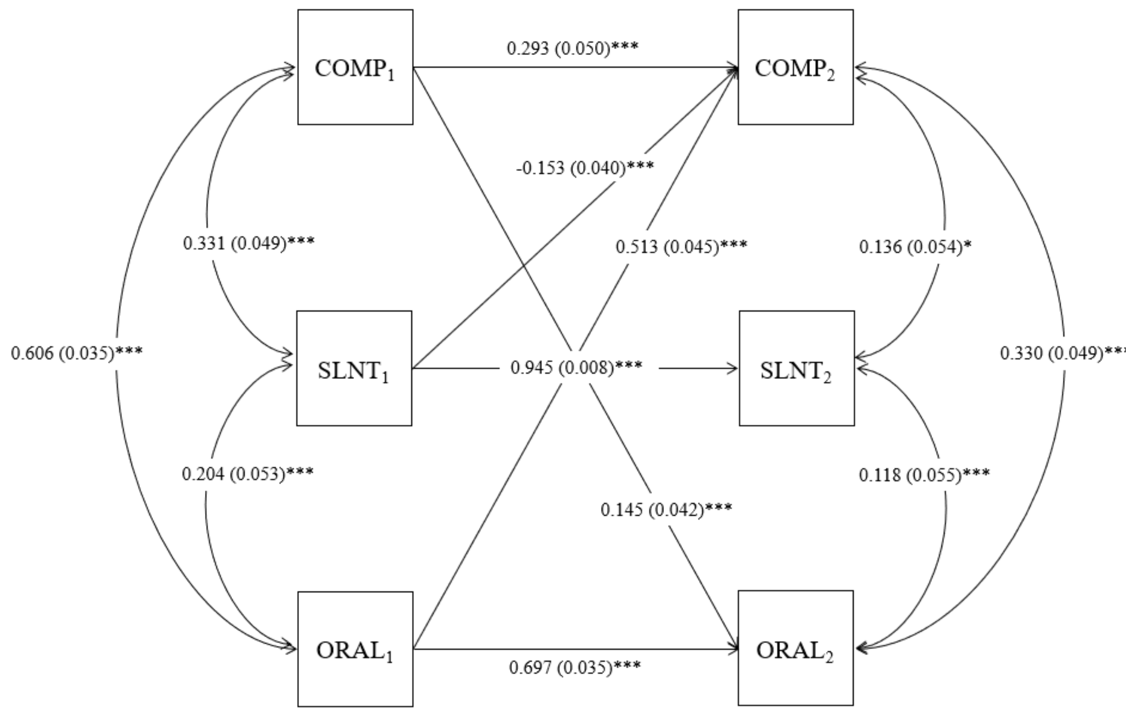

Figure 3. Grade 5 structural equation model[†].

Note: [†]Significant pathways only.
Statistical significance: *** p-value < 0.001, ** p-value < 0.01, * p-value < 0.05.

The structural equation model permits us to create numerous relationships within and across the contemporaneous and lagged values of the higher order (*reading comprehension*: $COMP_1$, $COMP_2$) and lower order (*oral reading*: $ORAL_1$, $ORAL_2$, *silent reading*: $SLNT_1$ and $SLNT_2$) variables. Because our data are standardized, we are able to compare and contrast the size of the model coefficients for each pathway (Figure 2). Here, we observe relationships that are consistent with the third grade data. Comprehension among fifth grade students in the first period covaries significantly with oral reading ($ORAL_1 \leftrightarrow COMP_1$, *covariance* = 0.606, p-value < 0.001), whereas the covariance with silent reading is not as strong ($SLNT_1 \leftrightarrow COMP_1$, *cov.* = 0.331, p < 0.001). This suggests that the variance in comprehension at the beginning of grade five is more closely related to students' oral reading skills at that time; this result parallels our observations for grade three.

We also observe that each variable in time two is a function of its own lagged value. For instance, silent reading at the end of the year is related to its lagged value (e.g., $SLNT_1 \rightarrow SLNT_2$, *coefficient* = 0.945, p < 0.05). If we compare the influence of the lagged variables on each variable in the final period, we observe that both lower levels skills, oral and silent reading, are closely related to their lagged priors; however, the relationship between comprehension at multiple periods is not as great. As demonstrated in Figure 3, oral reading during time one explains a large part of the oral reading skills at time two ($ORAL_1 \rightarrow ORAL_2$, *coef.* = 0.697, p-value < 0.001). Similar correlations exist between silent reading at times one and two ($SLNT_1 \rightarrow SLNT_2$, *coef.* = 0.945, p < 0.001). This finding is consistent with our theoretical understanding of higher order and lower levels skill sets. It follows intuitively that lower levels skills, such as oral or silent reading, would be closely correlated over time. In contrast, we observe that comprehension is much more complex; comprehension at the end of the year is less closely related to its lagged value ($COMP_1 \rightarrow COMP_2$, *coef.* = 0.293, p < 0.001) than similar relations within subtests. These relationships closely parallel relations across similar time periods within the grade three data.

Most notably, the standardized coefficients in this model permit us to analyze the relative contribution of each subtest at the beginning of the school year ($ORAL_1$, $SLNT_1$) to comprehension in the final time period ($COMP_2$) within grade five. Here, the data suggests that oral reading at the beginning of the year contributes positively and significantly to comprehension in the final time period ($ORAL_1 \rightarrow COMP_2$, *coef.* = 0.513, p < 0.001). This is its direct effect. We can also calculate the indirect effect of the oral reading subtest by

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analyzing the coefficients associated with the indirect paths that incorporate oral reading at time two ($ORAL_1$ → $ORAL_2$ → $COMP_2$). We are able to perform this calculation because oral reading at time two is a function of oral reading at time one. To calculate the indirect effect of oral reading on comprehension, we multiply the coefficients for these paths ($ORAL_1$ → $ORAL_2$ → $COMP_2$). As a result, the indirect effect of oral reading on comprehension is 0.697 * 0.330 = 0.23001. We calculate the total effect of oral reading on comprehension to be 0.513 + 0.23 = 0.74301. Notice that there are several similarities and differences here, in comparison with the grade three learners. First, observe the difference in coefficients for the effects of oral reading at times one ($ORAL_1$ → $COMP_2$, *coef.* = 0.513, $p < 0.001$) and two ($ORAL_2$ → $COMP_2$, *coef.* = 0.330, $p < 0.05$), respectively, on comprehension in the final time period. These results suggest that students' oral reading at the *beginning* of the school year is a better predictor of comprehension at the end of third grade than students' oral reading skills in the final period. Not only are lower-level, oral reading skills at the beginning of the year good indicators of current comprehension ($ORAL_1$ ←→ $COMP_1$, *cov.* = 0.606, $p < 0.001$), but the adequacy of these skills is also a strong predictor of future comprehension ($ORAL_1$ → $COMP_2$, *coef.* = 0.513, $p < 0.001$). Second, we employ these coefficients to contrast the findings across the two grade levels. Comprehension at the end of the school year is more closely correlated with oral reading skills during fifth grade (coefficient = 0.743) than similar skill sets at the third grade level (coefficient = 0.676). In addition, the indirect effect of oral reading at the end of the year is almost twice the size of the impact of oral reading skills at the end of the third-grade year. Oral reading skills contribute larger impacts on comprehension for fifth grade students than third grade students.

However – similar to the results among the third grade sample -- many of the effects that we observe with respect to oral reading cannot be applied to silent reading skills within fifth grade students. In Figure 3, we observe a negative direct effect ($SLNT_1$ → $COMP_2$, *coef.* = -0.153, $p < 0.001$) and positive indirect effect ($SLNT_2$ → $COMP_2$, *coef.* = 0.136, $p < 0.1$) of silent reading on reading comprehension in the final period. Combining these two effects, we observe a total effect of silent reading on end-of-year comprehension ($SLNT_1$ + $SLNT_2$→ $COMP_2$) to be [-0.153 + (0.945*0.136)] = -0.02448. This suggests that there is a small, negative correlation between silent reading and end-of-year comprehension. We argue that this finding many be an artifact of the data generation process.1 Alternatively, the inclusion of oral reading skills may create a negative interaction effect with silent reading. Regardless, we leave this leave a full explanation of this counter-intuitive results for future research.

In contrast with the third-grade data, we observe that both end-of-year oral and silent reading skills contributes significantly to comprehension in the final time period ($ORAL_2$ → $COMP_2$, *coef.* = 0.330; $p < 0.05$; $SLNT_2$ → $COMP_2$, *coef.* = 0.136; $p < 0.05$). These results reinforce the finding that both skills are strong correlates of *contemporaneous* comprehension as well as *future* reading comprehension within the fifth-grade sample; yet the size of the coefficients suggest that oral reading is much more impactful for comprehension than silent reading at the end of the fifth grade year.

The structural equation model for grade five (Figure 3) also suggests important inferences regarding the relationships between higher and lower order skills sets. Observe that in Figure 3 there is a clear bottom-up, forward relationship between oral reading at time one and comprehension at time two ($ORAL_1$ → $COMP_2$, *coef.* = 0.513, $p < 0.001$). This suggests bottom-up processes at work. In other words, lower-level skills affect higher order skill sets within future time periods. However, unlike the results regarding third grade students, the fifth-grade data also alludes to top-down processes. Notice in Figure 3, that there is a significant correlation between comprehension at time one and oral reading at time two ($COMP_1$ → $ORAL_2$, *coef.* = 0.145, $p < 0.001$. This suggests the effects of poor reading comprehension at the beginning of the fifth school year do have future consequences in terms of lower-level skills refinement later in the year. This contrasts sharply with the data for grade three. Among grade three learners we did ot observe top-down processes at work. However, this relationship changes by the fifth grade. Here, we find that comprehension skills at the beginning of the year do create an impact on future foundational skill sets. In other words, poor comprehension at the beginning of third grade does not limit students' basic skills acquisition. By fifth grade,

1 Prior to structural equation modeling, we stripped out all of the variation in the data due to curriculum, gender, and socioeconomics; this *pre-whitening* technique may contribute to the inconsistent finding.

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however, poor comprehension may also have secondary effects in terms of limiting the improvement of foundational reading skills.

4. Discussion

Our statistical results represent noteworthy implications. In this environment, we know that Indian learners first begin to learn English through choral reading, an important strategy to build oral reading fluency. Within our sample of students across both grade levels, we observe that the ability to connect the spelling of a word with its pronunciation at the word-level incorporates students' prior comprehension of spoken words. Thus, in contrast with silent reading, proficiency on tests of oral reading fluency demonstrate a student's ability to connect written words with comprehension of orally spoken words. It follows that proficiency with this skill set would be inherently tied to the process of comprehension at the sentence and passage level.

Silent reading fluency does not rely on oral elements of pronunciation. Thus, a student may be proficient at recognizing written words, yet she may fail to connect the information presented in writing with her pre-existing comprehension of spoken words. In sum, tests of *oral* reading fluency would seem to assess the question of whether students are able to connect written words with their pre-existing oral comprehension—this connection is not explicitly assessed within tests of *silent* reading fluency. It follows, therefore, that overall reading comprehension rests, in part, on the student's ability to connect written words with her pre-existing comprehension of orally spoken words. Thus, we would anticipate that oral reading skills would be more closely linked with comprehension; this is precisely what we observe.

In sum, analysis of the two grade levels provides a more complete picture of the ways in which Indian students develop reading comprehension. As predicted, we find that oral reading fluency is a better predictor of higher-level skills; this result is robust across the two grade levels. This would suggest that use of the ORF subtest as a diagnostic tool for *future* reading comprehension is not conditional upon *prior* comprehension levels. In other words, our research reinforces the general utility of the ORF subtest as a diagnostic tool across a range of grade levels and competencies.

5. Implications for Research and Practice

The analysis of the two grade levels provided a more complete picture of the ways in which Indian students developed reading comprehension. We found that oral reading fluency was a better predictor of reading comprehension; this result is robust across the two grade levels. Firstly, for students in the Indian context, the focus of reading instruction is on the alphabet-spelling method which bypasses letter sounds and focusses on sight word recognition. Many sight-word recognition tasks call upon the reader to rote memorize words and automatize their recall of words. It also calls upon the reader to orally read a list of words and commit the words to memory. This might be one reason why we would expect oral reading to be more predictive of comprehension than silent reading in this context. Secondly, this finding provides evidence for the role of oral reading fluency as an important predictor of comprehension for students who are learning English as a second language. Though multiple studies have established the role of ORF in monolingual readers, there is limited research to suggest the same is true for L2 readers, and this study aims at providing more evidence for the same. This finding has implications for assessment and intervention practices within this context and can inform teachers and researchers on the trajectory of reading acquisition for L2 readers in the Indian context.

6. Limitations and Future Directions

We chose the DIBELS and easyCBM progress-monitoring tools as a first step by looking at approaches widely used in the US. This study attempted to extend their use and observe their efficacy in Indian schools, but we do not know if they are the most optimal tools for this context or whether other approaches might be better. Therefore, the results of the study need to be viewed within the parameters of this limitation. A future direction would be to compare and contrast various assessment tools within this multilingual context and determine the optimal tool that meets the needs of Indian students. The field of assessment is still nascent in the Indian context. As a result, developing norms for oral language screeners, reading screeners and diagnostic assessment tools in this context are of paramount importance as a future research direction.

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