



Research Article

Student Literacy Skills and Teacher Literacy Practices: Effects on Reading Achievement Growth from First to Third Grade

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Abstract: A large body of research has established associations between self-regulated behaviors and students' academic achievement. The present study uses data from the Early Childhood Longitudinal Study, Kindergarten Class of 2010-11, to examine teacher-reported literacy behaviors of 18,135 (N = 18,135) first-grade children, and the longitudinal associations with reading achievement. Students' reading achievement was assessed at three data points: first, second, and third grades. Additionally, the study also examined the relationship between teachers' instructional practices in reading comprehension during first grade and their association with students' reading achievement across three waves. Using two-way hierarchical linear modeling, results indicated that first-grade students' self-regulated academic behaviors, such as participating in reading discussions, interpreting stories read, reading fluently, and writing clear stories, were positively associated with first-grade reading achievement, but these associations diminished over time. Female students scored higher than male students at the initial data point. Additionally, students whose home language was English scored significantly higher than students whose home language was not English at the initial data point. However, non-English students demonstrated greater growth in reading achievement over time. Parent education level was also associated with students' reading achievement. Teachers' instructional practices in reading comprehension during first grade were not significantly associated with students' reading achievement beyond first grade. The findings indicate that early self-regulated literacy behaviors in first grade were positively associated with reading achievement initially, but that this association diminished over time.

Keywords: reading achievement, self-regulation, self-regulatory behaviors, early childhood, home language, longitudinal Hierarchical Linear Modeling (HLM)

1. Introduction

In the 21st century, schools across the United States face the complex challenge of educating increasingly large and diverse student populations (Sáenz et al., 2005). General classroom teachers are expected to demonstrate the knowledge and pedagogical skills required to support the learning needs of all students, including linguistically diverse learners and students with learning disabilities who may encounter challenges in reading comprehension (National Center for Education Statistics (NCES), 2014; Vaughn et al., 2001). Additionally, the educational demands present in today's elementary classrooms that use texts with higher complexity levels require elementary-age students to be more cognizant of reading comprehension strategies and know when to use and how to apply these strategies. Students

must be exposed to higher-level instructional models to support struggling readers in reaching an appropriate reading comprehension level regarding complex texts (Boardman et al., 2016). For instance, educational policies such as the Common Core State Standards (CCSS) for English Language Arts and Literacy (National Governors Association Center for Best Practices, Council of Chief State School Officers (NGA & CCSSO), 2010) emphasize students' ability to read complex, grade-level texts and argue that developing advanced literacy skills is essential for college and workforce readiness (Kamil, 2016).

As of their adoption, the District of Columbia, four U.S. territories, the Department of Defense Education Activity, and forty-one states had incorporated the CCSS into instructional practice (NGA & CCSSO, 2010). While the CCSS articulates what students are expected to know and be able to do, they do not prescribe instructional methods, placing responsibility on teachers to implement practices that support students' reading comprehension development (Kamil, 2016). Therefore, teachers need to develop a repertoire of strategies and implement teaching practices that instruct students on applying these strategies to increase student reading achievement.

Reading complex texts requires sophisticated cognitive processing skills and deep engagement with the content (Best et al., 2008; Williams, 2004; 2005). Students often experience difficulty interpreting meaning, generating inferences, and understanding text structure, particularly in informational and expository texts, when they lack effective comprehension strategies (Pyle et al., 2017). Consequently, there is a need to incorporate effective educational practices to prevent students from later academic difficulties (Maheady et al., 2006). Strategy-based instruction may also promote the development of students' metacognitive awareness by applying specific strategies that contribute to self-monitoring and self-regulation of learning through social interactions (de Backer et al., 2011; 2014; Hadwin et al., 2018). Students are expected to meet the demands of increasingly rigorous curricula. However, instructional practices and the learning environment must be suitable for students to acquire metacognitive awareness skills, and opportunities to develop positive self-regulated academic learning behaviors must exist (Schreiber, 2005).

Much of the self-regulation research has focused on examining its effect on learners in preschool and kindergarten (Day & Connor, 2017). There is a limited amount of longitudinal research that explores how self-regulation skills in literacy across elementary-age children (McClelland et al., 2007) develop over time, and few studies have focused their research on the contribution of self-regulation to higher levels of reading skills, such as reading comprehension (Birgisdóttir, 2015; Skibbe et al., 2019). Recent developmental syntheses underscore the importance of examining self-regulatory processes longitudinally and within academic contexts beyond early childhood (Zelazo & Carlson, 2022). Accordingly, the present study seeks to advance the literature by investigating the long-term relationship between self-regulated literacy practices and students' reading comprehension achievement, with attention to how early instructional experiences may shape sustained learning outcomes.

Additionally, this study examines teachers' instructional practices in reading education and their long-term associations on students' reading comprehension, with particular attention to how classroom behaviors reflect underlying self-regulatory processes. Within the framework of self-regulated learning, teachers play a critical role in establishing instructional conditions and strategies for learning and adequate environment to support student's development of self-regulated skills (Zimmerman, 1990). In this study, teacher-reported literacy behaviors, such as students' participation in discussions and their ability to produce coherent written responses, are conceptualized not as isolated literacy skills, but as observable manifestations of self-regulated learning during academic tasks (Schunk & Zimmerman, 1997).

From a developmental perspective, early instructional practices such as retelling stories, identifying main ideas, and discussing text meaning may have lasting effects because they help students construct foundational comprehension schemas and establish habitual approaches to meaning-making (Paris & Paris, 2001). When introduced in the early grades, these practices may support students' ability to organize textual information, recognize narrative and informational structures, and engage in strategic processing that transfers to increasingly complex texts in later grades (Duke & Pearson, 2002). Thus, the long-term predictive association of first-grade reading instruction is theorized to operate not through isolated skill acquisition, but through the development of enduring comprehension strategies and self-regulatory routines that support sustained reading comprehension growth.

Drawing on Zimmerman's model, these behaviors align most closely with the performance phase of self-regulation, wherein students apply strategies, sustain attention, and monitor their engagement while completing literacy activities. Thus, the instructional practices examined in this study are theorized to support reading comprehension indirectly by fostering students' capacity to regulate their learning during literacy instruction.

The following literature review situates this conceptual model by synthesizing research on metacognition, self-regulated learning, self-regulation, student achievement in reading, and teacher practices.

2. Literature review

2.1 *Self-regulated learning in early grades and academic achievement*

Although researchers support the general concept that self-regulation skills contribute to students' academic achievement, a great emphasis has been placed on studying executive functions among primary-age students (Best & Miller, 2010). Contemporary conceptual reviews emphasize that self-regulated learning extends beyond executive control to include coordinated cognitive, behavioral, and motivational processes through which students actively manage their learning in academic contexts (Sinkkonen & Tapani, 2024). However, although a small number of recent studies have begun to examine self-regulated learning longitudinally in the elementary years, such research remains limited in scope relative to the extensive focus on preschool and kindergarten. In measuring the contribution of self-regulation skills, much research in this field has focused on its effects on kindergarten students' general academic achievement (e.g., Blair & Razza, 2007; Howse et al., 2003; McClelland et al., 2006; 2007; Neitzel & Connor, 2016; Ponitz et al., 2009). In measuring the academic effects of self-regulation over time, Ponitz et al. (2009) and McClelland et al. (2007) conducted hierarchical linear modeling studies to measure the predictability of students' behavioral regulation on academic achievement utilizing the Head-to-Toes-Knees-Shoulders (HTKS) task, which requires attention, working memory, and Inhibitory Control (IC) (McClelland et al., 2007; Ponitz et al., 2009). In Ponitz et al. (2009), 343 children (52% girls) participated in the fall and spring of kindergarten. After controlling for background variables, the results indicated that higher HTKS scores in the fall predicted students' academic achievement in the spring in mathematics, literacy, and vocabulary skills. Similarly, McClelland et al. (2007), which examined 310 kindergarten students (51% girls), indicated that students with stronger self-regulation in the spring demonstrated more significant gains in literacy, vocabulary, and mathematics skills.

These findings provide compelling evidence that behavioral self-regulation is associated with short-term academic growth during kindergarten; however, the concentration on a single developmental period and reliance on performance-based measures such as the HTKS limit conclusions about how self-regulated learning functions beyond school entry. Moreover, by emphasizing behavioral compliance and executive control, this body of work offers limited insight into how self-regulatory processes support increasingly complex academic tasks as students' progress into later elementary grades.

In addition, Howse et al. (2003) investigated a model that aimed to explain the relationship between self-regulation and achievement in 61 children at the kindergarten students with data collection spanning from preschool through the spring and summer following kindergarten. The authors investigated the mediating effects of behavioral self-regulation and achievement. Behavioral regulation was assessed using teacher ratings from eight items drawn from the Instrumental Competence Scale for Children (COMPSCALE), an 18-item measure designed to capture children's motivation and self-regulatory behaviors across school and home contexts. Teachers rated children on the following 8 items on a 4-point Likert scale: -is impulsive and careless in tasks and activities, -has difficulty planning and carrying out activities that have several steps (reverse), -finishes tasks and activities, -concentrates well and is not easily distractible when doing a task, -actively uses resources for help and information, -is not a self-starter (reverse), -does not readily ask questions (reverse), and likes to do challenging tasks. Children's academic measures included five subtests of the Wechsler Individual Achievement Test (WIAT) to examine basic reading, mathematical reasoning, spelling, numerical operations, and listening comprehension. Results indicated that students who initially had higher scores in behavioral self-regulation demonstrated higher achievement scores in literacy, mathematics, and listening comprehension.

Despite these significant associations, the literacy outcomes were limited to foundational skills, such as letter knowledge and basic decoding, constraining interpretations of how behavioral self-regulation supports more complex literacy processes. Consequently, while the findings highlight the early importance of behavioral regulation, they provide limited insight into the role of self-regulated learning as academic demands increase beyond early elementary instruction.

Similarly, Blair and Razza (2007) examined aspects of self-regulation (executive function and effortful control)

on emerging academic achievement in math and literacy for 141 3- to 5-year-old children from low-income homes. Executive function was assessed using a peg-tapping measure of inhibitory control and an item selection measure of attention shifting. Effortful control was measured through teacher and parent reports using a short form of the Children's Behavior Questionnaire. Literacy outcomes focused on reading readiness by measuring phonological awareness and letter knowledge skills. Phonological awareness was assessed via the Elision subtest of the Pre-school Comprehensive Test of Phonological and Print Processing (PreCTOPPP) and letter knowledge was measured using the Head Start National Reporting System Direct Child Assessment. Findings contrasted with those reported by Howse et al. (2003), as the results in Blair and Razza (2007) indicated that no preschool measures of self-regulation predicted phonemic awareness in kindergarten. However, teacher reports of inhibitory control during kindergarten were significantly associated with letter knowledge. These mixed findings suggest that the relationship between self-regulation and early literacy may be highly sensitive to developmental timing and measurement context. Specifically, self-regulatory processes assessed during formal schooling may be more predictive of literacy outcomes than those measured prior to school entry, highlighting the importance of examining self-regulation within instructional contexts rather than as a stable trait established in pre-school.

More recent longitudinal work extends these findings into the early elementary years and clarifies how different forms of self-regulation relate to academic development. Hernández et al. (2018b) followed children from kindergarten through second grade and found that behavioral self-regulation, assessed using the Head-Toes-Knees-Shoulders (HTKS) task, consistently predicted later reading and mathematics achievement even after controlling for prior achievement and demographic variables. In contrast, inhibitory-control-based self-regulation, measured through a Continuous Performance Task (CPT), predicted later achievement primarily for students with lower initial academic performance, suggesting a compensatory mechanism whereby regulatory skills are most consequential for children at greater academic risk. Notably, the association between behavioral self-regulation and reading achievement was unidirectional across grades, indicating that early regulatory capacities support later reading development rather than emerging solely as a consequence of academic success (Hernández et al., 2018b). Extending this developmental pattern into later elementary grades, Ha et al. (2023) found that students' use of metacognitive and effort-regulation strategies in sixth grade significantly predicted literacy and mathematics achievement, indicating that self-regulated learning continues to play a meaningful role in academic performance beyond the early elementary years. Moreover, meta-analytic evidence indicates that instructional interventions targeting self-regulated learning strategies yield moderate positive effects on students' academic achievement, reinforcing the view that regulatory processes are not only predictive but also responsive to educational supports (Xu et al., 2022). Observational research further suggests that students' self-regulatory behaviors vary systematically across classroom tasks and instructional conditions, highlighting the situational nature of Self-Regulated Learning (SRL) and its sensitivity to learning environments (Eberhart, 2024).

2.2 Instructional practices

Recent educational policies have increasingly emphasized the quality of teacher preparation programs and their potential to influence student learning outcomes (Carlisle et al., 2011). According to Carlisle et al. (2011), teaching quality is considered one of the most critical factors that affect students' performance; however, empirical evidence remains mixed regarding whether the association of teacher preparation can be directly attributed to student achievement outcomes (Von Hippel & Bellows, 2018) or whether teachers' foundational knowledge of reading instruction independently predicts student learning, with recent large-scale evidence suggesting that such knowledge predicts growth in foundational skills but not in reading comprehension (Moats & Foorman, 2003; Porter et al., 2023). Teacher quality is frequently measured through a value-added model of student achievement that accounts for prior achievement, school and peer influences, and family and neighborhood factors (Hanushek & Rivkin, 2010). Although these approaches offer useful estimates of teacher association, they provide limited insight into the instructional processes through which teachers influence students' learning behaviors. Recent multilevel work indicates that teachers' knowledge of language and literacy concepts is associated with observed instructional quality and, in some contexts, with students' reading growth, but these associations are not uniformly robust once prior achievement and other covariates are controlled, underscoring the complexity and indirect nature of instructional influences on literacy development (Guilbault et al., 2025; Parrila et al., 2024).

One instructional dimension that has received increasing attention is the learning environment teachers create,

particularly its role in supporting students' self-regulatory development. Connor et al. (2010) examined the effects of Individualized Student Instruction (ISI) provided by the teacher and its effects on the students' self-regulation growth of 445 first-grade students. The ISI framework required teachers to tailor literacy instruction based on students' vocabulary and reading skills. Teachers were trained to organize activities, minimize non-instructional time, and lesson planning. They hypothesized that providing an organized learning environment with minimal distractions where students would be highly engaged in the learning activities would promote students' self-regulation skills. Self-regulation was measured using the Head-Toes-Knees-Shoulders (HTKS) task, with results indicating that students who initially demonstrated lower levels of self-regulation in the fall exhibited significant gains by the spring. The modification of the learning environment through the implementation of the ISI resulted in self-regulation gains (Connor et al., 2010). These findings suggest that self-regulation is responsive to instructional design and classroom organization, underscoring the role of teachers not only as transmitters of content but as architects of learning environments that actively shape students' regulatory behaviors. However, recent evidence suggests that even when instructional quality and differentiation are observed directly, their associations with literacy outcomes are often small and inconsistent, raising questions about the sensitivity and validity of current instructional observational measures (Parrila et al., 2024).

3. Purpose of the study

This study focused on the relationship between students' self-regulatory literacy behaviors and reading achievement over three school years. This study examined whether a long-term association exists between students' self-regulatory literacy behaviors and reading achievement from the first-grade spring of 2012, second-grade spring of 2013, and third grade spring of 2014. Based on prior research findings, it was hypothesized that there is a positive relationship between students' self-regulated literacy behaviors learning in early grades and their reading achievement. This study also explored the relationship between teachers' instructional practices in reading on student achievement across time. The body of research examining teacher preparation programs and their relationship on student achievement is unclear (Von Hippel & Bellows, 2018). Recent research further suggests that evaluating teacher preparation solely through student achievement outcomes may obscure important dimensions of program influence, as many teacher candidates do not immediately enter classroom teaching or follow linear career pathways into the profession (Goldhaber et al., 2022).

Research Question 1: Do 1st-grade students' self-regulated literacy behaviors have a significant longitudinal relationship with their reading achievement?

Research Question 2: Do 1st-grade students' demographic factors have a significant association with students' reading achievement?

Research Question 3: Do 1st-grade teachers' instructional practices have a long-term relationship with their students' reading achievement?

4. Methods

4.1 Data

The present study used data from the Early Childhood Longitudinal Study, Kindergarten Class of 2010-11 (ECLS-K: 2011). During the initial data collection, over 18,000 kindergarteners from 970 schools, their parents, teachers, administrators, and before- and after-school care providers participated. The ECLS-K:2011 follows children from the 2010-11 school year through the 2015-16 school year when most students were in fifth grade. The final sampling for the ECLS-K:2011 included 1,352 schools, of which 1,052 were public, and 300 were private. The sample schools were in the northeastern, midwestern, southern, and western regions of the United States and included schools from cities, suburbs, towns, and rural areas.

Data preparation and preliminary analyses were conducted using SPSS (IBM Corp., 2020). This process included screening variables for missing data, constructing composite variables, and removing cases with missing values on selected study variables using listwise deletion. Item-level missingness in teacher-reported measures primarily reflected responses marked as "not applicable" or "skill not yet taught," as well as occasional teacher nonresponse. Cases

with missing values on any of the variables included in a given analysis were excluded from that analysis. Given the large analytic sample and the relatively small proportion of missing data across items, listwise deletion was deemed appropriate for the purposes of this study; however, if missingness was systematic rather than random, this approach may have introduced some degree of sample bias. Following data preparation, longitudinal analyses were conducted using Hierarchical Linear Modeling (HLM) (Raudenbush & Bryk, 2002) to account for the nested structure of repeated measurements within students and to examine changes in reading achievement over time.

4.2 Main independent variables

4.2.1 Students' self-regulated literacy behaviors, first-grade spring 2012

Self-regulated learners use strategies to engage in tasks that lead to learning and achieving specific goals. Furthermore, students with self-regulatory behaviors actively engage in cognitive tasks that contribute to constructing meaning and transferring skills across tasks. One of this study's two main independent variables is students' self-regulated behaviors in literacy in first grade.

Students' self-regulated literacy behaviors in first grade were operationalized using five teacher-reported items reflecting students' observable engagement and performance during literacy tasks. Self-regulated learning is conceptualized as the strategic coordination of cognitive, behavioral, and motivational processes during academic activity. From this perspective, teacher-observed behaviors such as participating in discussions, interpreting texts, and composing written responses represent task-level manifestations of self-regulation as enacted within literacy instruction rather than isolated skill attainment. In contrast to domain-general measures of self-regulation or executive function (e.g., the Head-Toes-Knees-Shoulders task), which assesses broad behavioral regulation across contexts, the present study focuses on literacy-specific expressions of self-regulation as they occur during reading and writing activities. The teacher-reported behaviors used in this study reflect how students apply regulatory processes (e.g., attention, persistence, strategy use) within reading and writing activities. Teachers completed a classroom questionnaire reporting students' academic behaviors, classroom engagement, and literacy achievement (Tourangeau et al., 2013).

The five items included as representations of the students' self-regulatory behaviors were: (1) contributes to class discussion (N = 13,415); (2) interprets stories read to him/herself (N = 13,357); (3) read first-grade books independently (N = 13,402); (4) reads first-grade books fluently (N = 13,394); and (5) composes clear stories (N = 13,122) (see Figure 1). Using a 6-point Likert scale, the teachers indicated at what level the students were demonstrating the skills for each of the five variables as follows: (1) not yet; (2) beginning; (3) in progress; (4) intermediate; (5) proficient; and (6) not applicable or skill not yet taught. Variation in sample sizes across items reflects instances in which teachers indicated that a skill had not yet been taught or was not applicable at the time of data collection, as well as occasional item-level nonresponse.

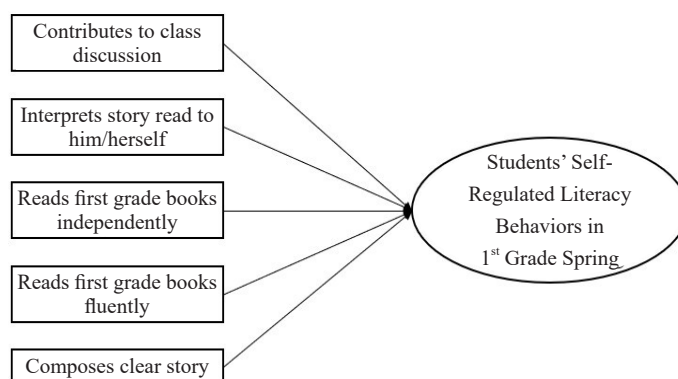


Figure 1. Students' Self-Regulatory Literacy Behaviors in 1st-Grade Spring

A factor analysis was used to construct the composite variable. The present study examines whether first-grade

students' self-regulated literacy behaviors demonstrate a significant longitudinal association with reading achievement across three measurement waves. Although the five indicators include behaviors reflecting both literacy engagement (e.g., contributing to discussions) and demonstrated competence (e.g., reading fluently, composing clear stories), this combination is theoretically consistent with models of self-regulated learning that emphasize the integration of strategy use, persistence, and achievement within authentic academic tasks. In classroom contexts, teachers observe self-regulation through students' ability to apply strategies effectively while engaging with literacy content, making behavioral regulation and demonstrated competence closely intertwined.

An Exploratory Factor Analysis (EFA) was conducted for the two construct variables of Students' Self-regulatory Behaviors in Literacy and Teachers' Instructional Practices in Reading. The EFA supported the indicators' commonalities and each construct's hypothesis (Yong & Pearce, 2013). The EFA supported a single-factor solution for Students' Self-Regulated Literacy Behaviors, with all indicators demonstrating strong factor loadings ranging from 0.863 to 0.931. Although the indicators reflected both literacy engagement (e.g., contributing to class discussions) and demonstrated literacy achievement (e.g., reading fluently, composing clear stories), alternative factor structures distinguishing these dimensions were considered but not retained conceptually. The high inter-item correlations and lack of clear theoretical separation among the indicators supported the interpretation of the construct as a unified, task-level manifestation of self-regulated learning within classroom literacy contexts. Consistent with prior research emphasizing the integrated nature of self-regulation during academic tasks, the single-factor solution was retained for conceptual coherence and parsimony.

In the Teachers Instructional Practices in Reading construct, the EFA indicated loadings ranging between 0.769 and 0.856 among all the components. The correlations within the items in each construct variable showed a significant value at the 0.001 level (2-tailed).

Table 1. Component Matrix with Correlations of Each Independent Variable Construct

Student Self-Regulatory Literacy Behaviors Construct		Correlations				
Reliability Cronbach's Alpha	0.944					
Items	Loading	1	2	3	4	5
1. Reads 1st-grade books independently	0.931					
2. Reads 1st-grade books fluently	0.916	0.922**				
3. Interprets stories read to him/herself	0.905	0.767**	0.733**			
4. Composes clear stories	0.902	0.797**	0.793**	0.772**		
5. Contributes to class discussion	0.863	0.704**	0.677**	0.818**	0.710**	1
<hr/>						
Teacher Practices in Literacy Construct						
Reliability Cronbach's Alpha	0.869					
Items	Loading	1	2	3	4	5
1. Retells stories	0.856					
2. Describes characters and events	0.853	0.794**				
3. Identifies the main idea in informational texts	0.832	0.626**	0.600**			
4. Describes similarities and differences between the two texts	0.777	0.507**	0.518**	0.634**		
5. Recognizes fiction and nonfiction	0.769	0.543**	0.551**	0.537**	0.546**	1

**Correlation is significant at the 0.01 level (2-tailed).

Table 1 presents the component matrices, factor loadings, inter-item correlations, and reliability estimates for the two independent variable constructs: student self-regulatory literacy behaviors and teacher practices in literacy instruction. For the student self-regulatory literacy behaviors construct, all five items loaded strongly on a single component, with factor loadings ranging from 0.86 to 0.93, and the scale demonstrated high internal consistency (Cronbach's $\alpha = 0.94$). The teacher practices in literacy construct also consisted of five items with factor loadings ranging from 0.77 to 0.86 and demonstrated strong internal consistency (Cronbach's $\alpha = 0.87$). Inter-item correlations for both constructs were statistically significant at the 0.01 level (two-tailed).

4.2.2 Teachers' instructional practices reading in first grade

The teachers' instructional practices in reading were measured using teacher-reported questionnaire addressing the frequency of specific literacy instructional activities. To represent the construct of teachers' instructional practices in reading, five instructional skills were selected: (1) retelling stories (N = 13,231); (2) identifying the main idea in informational texts (N = 13,205); (3) describing similarities and differences between two texts (N = 13,221); (4) describing characters and events (N = 13,179); and (5) recognizing fiction and nonfiction (N = 13,235) (see Figure 2).

Teachers reported how often each instructional activity was taught using a six-point scale reflecting the number of instructional days: (1) not taught; (2) 1–10 days; (3) 11–20 days; (4) 21–40 days; (5) 41–80 days; and (6) more than 80 days. Accordingly, this measure captures the frequency of instructional exposure to specific reading practices rather than the quality, depth, or effectiveness of instruction. An Exploratory Factor Analysis (EFA) was used to construct the variable *Teachers' Instructional Practices in Reading*. The research question examines whether the frequency whether 1st-grade teachers' instructional practices have a longitudinal relationship with students' reading achievement.

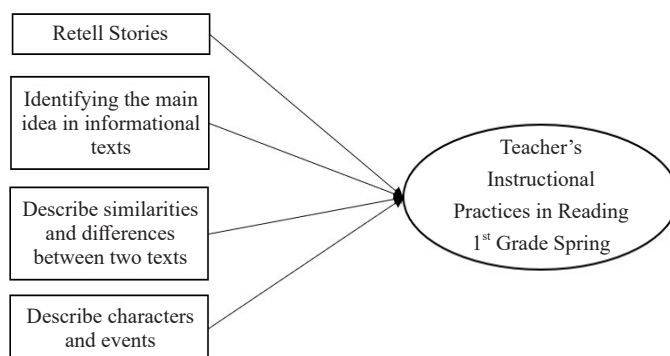


Figure 2. Teachers' Instructional Practices in Reading 1st-Grade Spring 2012

4.2.3 Student home language, gender, and parent education

This study investigated the reading achievement of three different waves, starting with first-grade students. The student's language data were collected from parent interviews included in the analysis. Approximately 80.6% of the students spoke English as their home language (N = 12,926). Approximately 18.3% spoke a language other than English as their home language (N = 2,941) (coded as non-English). Approximately 1.1% were students whose parents could not decide between the primary and second languages used at home (N = 178) (coded as dual language). There were 51.2% male students (N = 9,288) and 48.8% female students (N = 8,847). Parental education level served as an additional student and family background variable, with descriptive statistics summarized in Table 2. Parents reported their highest level of education on the parent questionnaire.

Table 2. Parents' Education Level

Education Level	N	%
8 th grade or less	661	5.1
9 th -12 th grade	1,010	7.8
High school diploma or equivalent	2,809	21.7
Vocational/technical program	676	5.2
Some college	3,303	25.5
Bachelor's degree	2,725	21.0
Graduate/professional school-no degree	230	1.8
Master's degree (MA, MS)	1,251	9.7
Doctoral Degree	287	9.7
Total	12,952	

4.3 Main dependent variable

4.3.1 Reading scores in 1st, 2nd, and 3rd grade

The study's dependent variable is comprised of three waves of reading scores. The ECLS-K:2011 data provide Item Response Theory (IRT) scores, thereby making it possible to calculate the students' overall scores in each domain in reading and compare the scores across different rounds as measured in the spring semesters of the 1st, 2nd, and 3rd grades. The IRT method allows for the direct comparison of scores among children, utilizes the same scale, and allows for cross-sectional and longitudinal analyses (Tourangeau et al., 2013). Students were administered the Preschool Language Assessment Scale (preLas2000)–Form C: Simon Says & Art Show and the Test for Early Reading Ability-3rd edition (TERA-3). The measured comprehension skills included foundational skills (e.g., print awareness, letter recognition, phonological awareness, word recognition), and more complex literacy skills such as vocabulary knowledge, and reading comprehension (e.g., definitions, facts, supporting details). Additionally, the students were asked to make complex inferences within the same texts and across different texts. For this study, student IRT scores from spring 2012 (wave 1), spring 2013 (wave 2), and spring 2014 (wave 3) were analyzed.

Table 3. Matrix Correlations Among Independent and Dependent Variables

	1	2	3	4	5	6	7	8	9
1. Reading Score in 1 st Grade									
2. Reading Score in 2 nd Grade	0.860**								
3. Reading Score in 3 rd Grade	0.785**	0.842**							
4. Self-regulatory Literacy Behaviors	0.706**	0.669**	0.617**						
5. English as the Home Language	0.166**	0.175**	0.165**	0.104**					
6. No English as the Home Language	-0.164**	-0.171**	-0.163**	-0.106**	-0.964**				
7. Dual Home Language	-0.022**	-0.028**	-0.021**	-0.003**	-0.216**	-0.050**			
8. Student Gender	0.110**	0.109**	0.081**	0.111**	-0.011	0.011	0.001		
9. Parent Education	0.366**	0.379**	0.385**	0.231**	0.327**	-0.328**	-0.024**	0.007	
10. Teacher Practices	0.035**	0.029**	0.026**	0.071**	-0.030**	-0.030**	-0.007	-0.005	0.000

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 3 correlations matrix shows significant correlations among the primary dependent variables (IRT scores with three waves) and the independent variables of self-regulatory literacy behaviors, English as the home language, non-English as the home language, dual languages at home, gender, parent education, and teacher practices.

5. Research analysis model

Using a longitudinal Hierarchical Linear Modeling (HLM) analysis (Singer & Willett, 2003), this study examined the longitudinal associations of the self-regulated behaviors identified in first-grade students and their reading achievement in the spring semesters of the 1st, 2nd, and 3rd grades.

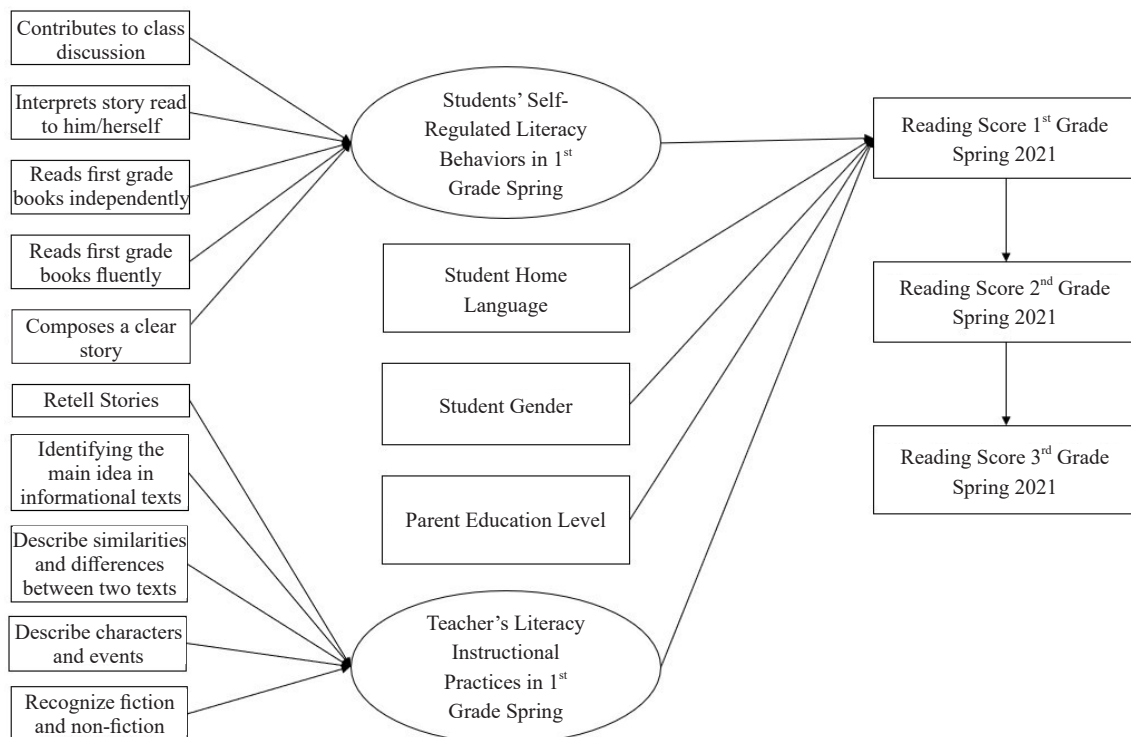


Figure 3. Longitudinal hierarchical linear model: Teachers' instructional practices, self-regulated behaviors, and academic achievement across three waves

The HLM shown in Figure 3 shows the main independent variables to the left, i.e., student self-regulated behaviors, home language, gender, parent education, and teacher instructional practices. The outcome variables or dependent variables are shown in the model, i.e., three waves of students' reading achievement in first, second, and third grade. Through a longitudinal hierarchical linear analysis, the results showed the longitudinal relationship of the leading independent variables on the dependent variables across three waves.

6. Results

The current study produced outcomes through a series of models conducted initially with only dependent variables (three waves of reading scores) and then adding independent variables step by step. The final HLM model indicated an acceptable model fit with a chi-square value and an acceptable Intraclass Coefficient Correlation (ICC) of 80.33%. The ICC indicates the model's total variance explained by the level two variables. It also represents the distribution of

individual-level variance to the total variance (Hox et al., 2017) and confirms the need for the HLM model for this study. The deviance statistic is a measure of model fit, with lower values indicating a better-fitting model relative to alternative or reference models (Singer & Willett, 2003). The fit statistics for the current covariance components model show a deviance equal to 193,793.676190 with 4 degrees of freedom. The final estimation of variance components indicates a variation of 140.03 among all the students in the baseline data, indicating a sufficient variance level among all students. The fixed effect for time indicates an average increase of 8.65 points in reading scores per wave, while the random slope variance (36.39) reflects substantial variability in growth trajectories across grade levels.

In the initial analysis for all students, the estimated fixed effects indicated an average reading achievement of 80.06 for 1st-grade students in the spring of 2012, significantly different from zero ($\beta_0 = 80.06$ s.e. = 0.211, $p = 0.001$). The time slope at intercept was 16.93, indicating that all students' average reading achievement growth rate increased by 16.93 for every wave ($\beta_1 = 16.93$, s.e. = 0.058, $p = 0.001$).

After the initial model with only three measures of reading achievement confirmed the use of HLM, the current study specified all independent variables at the second level. As shown in Table 4 with the final model effects, the intercept coefficient indicated the reference group's average reading achievement in the first grade and time was the average annual growth rate of reading for two years. The average reading achievement of the reference group (male students who speak only English) was 72.295 in the spring semester of first grade in 2012. The reading achievement increased by 17.119 points per year, thereby indicating a significant reading achievement growth during those two years ($\beta_{00} = 72.29$, s.e. = 0.152, $p = 0.000$).

Table 4. Final estimation of the fixed effects of all independent variables on reading achievement in first grade and the growth rate

Parameter	Coefficient	Standard error	t-ratio	Approx.d.f.	p-value
For INTRCPT1, π_0					
INTRCPT2, β_{00}	72.295	0.418	172.697	9,712	< 0.001
Self-Regulated Behaviors, β_{01}	13.205	0.165	79.692	9,712	< 0.001
Gender, β_{02}	1.465	0.310	4.719	9,712	< 0.001
Parent Education, β_{03}	1.778	0.086	20.665	9,712	< 0.001
Non-English, β_{04}	-3.293	0.429	-7.667	9,712	< 0.001
Dual Lang, β_{05}	-4.254	1.497	-2.840	9,712	0.005
Teacher Practices, β_{06}	-0.075	0.159	-0.475	9,712	0.635
For TIME slope, π_1					
INTRCPT2, β_{10}	17.119	0.153	111.802	9,712	< 0.001
Self-Regulated Behaviors, β_{11}	-1.610	0.060	-26.481	9,712	< 0.000
Gender, β_{12}	-0.398	0.113	-3.521	9,712	< 0.000
Parent Education, β_{13}	-0.006	0.031	-0.222	9,712	0.824
Non-English, β_{14}	0.797	0.156	5.101	9,712	< 0.000
Dual-Language, β_{15}	0.443	0.540	0.820	9,712	0.412
Teacher Practices, β_{16}	-0.031	0.057	-0.541	9,712	0.588

a. Dependent Variable: Reading Scores of Three Years.

b. Reference Group: English Only, Male Students.

At the initial data collection, the students with self-regulatory literacy behaviors experienced a significant positive

relationship with their reading achievement. These students had reading scores of 13.205 points higher per one-unit increase in self-regulatory literacy behaviors ($\beta_{01} = 13.205$, *s.e.* = 0.165, *p* = 0.000). Importantly, the findings of self-regulatory effects on reading achievement confirmed that self-regulatory literacy behaviors play an essential role in students' academic performance. However, the relationship of self-regulatory literacy behaviors slowed over the years ($\beta_{11} = 1.610$, *s.e.* = 0.060, *p* = 0.000), indicating that self-regulatory literacy behaviors demonstrated in the first grade do not affect reading achievement over time.

When examining gender differences, the current study found that, on average, female students had a higher reading score (1.465 points) than male students in the spring semester of first grade. This finding was significant ($\beta_{02} = 1.465$, *s.e.* = 0.310, *p* = 0.000). However, over time, male students seem to improve their achievement in reading compared to female students. Over time, female students' reading scores were lower than males ($\beta_{12} = -0.398$, *s.e.* = 0.113, *p* = 0.000). In analyzing parental education, the relationship was significant in the spring semester of first grade, with an increase of 1.778 in higher reading achievement when the variable of parent education increased by one level ($\beta_{03} = 1.778$, *s.e.* = 0.065, *p* = 0.000). However, parent education did not significantly affect the performance growth over time.

When analyzing language, the students who spoke a language other than English at home displayed significantly lower scores, *i.e.*, 3.293 points lower, compared to those who spoke only English at home in the first grade ($\beta_{04} = -3.293$, *s.e.* = 0.429, *p* = 0.000). Their achievement over time, however, increased significantly compared to the English only group ($\beta_{14} = 0.797$, *s.e.* = 0.156, *p* = 0.000). Students who spoke dual languages showed significantly lower scores than those of the English-only group at the initial data point ($\beta_{05} = -4.54$, *s.e.* = 1.147, *p* = 0.001). However, their achievement growth rate was similar to that of English-only students. The relationship between teachers' instructional practices on students' reading achievement was insignificant at the initial data point, and the growth rate contrasted with prior literature results. In other words, the teachers' instruction methods did not positively affect student achievement in this study.

7. Discussion and summary of findings

The main goal of this study was to explore the relationships of students' self-regulatory literacy behaviors on their reading achievement in early elementary grades. The study hypothesized that self-regulatory literacy behaviors acquired in the early years of schooling would lead to academic success for students and that the relationships would last for years. A composite measure of self-regulated literacy behaviors was derived from teacher-reported indicators, and exploratory factor analysis confirmed their conceptual coherence. In the subsequent stage, the study adopted longitudinal growth modeling using HLM. The model examined the self-regulatory literacy behaviors on students' reading achievement in the first grade and their achievement growth until the third grade. Specifically, the study used students' reading achievement scores collected for three school years, *i.e.*, from grade one to grade three, and their self-regulatory literacy behaviors observed in first grade. While examining student self-regulatory literacy behaviors, the study also considered student and familial demographic variables such as student home language, student gender, and parent education level because those variables exert significant associations as major common relationships; thus, these variables were explored to indicate whether they contribute to students' reading achievement over three school years. In addition, this study paid attention to teachers' instructional practices in literacy skills in first grade and the associations with students' reading achievement over time.

7.1 Literacy behaviors relationships

Unlike global measures of self-regulation, the literacy-specific behaviors examined in this study capture how regulatory processes are enacted within reading tasks, consistent with conceptualizations of self-regulated learning as domain- and context-dependent rather than a unitary, domain-general trait (Sinkkonen & Tapani, 2024). The present study aims to expand the understanding and predictability of students' literacy behaviors on reading achievement across time in early elementary grades. Considering the positive relationships of academic self-regulatory behaviors on students' academic performance in general, the following hypotheses for this study were addressed. First, this study examined whether there was a long-term relationship between students' literacy behaviors identified in first-grade spring 2012 and their reading achievement ranging from first- to third-grade spring. However, empirical studies on the long-

term relationships of self-regulatory behaviors on academic performance are limited (McClelland et al., 2006).

In this study, the students' self-regulated literacy behaviors positively affected their reading achievement in first grade. However, the student's literacy behaviors did not predict their reading achievement over time. The diminishing association between early self-regulated literacy behaviors and later reading achievement may reflect developmental shifts in the skills that most strongly support reading comprehension across elementary grades. In the early years of schooling, observable regulatory behaviors, such as sustained engagement, participation in literacy activities, and strategic interaction with text, may play a central role in supporting foundational comprehension. As students advance through elementary school, however, reading comprehension increasingly depends on linguistic and cognitive factors such as vocabulary knowledge, background knowledge, inferential reasoning, and comprehension monitoring, which may exert a stronger influence on achievement than early behavioral regulation (Paris & Paris, 2001; Snow, 2002).

In addition, self-regulation itself may evolve developmentally. Early self-regulation is often expressed through externally observable behaviors, whereas later grades require more internalized forms of regulation, including strategic planning, self-monitoring, and adaptive strategy use during complex reading tasks (Cleary & Zimmerman, 2012; Zimmerman, 2002). Consequently, first-grade measures of self-regulated literacy behaviors may capture regulatory processes that are developmentally salient at school entry but less directly aligned with the demands of reading comprehension in later grades. This developmental shift may help explain why early self-regulated literacy behaviors were predictive of first-grade achievement but did not demonstrate sustained relationships over time. This interpretation is consistent with longitudinal evidence indicating that behavioral self-regulation predicts early reading achievement but that its influence does not intensify across elementary grades, suggesting that regulatory processes may shift in form rather than simply increase in strength over time (Hernández et al., 2018b).

These findings support research on the relationships of self-regulatory behaviors and academic achievement. Research on self-regulated behaviors indicates that such behaviors make a significant contribution to students' early academic achievement in literacy (Boekaerts, 1999; Schunk & Zimmerman, 1997; Zimmerman, 1989; 1990). Similarly, Ponitz et al. (2009) reported positive effects of self-regulated behaviors across academic domains among kindergarten students. Consistent with this body of work, the current study aligns with evidence demonstrating positive associations between self-regulatory behaviors and reading achievement in first grade. This alignment extends to more recent findings showing that metacognitive and effort-regulation strategies continue to predict literacy outcomes in later elementary grades, even as the nature of regulatory demands becomes more complex (Ha et al., 2023).

Similarly, McClelland et al. (2007) reported that students in kindergarten have more significant academic gains if they have strong self-regulated behaviors. Mohammadi et al. (2020) observed that self-regulated learning positively relates to reading comprehension and problem-solving in students between 18 and 30 months old. In addition, Connor et al. (2016) reported that first-grade students' reading comprehension skills have a reciprocal effect on their self-regulation skills. Likewise, Howse et al. (2003) reported that high self-regulation positively affects achievement in early primary grades. However, low-level literacy skills such as letter knowledge, sound recognition, and word-level skills were measured in the abovementioned studies. There remains limited research exploring the effects of self-regulation on complex reading skills in elementary grades, despite growing evidence from intervention studies that self-regulated learning processes are malleable and can be strengthened through instructional supports (Birgisdóttir, 2015; Skibbe et al., 2019; Xu et al., 2022).

Much research on self-regulatory skills also focuses on preschool and kindergarten-age students (Day & Connor, 2017). The current study provides an important finding that showcases the positive effects of literacy behaviors and complex reading skills in elementary-age students. It is important to underscore that student engagement in behaviors such as reading books independently and fluently, interpreting stories, writing clearly, and actively contributing to class discussions are positively associated with reading achievement. For instance, the IRT scale scores report the students' foundational literacy skills and reading comprehension, definitions, supporting details, and making inferences. Thus, there is a need to develop a better understanding of how students' literacy behaviors affect complex reading skills in middle and upper elementary grades. Teachers and educational professionals could develop ways to enhance students' learning experiences and pedagogical approaches by achieving this understanding. The instructional goals could then include the development of self-regulation in students instead of only academic achievement. Moreover, because students' regulatory behaviors are sensitive to task demands and instructional context, as suggested by observational research, efforts to support self-regulation must attend not only to individual skills but also to classroom environments

and pedagogical design (Eberhart, 2024).

7.2 Demographic relationships

7.2.1 Student home language relationships

Students' home language relationships revealed that the students whose first language was not English demonstrated lower than native English-speaking students at the initial data point. This pattern is consistent with prior research indicating that students whose home language differs from the language of instruction often exhibit lower initial academic achievement due to differences in language exposure rather than underlying learning capacity, and with developmental findings suggesting that early academic trajectories are not fixed and that growth rates may differ across groups as instructional exposure and learning conditions change over time (Hernández et al., 2018b; van Laere et al., 2014). Importantly, however, students from non-English home language backgrounds demonstrated greater improvement in reading achievement over time, suggesting that increased exposure to English through formal schooling, academic instruction, and peer interaction may support accelerated literacy growth as language proficiency develops. This interpretation is consistent with longitudinal evidence indicating that language-minority bilingual students often show slower initial performance but comparable or converging growth trajectories in reading comprehension as schooling progresses, particularly when instructional exposure is sustained (Bonifacci et al., 2022). As students gain continued access to instruction in the language of schooling, linguistic proficiency and reading comprehension skills may develop at a faster rate, especially once foundational language barriers are reduced. Thus, early achievement gaps may narrow over time as instructional experiences become more aligned with students' developing language skills.

At the same time, these longitudinal gains should be interpreted cautiously. It is possible that selective attrition contributed to the observed pattern if lower-performing students were more likely to exit the analytic sample across waves. In addition, variation in family support for literacy development or potential cognitive and academic advantages associated with bilingualism may have also contributed to accelerated reading growth among some students from non-English-speaking homes. These considerations highlight the complexity of interpreting growth patterns and underscore the need for future research that directly examines these mechanisms.

In contrast, students identified as dual-language learners performed significantly lower than their English-only peers and their reading achievement did not improve across three school years. One possible explanation is that dual-language learners are simultaneously developing proficiency in two languages, which may place additional cognitive and instructional demands on early literacy development, particularly if instructional supports are not sufficiently aligned across languages (Guirguis & Antigua, 2017). This finding underscores the importance of instructional context and targeted support for dual-language learners, rather than suggesting inherent limitations in students' capacity for literacy development, consistent with evidence that learning trajectories are highly sensitive to instructional context and task demands (Eberhart, 2024).

7.2.2 Student gender relationships

Gender differences in reading achievement were also observed in this study. Female students demonstrated significantly higher reading achievement than male students at the initial data point in first grade, a pattern consistent with prior research documenting early female advantages in literacy-related skills. However, longitudinal analyses indicated that although female students maintained higher average achievement, their rate of growth in reading achievement across the early elementary years was relatively slower than that of male students. This pattern suggests that early gender differences in reading achievement may reflect developmental variation in language acquisition, engagement, or early literacy experiences rather than fixed trajectories. Prior research indicates that girls often exhibit earlier maturation in language-related skills and reading engagement, which may account for higher initial achievement. As instruction progresses and reading tasks become more complex, however, boys may demonstrate relatively greater gains, resulting in a narrowing or shifting of achievement gaps over time. Robinson and Lubienski (2011) examined gender patterns in student achievement gaps in mathematics and reading. When evaluating the students' achievement from kindergarten to eighth grade, the findings indicate no significant gap in reading achievement in kindergarten. However, gender gaps in reading achievement evolve across grade levels, underscoring the importance of examining growth patterns across development rather than single time-point comparisons.

Findings in the current study also align with meta-analytic evidence indicating that although females tend to outperform males in verbal and oral language tasks, gender differences in reading and language arts achievement are often smaller and vary across developmental stages (Petersen, 2018).

In contrast, other studies have reported persistent female advantages in reading achievement into later elementary and secondary grades (Legewie & DiPrete, 2012). This may suggest that gender patterns in literacy are not uniform and may be shaped by other factors, such as instructional context, school environment, and socioeconomic factors. Together, these findings highlight the importance of interpreting gender differences in reading achievement as dynamic and context-dependent, rather than as stable or universal disparities consistent with evidence that academic behaviors and achievement trajectories are sensitive to instructional context and task demands (Eberhart, 2024).

7.2.3 Parent education relationships

Parent education significantly contributed to the students' literacy achievement in the first wave, i.e., when the students were in first grade. In this study, the highest parent education reported was a doctoral degree, whereas the lowest educational level was the completion of eighth grade. Although this variable was not referred to as students' Socioeconomic Status (SES) and does not capture family income or parent occupation, it is assumed that the higher the education level is, the higher the family SES is. The results of the current study show that the higher the parent's education level is, the better the student's achievement in reading is.

Conclusively, these results are consistent with the general notion of research on SES and students' academic achievement (Chiu & Chow, 2015; Dolean et al., 2019; Gustafsson et al., 2011; Park & Holloway, 2016).

7.3 Teacher instructional practices in reading

This study examined the relationships between first-grade teachers' instructional practices in reading comprehension and students' reading achievement across three waves. It was hypothesized that teachers' early literacy skills practices would significantly positively affect students' academic achievement in reading across three waves. The findings indicated that the frequency of teachers' instructional practices in first-grade spring was not significantly associated with students' later reading comprehension outcomes. Although teachers' knowledge of foundational literacy skills is essential for effective instruction, prior research suggests that its relationship on student reading achievement may be indirect and mediated by instructional implementation (Moats & Foorman, 2003). This interpretation is consistent with more recent multilevel evidence indicating that teachers' language and literacy knowledge is associated with observed instructional quality, but that neither knowledge nor quality consistently predicts student outcomes once prior achievement is controlled (Guilbault et al., 2025; Parrila et al., 2024). This null finding represents an important result of the study and warrants careful interpretation.

A primary consideration in understanding this result is the manner in which instructional practices were operationalized. Teachers reported the frequency with which specific literacy skills, such as retelling stories, identifying main ideas, and recognizing text features, were taught, rather than the quality, depth, or instructional effectiveness of these practices. Prior research suggests that frequency of instruction alone may be insufficient to capture meaningful variation in instructional association, particularly when differences in instructional quality, scaffolding, and responsiveness to student needs are not assessed (Hiebert & Grouws, 2007; Pianta et al., 2012). Thus, the absence of significant associations may reflect limitations in measurement sensitivity rather than the ineffectiveness of the instructional practices themselves.

It is also possible that a threshold effect contributed to the null findings. The instructional practices examined represent foundational reading skills that are commonly emphasized in first-grade instruction. If most teachers provided instruction in these areas at or above a minimum level necessary to support reading development, variation in instructional frequency may have been insufficient to produce detectable differences in students' later reading achievement (Connor et al., 2014). In this context, instructional quality and how practices were enacted may be more influential than how often they occurred. This distinction aligns with observational evidence suggesting that students' engagement and regulatory behaviors vary systematically across instructional tasks and classroom conditions, highlighting the importance of situational and pedagogical context (Eberhart, 2024). These findings suggest that understanding the relationship of early literacy instruction requires attention not only to instructional frequency, but also

to instructional quality and potential developmental thresholds in students' reading growth.

Building on this interpretation, the findings highlight the importance of focusing instructional efforts on how literacy practices are implemented rather than on their frequency alone. Classroom instruction that explicitly supports students' self-regulatory processes during reading, such as modeling goal-setting prior to reading, prompting students to monitor comprehension during text engagement, and encouraging reflection after reading, may be particularly important for supporting sustained reading development. This emphasis is consistent with meta-analytic findings indicating that instructional interventions targeting self-regulated learning strategies produce moderate positive effects on students' academic achievement (Xu et al., 2022). Instructional approaches that emphasize scaffolding, strategic questioning, and guided discussion can help students internalize regulatory routines that extend beyond discrete skill practice. From a teacher education perspective, these findings suggest the value of preparing teachers to integrate self-regulated learning principles into literacy instruction, with attention to instructional quality, responsiveness to student needs, and the developmental progression of reading comprehension skills.

8. Limitations and future research

This study yielded informative findings associated with first-grade students' self-regulatory literacy behaviors and reading achievement across three school years. However, several limitations should be considered when interpreting the results. In the present study, parent education level was the sole indicator used to represent students' Socioeconomic Status (SES). Because students' SES is composed of multiple dimensions, future research should incorporate a broader range of SES indicators to better capture its longitudinal predictive association on reading achievement.

A primary limitation of this study is the reliance on teacher-reported measures for both students' self-regulated literacy behaviors and teachers' instructional practices in reading. Teacher ratings of student behaviors may be influenced by subjective perceptions, including expectations, stereotypes, or halo effects, which may affect how students' engagement and achievement are evaluated. Similarly, teachers' self-reports of instructional practices are based on retrospective estimates of instructional frequency and may be subject to overestimation or social desirability bias. The use of a single informant for both constructs also introduces the possibility of shared-method variance, which may have influenced the observed relationships.

In addition, the operationalization of teachers' instructional practices focused on the frequency with which specific reading activities were taught, rather than the quality, depth, or pedagogical effectiveness of instruction. While frequency of exposure provides useful information about instructional emphasis, it may not adequately capture important dimensions of instructional quality, such as scaffolding, responsiveness to student needs, or integration of strategies across lessons. Consequently, the absence of significant longitudinal associations for teachers' instructional practices may reflect limitations in measurement sensitivity rather than the ineffectiveness of the instructional strategies themselves.

Although the ECLS-K dataset offers rich, nationally representative data suitable for large-scale longitudinal analyses, the findings are also constrained by the historical and instructional context in which the data were collected. While the findings in this study are supported by research, it would be prudent to conduct additional statistical analyses that may provide a substantial understanding of the direct and indirect relationships of the independent variables observed in this study. Longitudinal studies extending beyond the elementary grades may also provide deeper insight into how instructional practices and self-regulatory behaviors interact over time to support sustained reading comprehension development.

Although hierarchical linear modeling was used to account for the nested structure of the data, the analyses did not incorporate detailed classroom- or school-level contextual variables, such as class size, instructional resources, or peer composition. These contextual factors may influence both teachers' instructional practices and students' literacy development and therefore represent potential sources of unmeasured variance. Future research incorporating richer classroom- and school-level data may further clarify the interplay between instructional practices, learning environments, and student reading outcomes.

Lastly, the selected reading skills and concepts are indicative of literacy skills that lead students to achieve text comprehension. However, it is unclear why these instructional practices did not have a positive association on student achievement. Perhaps analyzing the time spent teaching these skills could provide stronger evidence of how effectively

these skills were taught. Thus, it may be important to identify specific instructional practices for each elementary grade level. Analyzing specific reading instructional practices for each grade level may contribute to understanding the effects of this variable. Future studies are needed to explore specific teaching practices in reading skills and examine how these practices are associated with student achievement over time. Additional research focusing on teacher preparation programs, teacher certification type, and teacher experience may shed light on specific explanatory factors in teaching that may contribute to improving student achievement.

Additionally, there is a need for empirical research to examine the longitudinal relationships of self-regulated learning constructs across time in elementary-age students. These longitudinal studies may extend beyond the elementary grade levels and include middle and high school students. Furthermore, it would be interesting to investigate what aspects of self-regulatory behaviors may predict literacy academic achievement over time.

9. Conclusion

The findings in this study provide empirical support for the importance of self-regulatory literacy behaviors in early elementary-aged students' reading achievement. The longitudinal design allowed for examination of how students' early literacy-related behaviors are associated with both initial reading performance and subsequent growth over time. Results indicate literacy-specific self-regulatory behaviors are meaningfully related to early reading achievement and developmental trajectories, even as their predictive strength shifts as academic demands change across grades. Behaviors such as reading independently, participating in classroom discussions, writing clearly, and reading fluently emerged as meaningful contributors to reading achievement. In contrast, teachers' first-grade instructional practices, as measured in this study, did not demonstrate significant longitudinal associations with student achievement, underscoring the importance of how instruction is enacted rather than how frequently particular practices occur. The findings also align with prior research documenting differences in reading achievement related to student gender and parental education levels, while highlighting that these patterns are dynamic and context-dependent rather than fixed.

Collectively, these results suggest that instructional environments that extend beyond isolated reading skills to support students' engagement, strategy use, and self-regulatory capacities may play an important role in fostering early reading development and sustaining achievement growth over time. From both research and policy perspectives, these findings point to the value of integrating self-regulated learning principles into early literacy instruction and teacher preparation, with attention to instructional quality, developmental timing, and responsiveness to student needs. These findings point to the value of future research and policy efforts that integrate instructional practices and professional development explicitly focused on supporting the development of self-regulated literacy behaviors in the early elementary grades.

Conflict of interest

The authors declare no competing financial interest.

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Appendix

Teacher-Child Behavior Questionnaire to Assess Student Behaviors in Reading and Literacy.

SECTION I: LANGUAGE AND LITERACY

If you are not the child's primary teacher in this area, you may want to consult with the person most familiar with the child's progress in this area when completing these scales.

THIS CHILD...		MARK ONE RESPONSE FOR EACH ITEM.					
		Not yet	Beginning	In progress	Intermediate	Proficient	Not applicable or skill not yet taught
1	Contributes relevant information to classroom discussions—for example, during a class discussion, can express an idea or a personal opinion on a topic and the reasons behind the opinion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Understands and interprets a story or other text read to him/her—for example, by writing a sequel to a story, or dramatizing part of a story, or posing a question about why a particular story event occurred as it did.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Reads words with regular vowel sounds—for example, reads "coat," "tunk," "tent," "chimp," "halt," or "bite."	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	Reads words with irregular vowel sounds—for example, reads "through," "point," "enough," or "shower."	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	Reads first grade books independently with comprehension—for example, reads most words correctly and answers questions about what was read, makes predictions while reading, and retells a story after reading it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	Reads first grade books fluently—for example, easily reads words in meaningful phrases rather than reading word by word.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	Composes a story with a clear beginning, middle, and end.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Demonstrates an understanding of some of the conventions of print—for example, by appropriately using question marks, exclamation points, and quotation marks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	Demonstrates beginning writing skills—for example writes sentences to express ideas while correctly spelling many short words like "hop" or "bed," and, if necessary, attempts approximate phonetic spelling for more difficult words (for example, "vakashun" for "vacation").	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>