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Effects of Curriculum, Socioeconomic Status and Gender on L2 English Reading Acquisition for Students in Grade 1

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Abstract

This longitudinal study was targeted at (a) measuring L2 English reading acquisition across the school year using progress-monitoring tools and; (b) describing the effects of independent variables on the reading growth trajectory for students across first grade. Participants included 368 students in Grade 1 (ages 6-7 years), representing low-cost, middle-cost and high-cost schools in Bangalore, India. We utilized a mixed-effects hierarchical growth model to observe growth in their reading abilities. The results suggested that curriculum had the most significant and positive effect on skills acquisition, irrespective of gender or socio-economic status. These results will shed light on the linguistic context of learning English as a second language; reading assessment and intervention practices in the Indian context; and the implications on students from low-cost schools who do not have access to adequate reading assessment and instruction.

Keywords

English as a second language, reading assessment, reading acquisition, hierarchical growth model, Indian context, access to curriculum

1. Introduction

English and Hindi are the two official languages of India, but English is used as the link language for most people who speak different state languages (National Council of Educational Research and Training, 2011). It is the primary language of business and is viewed as the language for economic and social mobility (Ramanathan & Bruning, 2003). Currently, an estimated 90 million children in India are formally schooled in English, an alphabetic language (Kalia, 2007). However, "English and the privileges associated with it remain inaccessible to those who are from a lower SES in India, with the Indian middle-class assuming a position of power through its access to English" (Ramanathan & Atkinson, p. 212).

In India, schools typically follow a three-language formula (Aggarwal, 1991) that is ratified by the National Curriculum Framework 2005 (Ramachandran et al., 2005). The first language is the language of instruction (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 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. Typically, a child in India learns at least four languages from ages 0-13 years: a home language (L1), the language of instruction (L2), the official language that is not the language of instruction (L3), and the state language (L4). "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). Over 50% of children (27 million) in urban centers attend private schools (Annual Status of Education Report, 2016), which follow a state, national or international standardized curriculum and use English as the language of instruction (Kurrien, 2005). Government schools, however, follow a state-level curriculum and the language of instruction is the State language. In schools where English is the language of instruction, a student receives six hours of instruction in English per school day, and one hour of instruction in Hindi and/or the state language. By middle or high school, many students are proficient in all domains of speaking, listening, reading and writing in English and consider it their dominant language since they have been exposed to it more than the other languages, and it is pervasive across academic content areas. Therefore, our study focused on measuring students' L2 English reading skills because for our sample of students in Bangalore, it was the language of instruction and their access to literacy.

1.1 Role of Curriculum on Reading

In early elementary grades, it is important to teach foundational reading skills such as phonological awareness, phonics and fluent word recognition (Adams, 1990; Gersten et al., 2008; Foorman et al., 2016; Snow, Burns, & Griffin, 1998) to enhance students' comprehension of text in later grades. The most popular method for implementing reading instruction in English-speaking countries is systematic phonics. It stresses the acquisition of letter-sound correspondences to learn new, unfamiliar words. In India on the other hand, 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 words, bypassing the sound structure of the language, and are taught 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.

Systematic, synthetic phonics programs have been effective for monolingual speakers of English (Ehri et al., 2001, Johnston & Watson, 2005) and bilingual speakers for whom English is a second language (Stuart, 1999; Stuart, 2004). In the Indian context, students come from different home language backgrounds and this latter finding is relevant to these students. Moreover, most children are exposed to their native language at home, and if their parents speak different languages, then they may be exposed to two languages before starting school (Mishra & Stainthorp, 2007). In 2011, Dixon et al. introduced phonics-based instruction in low-income private schools in Hyderabad, India, where English was the medium of instruction. They had a control group of students who received traditional English instruction involving rote learning and whole word recognition, and the experimental group of students who received phonics-based instruction. Their findings showed a statistically significant difference between the experimental and control groups, with the experimental group performing better on measures of reading, spelling and sounding out letters and words (Dixon et al., 2011). Gupta (2014) reported similar findings for students attending rural schools in India. These students do not have English language support and are at a higher risk for reading difficulties before entering school but phonics programs have improved student outcomes (Nag, 2013).

1.2 Role of Socioeconomic Status and Gender on Reading

Studies on monolingual speakers of English have proved that language is greatly affected by differences in parental socioeconomic status (Hart & Risley, 1995; Noble et al., 2007), but we have little understanding of how this might apply across languages and cultures. A study using the Program for International Student Assessment (PISA, 2009) data found that gender and socio-economic status were statistically significant predictors of reading outcomes with socioeconomic status being the strongest predictor (Neff, 2015). Another study found that low-SES accounted for faster rates of reading growth for K-3 students and slower rates of reading growth for students in Grades 3-8 (Kieffer, 2011). A study conducted in China concluded that low SES was a contributing factor in phonological and vocabulary abilities in English in elementary school (Zhang et al., 2012). Chiu and Mc-Bride Chang (2006) tested reading comprehension in students in Grade 9 in 43 countries and found that in every country, girls outscored boys and reading enjoyment mediated 42% of the gender effect. They also found that family SES, number of books at home, and reading enjoyment all positively correlated with individual reading achievement.

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, using their rote-memorization skills (Ramanathan, 2008). Questions are extensively covered in class, and 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.

We adapted progress-monitoring tools used in the US 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 that measured content area skills; (b) Our sample of students was bilingual, but not bi-literate; they were only literate in English, not in their native languages; (c) Even though they spoke different languages at home, English was their link language in the classroom, and they used it to communicate with teachers and peers.

Thus, the purpose of our study was to measure L2 English reading skills. We investigated these research questions:

1) What is the growth trajectory in L2 English reading skills for individual Grade 1 students in Bangalore, India?
2) Do variables such as gender, SES and curriculum predict reading scores for students in the sample?

2. Method

2.1 Participants

The sample included 368 students in Grade 1 (ages 6-7 years). Students in our sample spoke different home languages and were instructed in English in school. Demographic data and home languages of students in our sample are presented in Tables 1 and 2 respectively.

Table 1. Demographic Data for the Students in the Sample

			Frequency	Percentage
Individual Characteristics	Gender	Male	171	49.42
		Female	175	50.58
	SES	Low-Income	46	13.29
		Middle-Income	175	50.58
		High-Income	125	36.13
School Characteristics	School Type	Low-Cost 1	37	10.69
		Low-Cost 2	9	2.6
		Middle-Cost 1	74	21.39
		Middle Cost 2	101	29.19
		High Cost 1	107	30.92
		High Cost 2	18	5.2
	Curriculum	State	46	13.29
		National	282	81.5
		Montessori	18	5.2

Table 2. Home Language (L1) Data for Students in the Sample

Names of Languages	Frequency	Percentage
Kannada	75	21.68
Hindi	55	15.89
Telugu	48	13.87
Bengali	36	10.40
Tamil	32	9.25
Urdu	29	8.38
Malayalam	25	7.23
Gujarati	25	7.23
Marathi	21	6.07
Kodava	0	0
Konkani	0	0
Tulu	0	0

2.2 School Setting

Our six school sites were located in an urban city center, Bangalore. Two schools were low-cost, two were middle-cost and two were high-cost schools. Table 1 presents the school characteristics. For the purposes of this study, a low-cost school was defined as a private school in Bangalore, India where the annual tuition costs per student was approximately Rupees 7,200 ($120); the middle-cost school was a private school where the annual tuition costs per student was approximately Rupees 40,000 ($667); and the high-cost school was a private school where the annual tuition costs per student was approximately Rupees 150,000 ($2,500). Moreover, low-income household was defined as families whose monthly income was between Rupees 0-20,000 ($0-275), middle-income household was defined as families whose monthly income was between Rupees 21,000-70,000 ($285-956) and high-income household was defined as families whose monthly income exceeded Rupees 71,000 (above $1,000).

The low-cost schools followed a State board curriculum that is prescribed by the state of Karnataka; the 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 National board curriculum is more rigorous, preparing students to find national and international jobs. The State board curriculum is less rigorous, intending for students to find jobs only within the state of Karnataka.

All schools in our sample introduced English in kindergarten and provided instruction in English in all content areas throughout the day. The language proficiency of teachers varied considerably with teachers from the State board schools being less fluent in English compared to teachers from the National board and Montessori schools. One low-cost school followed the alphabet-spelling method for 100% of their reading instruction, one low-cost school, two middle-cost schools and one high-cost school followed a combination of alphabet-spelling and phonics-based instruction; and the Montessori school followed a 100% phonics-based approach.

2.3 Measures

Three progress-monitoring tools, namely the Dynamic Indicators of Basic Early Literacy Skills-Next Edition (DIBELSNext, Good, Kaminski, & Cummings, 2011), Easy Curriculum Based Measures (easyCBM, Anderson et al., 2014) and Test of Silent Reading Efficiency and Comprehension (TOSREC, Author, 2010) were adapted for use in the Indian context.

For consistency, we maintained the content and administration procedures used 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 common names within the Indian context (e.g. "Asha" replaced "Abby") and some words were changed to reflect common usage in the culture (e.g. "skipping rope" replaced "jump rope"), but the essence of the passages in terms of comprehension was unchanged.

We administered the following subtests for 1 minute each and students earned 1 point for each correctly identified reading sub-skill:

2.3.1 DIBELS Next Subtests

1) Letter Naming Fluency: student's ability to name uppercase and lowercase letters;
2) Phoneme Segmenting Fluency: student's ability to break up a word into sound segments;
3) Nonsense Word Fluency: student's knowledge of letter-sound correspondences, and their ability to process CVC combinations that were non-words (e.g. /v/ /o/ /l/);
4) Oral Reading Fluency: the ability to accurately read an unknown passage; and
5) Retell Fluency: After the ORF subtest, students were immediately asked to recall and retell that story.

2.3.2 Easy CBM Subtests

The Letter Names, Phoneme Segmenting and Passage Reading Fluency subtests were equivalent versions of the Letter Naming Fluency, Phoneme Segmentation Fluency and Oral Reading Fluency subtests on the DIBELSNext respectively. In addition, the following subtests that were specific to the easyCBM were administered:

1) Letter Sounds: Uppercase and lowercase letters were presented to students and they were asked to produce as many letter sounds as possible.
2) Word Reading Fluency: A list of words was presented to students and they read as many words as possible.

2.3.3 TOSREC

The TOSREC was an additional comprehension measure. 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 written in American English were changed to Indian English so that students would comprehend them in this context (e.g. "cookies" was changed to "biscuits"). The meaning of the text was retained in all instances.

2.3.4 Student Oral Language Observation Matrix

Because students in our sample spoke different home languages and English was their language of instruction in school, we used an English language proficiency rating scale to understand how their proficiency in English would impact their reading scores. The SOLOM is an informal rating scale developed by Collier (2008) for teachers to rate Limited English Proficient students in their classrooms. For our study, researchers in the field observed students in classrooms and while they were being individually assessed, and rated them on five areas: Comprehension, Fluency, Vocabulary, Pronunciation and Grammar. This was then converted into a composite score that classified students by language proficiency in English: pre-production, early production, speech emergence, intermediate fluency, advanced fluency.

2.3.5 Reliability and Validity of the Measures

The internal consistency of the measures were tested using Cronbach's alpha to derive a reliability coefficient for all the subtests on the DIBELSNext and easyCBM as well as the TOSREC. The combined scale reliability coefficient for Grade 1 was 0.91, indicating a strong internal consistency on all the items of the tests.

We utilized the DIBELSNext and easyCBM to establish concurrent validity, and found strong correlations between equivalent subtests on the two measures. For Grade 1, the correlation between phoneme segmenting (easyCBM) and phoneme segmenting fluency (DIBELSNext) was 0.87; the correlation between passage reading fluency (easyCBM) and oral reading fluency (DIBELSNext) was 0.97 and the correlation between letter names (easyCBM) and letter naming fluency (DIBELSNext) was 0.82. This indicated a strong concurrent validity between equivalent measures.

Moreover, this study had strong construct validity because it was based on critical theoretical underpinnings that guide the field of reading in relation to best practices for utilizing these specific progress-monitoring tools. DIBELSNext is a widely used tool to measure reading and literacy skills in the 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), to promote progress-monitoring and universal screening in schools (Deno, 2003; Keller-Margulis et al., 2008).

Our rationale for utilizing both the DIBELS Next and easyCBM measures was to capture a wide variety of subtests that measured reading in Grade 1, and to observe their validity as assessments of L2 English reading development within the Indian context. We were also interested in assessing which set of subtests were easier for teachers in our sample to access, administer and score within this context. The TOSREC is a widely used progress-monitoring tool to assess reading comprehension. Our choice of the TOSREC (Author, 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. We found that out of all the fluency and comprehension measures, the TOSREC represented a somewhat culture-free test, because of the generic true/false statements, rather than a passage or story with many more cultural references. It seemed to be a preferred test for this context and captured comprehension at a sentence level. Our rationale for using these measures in the Indian context was further confirmed because of the strong internal consistency and concurrent validity that we established.

2.4 Procedure

The principals of the six schools signed a letter that confirmed their school's participation and parents signed an informed consent form that confirmed their child's participation in the study. A data collection schedule was developed for each of the participating schools based on the convenience of the school and students, aligned as best as possible to the terminal tests/exams conducted during the year. Data was collected using a team of 15 volunteer assessors, who underwent rigorous training on test administration and scoring at the start of the study, and refresher training before each subsequent data collection period.

Data collection for each time period ranged roughly between 3 weeks to one month. Efforts were made to ensure very minimal amounts of missing data (from students absent from school on the day(s) data was collected) from each time period, with assessors revisiting schools to assess absentees. The reading measures were administered across three phases during the 2017-18 academic year: 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. Each test was individually administered with care taken to ensure the students were given adequate breaks to prevent fatigue.

2.5 Data Analyses

We ran our analyses in Stata Version 14. We utilized a separate mixed-effects hierachical linear regression for each of the reading competency measures. This method capitalizes on higher-level grouping structures within the data (Gelman, 2006; Greene, 2003; Rabe-Hesketh & Skrondal, 2008). Each level represents a nesting structure which is modeled as a separate statistical object, assuming that groups of data—such as students grouped into classrooms—violate observational independence assumptions of the classical regression model (Levy, 2012). Thus, the hierarchical nature of the model separates out variation occurring at the individual level from variation occurring at the classroom or school level. Each model is designated mixed effects because it represented a combination of fixed (data at every level is pooled together) and random (whether individual differences contributed to both the slope and the intercept of the regression line) effects. We tested for the significance of variation within and between every level of the hierarchy and the significance of random effects at each level of the hierarchy. For the final version of the model, we only included statistically significant effects.

The interpretation for the fixed effects (month, month squared, gender SES, curriculum) in the models below are very similar to a traditional ordinary least squares regression model. The random effect is the coefficient for the variance associated with each level and they are stochastic in that these measures can vary over time. Diagnostic testing demonstrated that classroom level nesting did not contribute significantly to the hierarchical structure of the model. We therefore included nesting only at the individual and school levels in the final model. These nesting structures, consisting of (1) occasions, (2) individuals, and (3) schools created a three-level hierarchical model. Additionally, the hierarchical model contained a separate intercept coefficient for each of the three levels.

In addition to the hierarchical nature of the data, we also captured the role of student learning over time. This type of modeling is known as a *growth curve*, and these parametric growth curves may be linear or curvilinear. In this case, we have panels of three observations available for each student and we found, more generally, that student learning followed a curvilinear path. We operationalized the curvilinear path using a quadratic term for time and this term was generally statistically significant. We pooled these three observations into a cross-sectional panel, and tested ways that each observational time period is correlated both within and across students. Thus, our hierarchical growth curve model provides two distinct advantages over a simple linear regression. Firstly, it permitted us to incorporate the leveled nesting structure in the data; i.e. the importance of individual and school-level differences. Secondly, we could capture the change in student reading skills over time. It is the combination of these two processes—hierarchical structure and temporal change—that permitted us to create the most accurate description of true patterns in our data.

3. Results

3.1 Individual-Level Growth

Table 1 and 2 provide the demographics and the home languages of students in our sample respectively. We had an almost equal representation of boys and girls; a larger number of students from middle-high income backgrounds; and a majority of students who attended schools following the National-board curriculum. A majority of students in our sample spoke Kannada at home, followed by Hindi and Telugu.

Table 3 presents Pearson's r correlation coefficients for each of the subtests. The TOSREC is highly correlated with subtests that focus on reading fluency such as Passage Reading Fluency (PRF) ($r = 0.8688$), Word Reading Fluency (WRF) ($r = 0.8674$), Oral Reading Fluency (ORF) ($r = 0.8539$), and Nonsense Word Fluency-Words Read Correctly (NWF-WRC) ($r = 0.7067$). Moreover, similar tests are correlated across the easyCBM and DIBELSNex, such as: (a) Passage Reading Fluency and Oral Reading Fluency ($r = 0.9419$); (b) Letter Names and Letter Naming Fluency ($r = 0.8072$); and (c) Phoneme Segmentation and Phoneme Segmentation Fluency ($r = 0.8593$). Both these observations suggest that the separate reading assessments are reliable and consistent with one another.

Table 4 depicted that at the beginning of the school year, the participants' mean score on the TOSREC was 4.89 (SD=7.06), and by the end of the school year, it increased to 9.66 (SD=8.31). On the easyCBM, the mean composite score on all subtests during phase 1 was 22.12, which increased to 36.33 in phase 3. On the Letter Names subtest, students' average scores increased from 48.17 (SD=15.62) in the first phase to 63.49 (SD=18.46) at the end of the school year. On the Word Reading Fluency (WRF) test the students' means increased from 14.31 (SD=15.53) in phase 1 to 30.83 (SD=24.26) in phase 3. Finally, on the DIBELSNext, the mean composite score on all subtests during phase 1 was 17.21, which increased to 27.24 in phase 3. Of particular interest were scores on the Letter Naming Fluency (LNF) subtest which increased from 47 (SD=17.78) to 61.88 (SD=19.32), as this reading sub-skill was specifically taught across all schools.

Table 3. Correlation Matrix of Reading Subtests

	TOSREC	LN	LS	PS	WRF	PRF	LNF	PSF	NWF-letter sounds	NWF-words	ORF	RTF
TOSREC	1											
LN	0.52	1										
LS	0.54	0.56	1									
PS	0.41	0.34	0.69	1								
WRF	0.86*	0.60	0.62	0.46	1							
PRF	0.85*	0.50	0.52	0.38	0.91*	1						
LNF	0.52	0.82*	0.53	0.38	0.62	0.50	1					
PSF	0.45	0.32	0.68	0.87*	0.50	0.41	0.36	1				
NWF-letters	0.15	0.23	0.52	0.47	0.23	0.11	0.26	0.47	1			
NWF-words	0.75*	0.52	0.68	0.58	0.79*	0.76*	0.53	0.59	0.31	1		
ORF	0.85*	0.52	0.54	0.41	0.93*	0.97*	0.53	0.44	0.12	0.77*	1	
RTF	0.58	0.30	0.44	0.31	0.56	0.61	0.33	0.29	-0.01	0.64	0.62	1

Key: Test of Silent Reading Efficiency and Comprehension (TOSREC); Letter Names (LN); Letter Sounds (LS); Phoneme Segmentation (PS); Word Reading Fluency (WRF); Passage Reading Fluency (PRF); Letter Naming Fluency (LNF); Phoneme Segmentation Fluency (PSF), Nonsense Word Fluency-Letter Sounds (NWF-CLS); Nonsense Word Fluency-Words Read Correctly (NWF-WRC); Oral Reading Fluency (ORF); Retell Fluency (RTF)
*$p<0.05$

Table 4. Summary Statistics for Reading Subtests

		Month Zero; N= 346		Month Three; N= 368		Month Six; N=364	
		Mean (SD)	**Min Max**	**Mean (SD)**	**Min Max**	**Mean (SD)**	**Min Max**
TOSREC		4.89	0	6.89	0	9.67	0
		(7.06)	40	(7.83)	49	(8.31)	41
EasyCBM	LN	48.18	7	58.61	0	63.50	19
		(15.63)	90	(19.50)	100	(18.46)	100
	LS	20.64	0	30.09	0	31.09	0
		(14.56)	63	(17.77)	99	(18.21)	90
	PS	14.72	0	22.71	0	23.62	0
		(12.01)	51	(16.12)	73	(16.88)	68
	WRF	14.31	0	23.50	0	30.83	0
		(15.53)	118	(21.13)	120	(24.26)	109
	PRF	12.72	0	23.83	0	34.27	0
		(23.35)	185	(26.87)	162	(33.73)	254
DIBELS	LNF	47.00	3	56.48	0	61.88	1
		(17.79)	96	(20.60)	110	(19.32)	110
	PSF	18.11	0	24.42	0	27.80	0
		(16.13)	80	(18.42)	80	(19.08)	80
	NWF-CLS	15.46	0	28.17	0	26.83	0
		(16.64)	143	(25.21)	141	(22.18)	100
	NWF-WWR	7.28	0	10.17	0	11.88	0
		(9.24)	50	(10.83)	50	(11.54)	50
	ORF	13.52	0	25.70	0	32.70	0
		(20.49)	192	(31.51)	207	(33.93)	250
	RTF	1.89	0	3.10	0	3.59	0
		(4.47)	36	(6.20)	48	(5.64)	35

Key: Test of Silent Reading Efficiency and Comprehension (TOSREC); Letter Names (LN); Letter Sounds (LS); Phoneme Segmentation (PS); Word Reading Fluency (WRF); Passage Reading Fluency (PRF); Letter Naming Fluency (LNF); Phoneme Segmentation Fluency (PSF), Nonsense Word Fluency-Letter Sounds (NWF-CLS); Nonsense Word Fluency-Words Read Correctly (NWF-WRC); Oral Reading Fluency (ORF); Retell Fluency (RTF)

Tables 5 and 6 present the hierarchical mixed effects model of students' scores on the TOSREC, easyCBM and DIBELSNext measures. For the TOSREC, the growth trajectory of scores appears to be approximately linear, and a substantial variation across individuals was recorded at baseline, i.e. the coefficient for individual intercepts is statistically significant in every model ($p < 0.001$). On the DIBELSNext measure, the trajectory of scores on the Phoneme Segmentation Fluency (PSF), Nonsense Word Fluency-Words Read Correctly (NWFWWR) and Reading Fluency (RF) subtests appeared to be approximately linear because the coefficient for the quadratic term (*monthsquared*) is not statistically significant. In contrast, however, the quadratic term *is* statistically significant for the Letter Naming Fluency (LNF) ($p < 0.001$), Nonsense Word Fluency—Correct Letter Sounds (NWFCLS) ($p < 0.001$), and Oral Reading Fluency (ORF) ($p < 0.05$) subtests. This latter finding was similar for all the subtests on the easyCBM measure depicting that the student scores increased at a decreasing rate over time. This represents a classical sigmoid shape (S-shape) with an increasing slope from month zero to month three followed by "flattening" or less steep slope from month three to month six.

Table 5. Hierarchical Mixed-Effects Linear Growth Model for TOSREC and easyCBM Subtests

	(1) TOSREC	(2) LN	(3) LS	(4) PS	(5) WRF	(6) PRF
Fixed Effects						
Month	0.0378	4.222***	4.175***	3.072***	1.532***	1.456*
	(0.207)	(0.620)	(0.485)	(0.528)	(0.435)	(0.647)
Month Squared	0.0487*	-0.314***	-0.474***	-0.400***	-0.0904*	-0.0277
	(0.0240)	(0.0789)	(0.0593)	(0.0639)	(0.0400)	(0.0687)
Female Gender	0.261	2.335	3.312*	1.976	1.267	0.604
	(0.600)	(1.450)	(1.325)	(1.109)	(1.484)	(2.077)
Socioeconomics	0.587	-4.962	-0.844	-2.604	1.395	2.973
	(1.350)	(4.900)	(2.888)	(2.819)	(3.953)	(4.527)
National Cur.	3.391	16.25*	18.06***	15.11**	8.485	5.311
	(2.254)	(7.894)	(4.867)	(4.679)	(6.429)	(7.556)
Montessori Cur.	17.56***	31.71**	33.60***	31.21***	40.82***	53.60***
	(3.399)	(11.73)	(7.366)	(7.031)	(9.591)	(11.40)
National x Time	0.496**	0.132	0.366	0.889*	1.858***	2.381***
	(0.160)	(0.432)	(0.355)	(0.392)	(0.390)	(0.537)
Mont. x Time	0.726**	1.367	1.772**	1.700*	3.252***	5.460***
	(0.280)	(0.757)	(0.622)	(0.686)	(0.685)	(0.942)
Constant	-0.0242	43.71***	4.399	5.413	2.149	-0.707
	(1.817)	(6.200)	(3.940)	(3.746)	(5.100)	(6.096)
Random Effects (SD) School Intercepts						
	-0.0493	1.327**	0.700	0.723	1.072**	1.149*
	(0.442)	(0.420)	(0.816)	(0.439)	(0.389)	(0.451)
(SD) Individual Slopes						
	-0.464***	-0.198	0.0932	0.259*	0.735***	0.929***
	(0.0995)	(0.382)	(0.153)	(0.121)	(0.0523)	(0.0674)
(SD) Individual Intercepts	1.642***	2.486***	2.425***	2.147***	2.590***	2.906***
	(0.0465)	(0.0521)	(0.0485)	(0.0597)	(0.0425)	(0.0444)
(SD) Residual						
	1.207***	2.399***	2.112***	2.187***	1.714***	2.256***
	(0.0364)	(0.0313)	(0.0323)	(0.0318)	(0.0348)	(0.0335)
Observations	1078	1078	1078	1078	1078	1078
AIC	6657.1	8861.5	8447.8	8441.4	8317.4	9174.6
BIC	6721.9	8926.3	8512.6	8506.2	8382.2	9239.4

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Key: Test of Silent Reading Efficiency and Comprehension (TOSREC); Letter Names (LN); Letter Sounds (LS); Phoneme Segmentation (PS); Word Reading Fluency (WRF); Passage Reading Fluency (PRF)

Table 6. Hierarchical Mixed-Effects Linear Growth Model for DIBELSNext Subtests

	(1) LNF	(2) PSF	(3) NWF-CLS	(4) NWF-WWR	(5) ORF	(6) RF
Fixed Effects						
Month	3.624***	2.112***	6.124***	0.502	2.636***	0.327
	(0.588)	(0.601)	(0.909)	(0.350)	(0.679)	(0.217)
Month Squared	-0.228**	-0.171*	-0.782***	-0.0626	-0.273***	-0.0406
	(0.0757)	(0.0743)	(0.115)	(0.0428)	(0.0705)	(0.0279)
Female Gender	2.251	2.646*	5.318***	0.996	0.540	0.146
	(1.610)	(1.343)	(1.587)	(0.811)	(2.065)	(0.360)
Socioeconomics	-5.319	-0.955	-0.589	1.073	2.225	0.374
	(6.916)	(3.660)	(3.003)	(0.921)	(4.659)	(0.410)
National Curr.	15.75	15.49*	18.55***	3.807*	7.707	0.994
	(10.93)	(6.022)	(5.373)	(1.858)	(7.739)	(0.893)
Montessori Curr.	36.02*	38.90***	10.57	21.29***	57.49***	11.49***
	(16.13)	(9.019)	(8.301)	(3.009)	(11.65)	(1.463)
National x Time	0.202	0.594	0.336	0.724**	2.247***	0.201
	(0.402)	(0.434)	(0.636)	(0.257)	(0.572)	(0.149)
Montessori x Time	0.317	0.830	3.476**	0.484	5.355***	0.676**
	(0.704)	(0.761)	(1.115)	(0.449)	(1.003)	(0.261)
Constant	43.90***	4.104	-1.775	0.274	-0.248	-0.405
	(8.472)	(4.796)	(4.459)	(1.634)	(6.224)	(0.794)
Random Effects (SD) School Intercepts						
	1.695***	1.000*	0.674	-23.77	1.190**	-13.73
	(0.376)	(0.433)	(0.548)	(1703.8)	(0.439)	(852.6)
(SD) Individual Slopes						
	-0.760	0.211	0.263	-0.232	1.019***	-1.626*
	(1.100)	(0.166)	(0.288)	(0.143)	(0.0630)	(0.661)
(SD) Individual Intercepts						
	2.639***	2.376***	2.422***	1.886***	2.891***	0.923***
	(0.0462)	(0.0541)	(0.0773)	(0.0539)	(0.0458)	(0.0816)
(SD) Residuals						
	2.357***	2.338***	2.778***	1.788***	2.282***	1.361***
	(0.0323)	(0.0325)	(0.0292)	(0.0318)	(0.0325)	(0.0289)
Observations	1078	1078	1078	1078	1078	1078
AIC	8859.4	8763.5	9468.3	7622.6	9233.2	6339.2
BIC	8924.2	8828.2	9533.1	7687.4	9297.9	6404.0

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Key: Letter Naming Fluency (LNF); Phoneme Segmentation Fluency (PSF), Nonsense Word Fluency-Letter Sounds (NWF-CLS); Nonsense Word Fluency-Words Read Correctly (NWF-WRC); Oral Reading Fluency (ORF); Retell Fluency (RTF)

Moreover, random effects capture variation both *within* and *across* individuals. In general, there is substantial variation across individuals at baseline for all three measures (TOSREC, easyCBM and DIBELSNext), i.e. the coefficient for individual intercepts is statistically significant (p < 0.001). This reinforces the importance of using a hierarchical mixed effects model insofar as there is substantial variation both within and across individuals. Despite the importance of individual variation at baseline, we did not observe consistent conclusions about the role of individual slopes in the growth trajectories for the easyCBM and DIBELSNext subtests. Several of the subtests, such as the Word Reading Fluency

(WRF), Passage Reading Fluency (PRF) and Oral Reading Fluency (ORF), suggested that there was substantial variation in the slope of the growth trajectories *across* individuals ($p < 0.05$), while other tests, such as Letter Names (LN), Letter Sounds (LS), and Phoneme Segmentation (PS), suggest that the slope of the growth trajectory remains the same across individuals.

We also measured the role of several independent variables. We analyzed the effect of one continuous variable: language proficiency scores; and three categorical variables: gender, socioeconomic status, and curriculum. Language proficiency scores obtained from the Student Oral Language Observation Matrix (SOLOM) were regressed with reading subtest scores to determine if they predicted student performance on reading. We found that it was a significant predictor ($R^2 = .12$, $F (12, 333) = 3.89$, $p<.01$), with students who were more proficient in English language skills performing better than students who were not. The most significant differences were observed for subtests of nonsense word fluency and phoneme segmentation. Moreover, neither gender nor SES played a statistically significant role in student progress. In contrast, however, curriculum contributed substantially to student growth. We operationalized curriculum as a nominal variable with three designations: state, national, and Montessori curriculum. The state curriculum is the baseline used for comparison. For students following the Montessori curriculum, the coefficient for all measures (TOSREC, DIBELSNext and easyCBM), was significantly higher than the state curriculum at baseline. This suggested that students at Montessori schools started the school year with greater reading aptitude than students who begin schools with state curricula. For example, on the WRF subtest, students at Montessori schools begin the school year with an average of 40.82 points higher than students at state schools. With respect to the WRF subtest over time, students at Montessori schools grow with an average of 3.252 points higher than students at state schools at each test occasion. Thus, curriculum affects both the intercept and the slope of the growth curve for the TOSREC and easyCBM measures.

Unlike the TOSREC and the EasyCBM, the slope coefficient for each curriculum is not necessarily consistent across the DIBELSNext subtests. For example, with respect to the ORF subtest, the slope of the growth curve for students learning under both the national curriculum and the Montessori curriculum is statistically significant ($p < 0.001$). This suggested that students not only began the year with greater skills, but they also acquired skills at a faster rate while following the national and Montessori curricula. For example, on the ORF subtest, students at Montessori schools begin the school year with an average of 57.49 points higher than students at state schools. In addition on the ORF subtest, students at Montessori schools grow with an average of 5.35 points higher than students at state schools at each test occasion. The comparison of curriculums present in Figure 1 also reinforces this conclusion.

3.2 School-Level Growth

Tables 7 and 8 depict growth in average scores for each reading measure across the six schools under study. The scores on each measure varied according to income of students and cost of attending the schools, with students from high-cost schools outperforming students from low-cost schools. Irrespective of the school that students were enrolled in, all students in the sample made considerable progress on reading sub-skills from the beginning to the end of the school year. On all the subtests, the high-cost Montessori school performed well-above US norms, but all other schools performed well-below US norms. It is interesting to note that the trajectory of growth on comparable subtests--such as Letter Names (EasyCBM) and Letter Naming Fluency (DIBELSNext); Phoneme Segmentation (EasyCBM) and Phoneme Segmentation Fluency (DIBELSNext); and Passage Reading Fluency (EasyCBM) and Oral Reading Fluency (DIBELSNext)--look very similar, indicating reliable and valid scores across these measures.

Tables 5 and 6 present the hierarchical model of individual students nested in schools. In addition to individual student effects we also capture variation at the school level. In several of the models, the random effect coefficient for school-level intercepts is statistically significant. This suggests that, despite controlling for individual variation, there is meaningful variation in student test scores *across* schools within selected subtests--the LNF (EasyCBM), LN (DIBELSNext), and WRF (DIBELSNext).

Though the schools showed variance in SES and curriculum, the hierarchical model of individual scores suggested that SES is not a meaningful predictor of student performance. To test this finding at the school-level, we created a simplified panel, regression model of average school-level test scores. In Tables 7 and 8, we see that—while controlling for curriculum—SES is not a meaningful predictor of student skills acquisition. In addition, with the exception of the Retell Fluency (DIBELSNext) subtest, the scores for schools that employ a national curriculum are not meaningfully different from schools that employ state curriculum (baseline). Similar to the hierarchical model of individual scores, schools employing the Montessori curriculum score significantly higher than schools employing the state curriculum. On the TOSREC, students following the Montessori curriculum scored an average of 34.61 points higher than students following a state curriculum. On the EasyCBM, students following the Montessori curriculum scored between 33-67 points higher than students following a state curriculum. Finally, on the DIBELSNext, students following the Montessori curriculum scored between 18-68 points higher than students following a state curriculum.

Table 7. Panel Linear Regression of School Averages for TOSREC and easyCBM Subtests

	(1) TOSREC	(2) LN	(3) LS	(4) PS	(5) WRF	(6) PRF
Socioeconomics	0.773	-4.826	-0.852	-2.457	2.384	3.632
	(1.589)	(3.840)	(1.891)	(3.199)	(4.820)	(5.755)
National Curr.	4.222	14.27	15.34*	15.65*	11.36	10.47
	(3.255)	(9.905)	(7.803)	(7.300)	(9.922)	(11.67)
Montessori Curr.	18.97***	33.39***	35.33***	34.25***	47.28***	67.49***
	(3.255)	(9.905)	(7.803)	(7.300)	(9.922)	(11.67)
Constant	1.179	54.98***	15.26*	11.34*	6.421	4.092
	(1.738)	(7.339)	(7.083)	(4.752)	(5.362)	(6.064)
Observations	18	18	18	18	18	18

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Panel Linear Regression of School Averages for DIBELSNext Subtests

	(1) LNF	(2) PSF	(3) NWF-CLS	(4) NWF-WWR	(5) ORF	(6) RF
Socioeconomics	-5.131	-0.884	0.0182	0.730	4.122	0.399*
	(5.412)	(3.732)	(3.548)	(0.566)	(5.917)	(0.165)
National Curr.	14.08	14.88	16.99*	5.200*	10.34	1.347**
	(13.43)	(8.758)	(7.477)	(2.045)	(12.13)	(0.450)
Montessori Curr.	34.61**	39.15***	18.48*	22.22***	68.19***	13.25***
	(13.43)	(8.758)	(7.477)	(2.045)	(12.13)	(0.450)
Constant	54.41***	11.37	8.517*	2.941	3.533	0.240
	(9.617)	(5.909)	(4.259)	(1.795)	(6.490)	(0.349)
Observations	18	18	18	18	18	18

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4. Discussion

4.1 Role of Independent Variables

Neither gender nor SES played a significant role in student progress across measures, but curriculum accounted for the largest variance in scores. This result is not consistent with other studies, for example the Program for International Student Assessment (PISA, 2009) data which found that gender and socio-economic status were statistically significant predictors of reading outcomes with socioeconomic status being the strongest predictor (Neff, 2015). Interestingly, another study found that low-SES accounted for faster rates of reading growth for K-3 students and slower rates of reading growth for students in Grades 3-8 (Kieffer, 2011), so that might explain why SES was not predictive of reading outcomes for our sample of students in Grade 1. Even after controlling for SES and gender, we found that curriculum was a strong predictor of reading outcomes for Grade 1 students. Students from the Montessori curriculum started the school year with greater reading aptitude than students in the State curriculum. Students from both National and Montessori curricula acquired reading skills at a faster rate compared to students from the State curriculum. This finding is critical because phonics-based instruction programs followed in the Montessori curriculum might be effective even in low and middle cost schools and could be a future direction for research. There is considerable support for systematic, synthetic phonics programs for native speakers of English (Ehri et al., 2001; Johnston & Watson, 2005), and students who speak English as a second language (Stuart, 1999; Stuart, 2004). This latter finding is especially relevant to an Indian context where students come from bilingual or multilingual homes.

4.2 School Level Performance

The trajectory of scores on equivalent tests (e.g. phoneme segmentation on the easyCBM and phoneme segmentation fluency on the DIBELSNext) looked very similar, indicating reliable and valid scores across these measures. Moreover, after controlling for individual variation, variation existed between schools on subtests of Letter Naming Fluency (EasyCBM), Letter Names (DIBELSNext), and Word Reading Fluency (DIBELSNext). Five out of six schools in our sample followed the "alphabet-spelling method" (Gupta, 2014, p. 3911) to teach reading, indicating that most students in our sample would be taught a progression of reading skills that moved from letter names, to spelling and to reading words. Therefore, the variances between schools on these particular subtests can be explained by the focus and quality of the reading instruction at each school site.

4.3 Implications for Research and Practice

Firstly, the DIBELSNext and easyCBM measures depicted an overall moderate to high level of reliability, suggesting that other researchers and teachers can use them to assess reading acquisition in the Indian context.

Secondly, English-immersion models with no bilingual support is a common model of instruction in private schools in India. While students from middle and high-cost schools seem to benefit from this model because they have access to resources such as English literacy practices at home, it does not seem to be beneficial for students from low-cost schools because (a) they are first generation school goers and do not have continuous access to English literacy at home, (b) they do not have strong role models in English in school, and (c) they have no access to bilingual supports to use their L1 to enhance their L2 acquisition. These results remind us of Ramanathan and Atkinson's (1999) finding that English remains a language of the elite, and is inaccessible to students from low SES backgrounds in the Indian context. In 2018, the Authors conducted a more recent study to measure oral language precursors to reading and found that students from low-cost schools in Bangalore were performing below grade level on both English (L2) and Kannada (L1) measures in elementary grades, indicating both L1 and L2 language loss. The researchers also recommended that low-cost schools consider late-exit bilingual programs, to use students' L1 to facilitate their L2 acquisition, but the school management rejected this recommendation, because of the push towards English-medium instruction. Moreover, Nakamura et al. (2018) observed that early exposure to English might have poor consequences on literacy acquisition compared to waiting for students to develop a basic threshold reading level in their native language before transitioning to English. According to their findings, 20% of students were not ready to be taught in English even by Grade 5.

Finally, the results indicated that Montessori curriculum and phonics-based approaches to teaching reading was strongly predictive of better reading outcomes for these students. And even though our sample of students came from higher SES backgrounds, and started the study with higher reading scores, it would be worth exploring the benefits of phonics-based instruction programs for low and middle-cost schools in the Indian context. Dixon et al. (2011) and Gupta (2014) found substantial evidence of phonics-based approaches improving reading outcomes for students from slums and rural parts of India.

4.4 Limitations and Future Directions

Firstly, selecting the DIBELSNext and easyCBM reading measures was a first step in extending their use and observing their efficacy in an Indian context. Given the complexity of language acquisition in the Indian context, we did not have access to an appropriate oral language proficiency test and the results of the study need to be viewed within the parameters of this limitation. A future goal would be to develop an oral language competency measure for use with Indian students.

Secondly, our sample from the Montessori school was limited, and a future research direction would be a follow-up study involving a larger sample of students from Montessori schools. Moreover, all these students came from high-income backgrounds, so a future research direction would be to implement phonics-based approaches in low-cost schools to observe their efficacy. We hope to bring about a systemic change in reading instruction in these schools.

Thirdly, students are exposed to languages at home and school at different rates and varying proficiency levels, but capturing these data would mean forming sub-groups of students to take part in our study rather than recruiting entire classrooms. The common underlying denominator was that all students were exposed to the same language of instruction in school and we focused on studying L2 English reading development in this context.

Finally, our independent variables were not manipulated, so we were not able to randomly assign curriculum to different student samples from low-cost and middle-cost schools. In a future study, we plan to investigate the broader implications of a Montessori-based curriculum and its effect on students from various socio-economic backgrounds attending a wide variety of schools.

5. Conclusion

Our results suggested that curriculum was the most significant predictor of reading outcomes for Grade 1 students in Bangalore, India. The discussion revealed underlying socio-political and cultural tensions within the Indian education system that impacted all stakeholders: parents, teachers and students. Thus, through our analyses, we concluded that for many students, access to a particular curriculum within the Indian education system seems to be a privilege rather than a right.

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