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Hierarchical linear modeling of reading motivation and literacy performance among high-achieving readers in PISA 2018

PISA 2018'de yüksek başarılı okurların okuma motivasyonu ve okuma başarılarının hiyerarşik lineer modelleme ile incelenmesi

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Abstract

This study used hierarchical linear modeling to examine the extent to which student-level enjoyment of reading and reading self-efficacy, together with country-level aggregates of student-reported instructional experiences, accounted for variation in reading literacy scores among high-achieving readers in PISA 2018. The analytic sample consisted of 19,932 students from 79 country groups who were consistently located in the highest 10% of the country-specific reading distribution across all ten reading plausible values. Student-level reading motivational resources were operationalized through enjoyment of reading and reading self-efficacy, whereas extrinsic motivational background was operationalized through country-level aggregates of student-reported instructional climate variables. These country-level indicators included adaptive instruction, teacher support, teacher enthusiasm, teacher feedback, stimulation of reading engagement, and teacher-directed instruction. The results showed that enjoyment of reading and reading self-efficacy were positively associated with reading literacy scores, although the magnitudes of these associations were modest. At the country level, adaptive instruction was positively associated with reading literacy scores, whereas teacher support and teacher-directed instruction showed negative conditional associations. Teacher enthusiasm, teacher feedback, and stimulation of reading engagement were not statistically reliable predictors in the full model. The findings indicate that adaptive instructional conditions may be especially important for explaining variation in advanced reading performance among high-achieving readers.

Keywords: *Reading-related motivation, intrinsic motivation, extrinsic motivation, reading literacy scores, PISA 2018*

Öz

Bu araştırmada PISA 2018'de yüksek başarılı okurların okuma puanlarındaki değişkenliğin öğrenci düzeyindeki okuma zevki ve okuma öz yeterliği ile ülke düzeyinde toplulaştırılan öğrenci bildirimli öğretim deneyimleri tarafından ne ölçüde açıklandığı hiyerarşik lineer modelleme ile incelenmiştir. Araştırma örneklemi ülke bazlı okuma başarısı dağılımında on olası değerin tamamında en yüksek %10'luk dilimde tutarlı biçimde yer alan 79 ülke grubundan 19.932 öğrenciden oluşmuştur. Öğrenci seviyesindeki okumayla ilişkili motivasyon kaynakları, okuma zevki ve okuma öz yeterliği ile temsil edilmiştir. Dış motivasyonun arka planı ise öğrencilerin bildirdiği öğretim iklimi değişkenlerinin ülke seviyesindeki ortalamalarıyla ele alınmıştır. Bu ülke seviyesindeki göstergeler uyarlanabilir öğretim, öğretmen desteği, öğretmen coşkusu, öğretmen geri bildirimi, okuma katılımını teşvik etme ve öğretmen yönlendirmeli öğretim değişkenlerinden oluşmuştur. Bulgular okuma zevki ve okuma öz yeterliğinin okuma başarısıyla pozitif ancak sınırlı seviyede ilişkili olduğunu göstermiştir. Ülke seviyesinde uyarlanabilir öğretim okuma başarısıyla pozitif ilişkiliyken, öğretmen desteği ve öğretmen yönlendirmeli öğretim şartlı olarak negatif ilişkiler göstermiştir. Öğretmen coşkusu, öğretmen geri bildirimi ve okumaya katılımı teşvik etme değişkenleri tam modelde istatistiki olarak anlamlı açıklayıcılar olmamıştır. Bulgular yüksek başarılı okurların homojen bir grup olmadığını ve uyarlanabilir öğretim şartlarının ileri seviye okuma performansını sürdürmede özellikle kıymetli olabileceğini göstermektedir.

Anahtar Kelimeler: *Okumayla ilişkili motivasyon, iç motivasyon, dış motivasyon, okuma başarısı, PISA 2018*

Introduction

Reading literacy performance is a central indicator of students' educational development because it reflects their capacity to understand, interpret, evaluate, and use written texts for learning (Afflerbach et al., 2020). In school contexts, reading functions as a foundation for learning across subject areas (Akhmetova et al., 2022). Students who reach advanced levels of reading literacy performance are therefore not only successful readers, but also learners who can use texts to access complex information, construct meaning, and participate more effectively in academic life (Brighton et al., 2015). Accordingly, explaining why reading literacy scores vary even among students who perform at advanced levels remains an important issue in education.

Reading literacy performance, however, cannot be understood only as the result of cognitive skill (Sağlam et al., 2023). Students' motivational orientations influence how they approach texts, how persistently they engage with reading tasks, and how confidently they respond to demanding comprehension situations (Göktentürk & Oluşan, 2026). Research shows that motivation is significantly related to reading literacy performance, yet this relationship varies according to the motivational construct examined (Toste et al., 2020). Therefore, reading motivation should not be treated as a single undifferentiated factor; different motivational dimensions may contribute to reading literacy performance through different pathways.

This multidimensional perspective is particularly important for high-achieving readers. Students at the upper end of the reading literacy distribution may share advanced performance, but they do not necessarily constitute a homogeneous group in terms of their motivational characteristics or instructional experiences (Ziernwald et al., 2022). Some may approach complex texts with greater enjoyment and stronger perceptions of competence, whereas others may attain high scores despite less favorable motivational orientations. Their classroom experiences may also differ in the extent to which instruction provides appropriate challenge, support, feedback, and opportunities for independent engagement. Research on advanced readers further indicates that instruction does not always address the needs of students who already perform at high levels (Brighton et al., 2015; Reis & Fogarty, 2022). Explaining variation within this group therefore requires attention to both student-level motivational resources and the instructional conditions in which reading takes place.

Motivation theories differ in the aspects of motivated behavior they emphasize. Some approaches focus primarily on students' expectations of success and the value they attribute to a task, whereas others emphasize competence beliefs, achievement goals, or the regulatory reasons underlying participation in an activity (Schiefele et al., 2012; Toste et al., 2020). Self-determination theory (SDT) is particularly relevant to the present study because it distinguishes forms of motivation according to their source and quality of regulation. Intrinsic motivation refers to engaging in an activity because the activity itself is experienced as interesting, enjoyable, or inherently satisfying (Arens & Möller, 2025). Extrinsic motivation refers to engaging in an activity to attain an outcome that is separable from the activity itself (Ives et al., 2023). However, SDT does not treat all extrinsic motivation as equally controlled. Extrinsic regulation ranges from externally imposed behavior to more autonomous forms in which the value of the activity has been internalized (Ryan & Deci, 2020).

This theoretical distinction is important for the present study because intrinsic and extrinsic motivation concern students' reasons for engaging in reading. An instructional condition located outside the student is not, by itself, equivalent to the student's extrinsic motivation. Teacher support, feedback, enthusiasm, or instructional direction may shape the quality of students' motivation, but these conditions do not directly measure whether students read for rewards, approval, obligation, personal importance, or inherent enjoyment.

Intrinsic reading motivation is especially relevant for understanding high achievers because advanced reading requires sustained engagement with complex texts (Suárez-Fernández & Boto-García, 2022). Enjoyment of reading reflects the extent to which students value reading as an interesting and personally rewarding activity (Cai et al., 2024) and may support engagement with texts beyond external requirements (Göktentürk & Oluşan, 2026). Reading self-efficacy is another central motivational resource because it concerns students' beliefs about their own competence as readers (Li et al., 2022). Students who perceive themselves as capable readers may approach difficult texts with greater confidence and persistence Sağlam et al., 2023). Thus, enjoyment of reading and reading self-efficacy represent complementary aspects of students' motivational functioning: interest/value and perceived competence.

The PISA 2018 reading framework likewise treats motivation as multidimensional. It distinguishes motivation, which concerns readers' goals, values, and beliefs, from engagement, which is manifested through effort, time, and persistence (OECD, 2019b, 2019d). In the previous PISA cycles in which reading was the major domain, the principal motivational constructs were interest in reading and intrinsic motivation (OECD, 2010). PISA 2018 extended this perspective by including competence-related constructs concerning students' perceived competence and perceived difficulty in reading (OECD, 2019a). The PISA 2018 questionnaire framework also identifies SDT as one of the theoretical foundations for selecting teaching practices intended to support reading engagement and motivation. According to this framework, supportive family and school contexts can strengthen students' confidence, autonomy, ownership of reading activities, and self-determined engagement (OECD, 2019a). Accordingly, the present study distinguishes student-level reading motivational resources from country-level instructional conditions. Enjoyment of reading and reading self-efficacy represent interest/value and perceived competence, whereas adaptive instruction, teacher support, teacher enthusiasm, teacher feedback, stimulation of reading engagement, and teacher-directed instruction are treated as extrinsic motivational background indicators. This label refers to external conditions with motivational relevance; it does not imply that these variables directly measure students' extrinsic motivational regulation.

PISA 2018 provides a suitable empirical context for examining high achievers because reading was the major assessment domain in that cycle, and the assessment framework treated reading as both a cognitive skill and a domain connected to engagement with texts (OECD, 2019a). PISA 2018 also included student questionnaire indicators related to reading enjoyment and classroom practices in language-of-instruction lessons. These indicators make it possible to examine how student motivation and instructional climate are associated with reading performance in a large cross-national dataset (OECD, 2019d). Because PISA data are hierarchically structured and students are located within national or country-group contexts, a multilevel approach is necessary to distinguish student-level motivational variation from between-country instructional-climate variation (OECD, 2018). This analytic structure is directly aligned with the problem addressed in this study because high-achieving readers' performance may be differentiated simultaneously by their own motivational resources and by the broader instructional climates in which they learn. The theoretical rationale for using SDT and the empirical literature concerning the selected motivational and instructional variables are presented in the following section. The research gap and problem statement are then formulated on the basis of this theoretical and empirical background.

Theoretical Background and Literature Review

SDT provides the theoretical basis for examining reading-related motivation in the present study because it offers a framework for understanding both the quality of students' motivation and the role of the learning environment in supporting or constraining that motivation (Alamer et al., 2025;

Göktentürk & Oluşan, 2026). The theory proposes that social and instructional conditions can strengthen or weaken the basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2012). When these needs are supported, students are more likely to engage willingly, internalize the value of learning activities, and persist in challenging tasks; when they are constrained, motivation may become controlled or engagement may decline (Ryan & Deci, 2020; Svrcek & Abugasea Heidt, 2022). This framework is especially useful in the reading domain because successful reading requires not only cognitive processing but also sustained engagement, perceived competence, and willingness to interact with complex texts (Karatay, 2023).

The selection of SDT is also consistent with the theoretical organization of the PISA 2018 questionnaire. PISA does not employ one motivation theory to explain every student and instructional variable. Its broader framework includes constructs related to interest, intrinsic motivation, competence beliefs, goals, attitudes, teaching practices, and classroom support (OECD, 2019b, 2019d). Nevertheless, PISA 2018 explicitly connects practices that support reading engagement and motivation with SDT. It proposes that supportive school and classroom contexts may enhance students' confidence in their reading ability, autonomy in directing their reading activities, and intrinsically motivated or self-determined reading engagement (OECD, 2019a). Practices intended primarily to enhance reading skills and metacognitive strategies are additionally informed by direct-instruction approaches and multidimensional models of teaching quality. SDT is therefore used in the present study as an integrative motivation framework, not as a claim that all selected PISA variables constitute direct measures of intrinsic or extrinsic regulation.

Research using PISA data has similarly considered motivational beliefs and instructional conditions as related but analytically distinct components of reading performance. PISA-based research has examined, for example, relationships among teacher feedback, reading self-concept, classroom conditions, and reading performance (Ma et al., 2022); differences in the contribution of instructional practices across high-performing education systems (Ho & Gan, 2023); and the links between teacher enthusiasm, stimulation of reading engagement, students' enjoyment, and reading outcomes (OECD, 2019d; Zhang & Zhu, 2025). Such studies indicate that instructional practices can have motivational significance without being treated as direct measurements of students' extrinsic regulation.

Within this framework, enjoyment of reading and reading self-efficacy represent two complementary student-level motivational resources. Enjoyment of reading is most directly aligned with intrinsic motivation because it reflects interest and inherent satisfaction in reading (Cai et al., 2024; Ma et al., 2023). Reading self-efficacy reflects perceived competence and may shape confidence, effort, and persistence (Baldwin & Nadelson, 2023). In the present study, the six instructional variables were conceptualized as extrinsic motivational background indicators because they represent external classroom conditions that may support or constrain competence, autonomy, relatedness, and engagement (OECD, 2019d; Ryan & Deci, 2020). This distinction permits the individual and instructional dimensions of reading-related motivation to be examined together without treating them as conceptually identical.

High-achieving readers require particular attention because high achievement is not necessarily homogeneous (Ziernwald et al., 2022). Students at the upper end of the reading literacy distribution may share advanced performance, yet they can differ in motivational-affective characteristics and instructional experiences that support or constrain their continued development (Brighton et al., 2015). Research on advanced readers has also indicated that classroom instruction may not always address the learning needs of students who already perform at high levels (Reis & Fogarty, 2022). Therefore, examining reading-related motivation among high achievers can clarify how reading literacy performance differs within an already success-

ful group. This focus is important because motivational and instructional factors that explain variation in general student populations may not operate in the same way among students who already perform at the upper end of their national reading distributions.

Intrinsic reading motivation and reading literacy performance

Enjoyment of reading is one of the clearest indicators of intrinsic reading motivation. It reflects the extent to which students experience reading as interesting, satisfying, and personally valuable (Cheema, 2018). This construct aligns with SDT's view of intrinsic motivation as activity engagement based on inherent satisfaction (Ryan & Deci, 2020). In reading, enjoyment may encourage voluntary reading, deeper textual interaction, and sustained attention during demanding tasks (Ma et al., 2023). Motivation is significantly associated with reading literacy performance among K–12 students, although the strength of this association differs across motivational constructs (Toste et al., 2020). Recent research also indicates that intrinsic reading motivation is related to broader school performance and motivation in the language domain (Arens & Möller, 2025; Yoon et al., 2026). Taken together, these studies suggest that enjoyment of reading is not merely an affective preference, but a motivational resource that may help explain why some high-achieving readers remain more engaged with complex reading tasks than others.

Reading self-efficacy represents the competence-related dimension of students' motivational functioning (Göktentürk et al., 2025). It refers to students' beliefs about their capability to understand texts, complete reading tasks, and respond successfully to reading challenges (Chen et al., 2021). Self-efficacy is closely aligned with the competence need emphasized in SDT because students who feel capable are more likely to persist, regulate effort, and engage with demanding academic tasks (Ryan & Deci, 2020; Yeh et al., 2023). Reading-motivation research indicates that competence-related beliefs are linked to reading engagement and performance (Çalışkan & Göktentürk, 2026; Toste et al., 2020), and recent work has emphasized the association of reading self-efficacy with strategy use, motivation, and reading performance (Göktentürk et al., 2025). For high-achieving readers, reading self-efficacy may be especially relevant because advanced reading tasks require confidence in handling complex texts, monitoring comprehension, and sustaining effort when interpretation becomes demanding.

Extrinsic motivational background and reading literacy performance

Within an SDT framework, the motivational processes involved in reading are shaped not only by students' interest and competence beliefs but also by the instructional environments in which reading activities take place. Instructional conditions may support or constrain students' perceived competence, autonomy, relatedness, and willingness to engage with texts (Ryan & Deci, 2020). In this respect, adaptive instruction, teacher support, teacher enthusiasm, teacher feedback, stimulation of reading engagement, and teacher-directed instruction constitute motivationally relevant features of the reading-related instructional environment. Together, these conditions form the extrinsic motivational background through which students experience reading tasks as more or less meaningful, manageable, engaging, and supportive of sustained effort.

Adaptive instruction concerns the extent to which teaching responds to students' learning needs (OECD, 2019d). In SDT terms, adaptive instruction may support competence when it provides appropriate structure, challenge, and guidance without undermining students' agency (Ryan & Deci, 2020; Wong & Wong, 2021). It may also help teachers adjust explanations, tasks, or support according to students' readiness and understanding (Wang et al., 2023; Wong & Wong, 2021). This is particularly relevant for high-achieving readers because advanced readers may require instruction that extends existing competence rather

than repeating routine practice (Reis & Fogarty, 2022). Such differentiation is important because high achievers' needs may remain unmet in classrooms designed primarily around average performance levels (Ziernwald et al., 2022).

Teacher support reflects the relational and instructional assistance students perceive from their teachers (OECD, 2019d). From an SDT perspective, supportive teaching can contribute to relatedness and competence when students feel understood and effectively assisted (Ryan & Deci, 2020). Empirical research grounded in SDT has shown that teacher support is meaningfully related to students' motivational functioning (Banerjee & Halder, 2021). In reading-related classrooms, such support may help students maintain effort during challenging comprehension tasks (Sağlam et al., 2023). PISA 2018 reporting also showed that students who perceived greater teacher support tended to score higher in reading after accounting for socioeconomic profiles (OECD, 2019d). However, teacher support may not operate uniformly across all achievement groups. Among high-achieving readers, general assistance may be beneficial when it is combined with intellectual challenge and autonomy-supportive guidance, but it may be less explanatory when it reflects broad support rather than advanced reading extension.

Teacher enthusiasm represents the affective energy, interest, and involvement that teachers communicate during instruction (Shao, 2023). Enthusiastic teachers may help students perceive reading-related activities as meaningful and worthy of attention. This is theoretically relevant because motivationally supportive environments can strengthen students' engagement and enjoyment (Lazarides et al., 2018; OECD, 2019d). Prior research has shown that teacher enthusiasm is associated with students' motivational experiences, including enjoyment and engagement (Lazarides et al., 2018; Shao, 2023). PISA 2018 further indicated that teacher enthusiasm and stimulation of reading engagement were among the teaching practices most strongly associated with students' enjoyment of reading (OECD, 2019d). Accordingly, teacher enthusiasm is conceptually relevant for this study because it may shape the motivational climate in which students encounter reading-related tasks, even if its direct association with reading literacy scores may depend on how enthusiasm is connected to cognitively demanding reading instruction.

Teacher feedback is treated as an instructional component of the extrinsic motivational background rather than as a direct measure of students' extrinsic motivation. It can support competence when it provides useful information about students' strengths, areas for improvement, and strategies for progress (OECD, 2019d). Within SDT, feedback is more likely to support motivation when it is informational rather than controlling (Zhang et al., 2024). In reading instruction, feedback may help students refine comprehension strategies and address difficulties in complex texts (Carless & Winstone, 2023). Multilevel research using PISA reading data has shown that teacher feedback can be related to reading literacy performance through students' reading self-concept and classroom climate conditions (Ma et al., 2022). For high-achieving readers, feedback may be especially meaningful when it is specific, strategy-oriented, and directed toward deeper interpretation rather than limited to general praise or correction.

Teachers' stimulation of reading engagement is a reading-specific dimension of extrinsic motivational background (Göktentürk & Oluşan, 2026; Zhang & Zhu, 2025). It refers to instructional practices that encourage students to become interested in texts, participate in reading activities, and connect reading with meaningful purposes (Urfali Dadandi & Dadandi, 2022; Zhang & Zhu, 2025). This variable is closely aligned with SDT because reading engagement is more likely to develop when students experience reading as meaningful rather than merely required (Ryan & Deci, 2020). Motivational reading interventions have been shown to improve both reading motivation and reading performance, suggesting that classroom practices designed to stimulate engagement can matter for reading outcomes (McBreen & Savage, 2021). PISA 2018 also identified teachers' stimulation of reading engagement as one of the teaching

practices most strongly associated with students' enjoyment of reading (OECD, 2019d). Therefore, stimulation of reading engagement was included as a reading-specific instructional climate indicator that may help explain whether high-achieving readers encounter classroom practices that sustain interest in texts and meaningful reading participation.

Teacher-directed instruction has a more complex theoretical position than the other extrinsic motivational background indicators. It can provide structure, clarify expectations, and support competence when students need guidance in approaching reading tasks (Schweder et al., 2026; Schweder & Raufelder, 2022). However, highly directive instruction may be less supportive of autonomy if students experience it as controlling or limiting (Ho & Gan, 2023). This tension may be especially relevant for high-achieving readers because they may benefit from structure in some situations while also requiring autonomy, challenge, and opportunities for deeper textual exploration (Sağlam et al., 2023). Because teacher-directed instruction may operate differently across instructional contexts, its association with reading literacy scores was examined without specifying direction (OECD, 2019d). This non-directional treatment is important because teacher-directed instruction may function as supportive structure in some contexts but as autonomy-limiting control in others.

Overall, the theoretical and empirical literature supports examining high-achieving readers through both student-level motivational resources and motivationally relevant instructional conditions. Enjoyment of reading represents students' inherent interest and satisfaction in reading, whereas reading self-efficacy represents their perceived competence in responding to reading demands. Adaptive instruction, teacher support, teacher enthusiasm, teacher feedback, stimulation of reading engagement, and teacher-directed instruction represent external features of students' reading-related instructional experiences. SDT provides a basis for considering these two sets of factors together because it explains how instructional contexts may support or constrain competence, autonomy, relatedness, internalization, and sustained engagement.

Despite this theoretical and empirical basis, an important problem remains. Reading motivation is widely linked to reading performance, and motivational reading interventions have shown positive effects on reading outcomes and motivation (McBreen & Savage, 2021; Toste et al., 2020). However, less is known about how reading-related intrinsic motivational resources and extrinsic motivational background indicators operate specifically among high-achieving readers. Much of the existing literature focuses on general student populations (OECD, 2019c), while fewer studies isolate students who consistently perform at the top of their national reading distributions (Ziernwald et al., 2022).

Consequently, it remains unclear whether variation in high achievers' reading performance is differentiated primarily by their enjoyment of reading and reading self-efficacy, by broader instructional-climate indicators, or by the combined contribution of both. The problem addressed in the present study is therefore the limited understanding of how student-level motivational resources and country-level instructional conditions jointly differentiate reading literacy performance within an already high-performing group. The study goes beyond testing simple bivariate associations by examining whether these two sets of variables jointly explain variation in PISA 2018 reading literacy scores among high-achieving readers.

Research Question and Hypotheses

Building on this theoretical and empirical background, the study addressed the following research question:

RQ. How are reading-related motivational variables associated with PISA 2018 reading literacy scores among 15-year-old high-achieving readers?

Because the study uses cross-sectional large-scale assessment data, the hypotheses concern

statistical associations rather than causal effects. The hypotheses were formulated as follows:

- H[1]. Enjoyment of reading is positively associated with reading literacy scores among high-achieving readers.
- H2. Reading self-efficacy is positively associated with reading literacy scores among high-achieving readers.
- H3. Adaptive instruction is positively associated with reading literacy scores among high-achieving readers.
- H4. Teacher support is significantly associated with reading literacy scores among high-achieving readers.
- H5. Teacher enthusiasm is significantly associated with reading literacy scores among high-achieving readers.
- H6. Teacher feedback is significantly associated with reading literacy scores among high-achieving readers.
- H7. Stimulation of reading engagement is significantly associated with reading literacy scores among high-achieving readers.
- H8. Teacher-directed instruction is significantly associated with reading literacy scores among high-achieving readers.

Method

Data and participants

The present study used the PISA 2018 student questionnaire and reading literacy scores. PISA 2018 was selected because reading was the major assessment domain in this cycle, and the student questionnaire included several reading- and language-of-instruction-lesson-related motivational and instructional variables (OECD, 2019a). The analytic sample was constructed from the PISA 2018 student dataset. Reading literacy performance was represented by the ten PISA 2018 reading plausible values, PV1READ to PV10READ. Because plausible values are multiple draws from each student's latent reading-proficiency distribution, all ten values were used separately in both high-achiever classification and model estimation. They were not averaged into a single outcome; instead, the results were combined at the estimate level (Aparicio et al., 2022; OECD, 2018).

High achievers were identified separately within each participating country. The top 10% threshold was selected to identify students at the upper end of the country-specific reading literacy distribution while retaining sufficient within-country sample size for multilevel modeling. A student was retained in the analytic sample only if the student was located in the highest 10% of the country-specific reading distribution for all ten plausible values. This conservative rule was used to reduce classification instability due to plausible-value uncertainty and to ensure that the final analytic group represented consistently high-performing readers rather than students whose classification depended on a single plausible value (Saglam & Goktenturk, 2024). After applying this criterion, the analytic sample included 19,932 students from 79 country groups. The country identifier CNTRYID was retained as the clustering variable (OECD, 2018).

Measures

Reading literacy scores were the dependent variable. They were operationalized using all ten PISA 2018 reading plausible values, PV1READ–PV10READ (OECD, 2018). The student-level motivational variables and country-level extrinsic motivational background indicators are described in the following sections. Table 1 presents the variables, their analytical levels, and the corresponding PISA codes and labels.

Student-level reading motivational resources

Two student-level motivational resources were included: enjoyment of reading and reading self-efficacy. *Enjoyment of reading* was measured using five items: ST160Q01IA, ST160Q02IA, ST160Q03IA, ST160Q04IA, and ST160Q05IA. Items ST160Q01IA, ST160Q04IA, and ST160Q05IA were reverse coded so that higher scores represented greater enjoyment of reading

(OECD, 2019c). A composite score was computed by averaging the five items within each imputed dataset.

Reading self-efficacy was operationalized in the present study using six ST161 items: ST161Q01HA, ST161Q02HA, ST161Q03HA, ST161Q06HA, ST161Q07HA, and ST161Q08HA. In the PISA 2018 framework, the first three items assess perceived competence in reading, whereas the latter three assess perceived difficulty in reading (OECD, 2019a, 2019c). The interpretation of perceived reading competence as a reading self-efficacy construct is also consistent with prior PISA-based research (Urfali Dadandi & Dadandi, 2022). In the present study, the perceived-difficulty items were reverse coded so that all six items indicated stronger perceived reading competence in the same direction. The items were then averaged to form a study-specific reading self-efficacy composite, following the six-item operationalization adopted in earlier PISA-based research (Sağlam et al., 2023). This composite should therefore be understood as the operationalization adopted in the present study rather than as an official six-item PISA index.

Country-level aggregates of student-reported instructional experiences

The contextual predictors were constructed as country-level aggregates of student-reported language-of-instruction-lesson experiences. They represent between-country indicators of the motivational and instructional climate reported by high-achieving students (OECD, 2018). Six instructional variables were included: adaptive instruction, teacher support, teacher enthusiasm, teacher feedback, teachers' stimulation of reading engagement, and teacher-directed instruction (OECD, 2019d). Although PISA provides scaled indices for several constructs, this study reconstructed item-level composites to maintain a consistent item-level missing-data and reliability workflow across all selected variables. For each instructional variable, student-level composites were first created within each imputed dataset.

Table 1. Variables

Construct	Level in analysis	Item codes and labels
Gender	Student level	ST004D01T: 1: female; 2: male.
Immigration background	Student level	IMMIG: 1: native student; 2: second-generation immigrant student; 3: first-generation immigrant student.
Socioeconomic status	Student level	ESCS: PISA index of economic, social, and cultural status.
Enjoyment of reading	Student level	ST160Q01IA: I read only if I have to (RC); ST160Q02IA: Reading is one of my favourite hobbies; ST160Q03IA: I like talking about books with other people; ST160Q04IA: For me, reading is a waste of time (RC); ST160Q05IA: I read only to get information that I need (RC).
Reading self-efficacy	Student level	ST161Q01HA: I am a good reader; ST161Q02HA: I am able to understand difficult texts; ST161Q03HA: I read fluently; ST161Q06HA: I have always had difficulty with reading (RC); ST161Q07HA: I have to read a text several times before completely understanding it (RC); ST161Q08HA: I find it difficult to answer questions about a text (RC).
Adaptive instruction	Country aggregate	ST212Q01HA: The teacher adapts the lesson to my class's needs and knowledge; ST212Q02HA: The teacher provides individual help when a student has difficulties; ST212Q03HA: The teacher changes the structure of the lesson on a topic that most students find difficult to understand.
Teacher support	Country aggregate	ST100Q01TA: The teacher shows an interest in every student's learning (RC); ST100Q02TA: The teacher gives extra help when students need it (RC); ST100Q03TA: The teacher helps students with their learning (RC); ST100Q04TA: The teacher continues teaching until the students understand (RC).
Teacher enthusiasm	Country aggregate	ST213Q01HA: It was clear to me that the teacher liked teaching us; ST213Q02HA: The enthusiasm of the teacher inspired me; ST213Q03HA: It was clear that the teacher likes to deal with the topic of the lesson; ST213Q04HA: The teacher showed enjoyment in teaching.
Teacher feedback	Country aggregate	ST104Q02NA: The teacher gives me feedback on my strengths in this subject; ST104Q03NA: The teacher tells me in which areas I can still improve; ST104Q04NA: The teacher tells me how I can improve my performance.
Stimulation of reading engagement	Country aggregate	ST152Q05IA: The teacher encourages students to express their opinion about a text; ST152Q06IA: The teacher helps students relate the stories they read to their lives; ST152Q07IA: The teacher shows students how the information in texts builds on what they already know; ST152Q08IA: The teacher poses questions that motivate students to participate actively.
Teacher-directed instruction	Country aggregate	ST102Q01TA: The teacher sets clear goals for our learning (RC); ST102Q02TA: The teacher asks questions to check whether we have understood what was taught (RC); ST102Q03TA: The teacher presents a short summary of the previous lesson (RC); ST102Q04TA: The teacher tells us what we have to learn (RC).

Note. RC: Reverse coded.

Weighted country means were then computed using the student final weight, W_FSTUWT (OECD, 2018), and the resulting country-level aggregates

were standardized across country groups before model estimation.

Control Variables

The control variables presented in Table 1 were included because prior large-scale reading research consistently shows that reading literacy scores vary according to students' demographic, migration-related, and socioeconomic characteristics (OECD, 2019b, 2019c). Including them allowed the focal motivational associations to be estimated after accounting for major background differences. Gender was represented by ST004D01T and coded as 1: female and 2: male. Immigration background was represented by IMMIG and coded as 1: native student, 2: second-generation immigrant student, and 3: first-generation immigrant student, with native students used as the reference category. Socioeconomic status was represented by the PISA index of economic, social, and cultural status, ESCS. ESCS was standardized before model estimation (OECD, 2019a).

Data analysis

Data preparation

The analysis proceeded in four stages: data preparation, missing-data treatment, descriptive and reliability analyses, and multilevel modeling using all ten reading plausible values. PISA-specific missing-value codes and labelled responses were converted into analyzable numeric or categorical formats. All selected questionnaire items were checked for coding direction before composite-score construction. Reverse coding was completed before scale construction so that higher scores consistently indicated higher levels of the target construct. After reverse coding, all composite scores were constructed within each imputed dataset rather than before imputation.

Sampling weights were incorporated using W_FSTUWT (OECD, 2018). Because the analytic sample was constructed as the country-specific top 10% of reading performers, weights were normalized within CNTRYID before multilevel model estimation. Operationally, each student's final weight was divided by the mean final weight within the same country group. This procedure preserved relative student weights within country groups while preventing countries with larger original population weights from dominating the pooled multilevel estimates. All analyses were conducted in R. The haven, *dplyr*, and *tidyr* packages were used for data import and management. Multiple imputation was implemented using *mice* (van Buuren & Groothuis-Oudshoorn, 2011), and the hierarchical linear models were fitted using *lme4* (Bates et al., 2015).

Missing data and multiple imputation

The initial high-achiever dataset contained 19,932 students. Before imputation, missing-data proportions were examined for the focal questionnaire items and control variables. Across the 33 questionnaire items used to construct the motivational and instructional variables, item-level missingness ranged from 2.10% to 4.23%. Overall, 1,564 students (7.85%) had at least one missing response in the focal item set, and 1,821 students (9.14%) had at least one missing value when the focal items and control variables were considered together. Gender had no missing values, ESCS had 77 missing values (0.39%), and immigration background had 311 missing values (1.56%). The country identifier, student final weight, and ten reading plausible values had no missing values.

Missing item responses were handled using multiple imputation by chained equations with predictive mean matching, which preserves observed response distributions and avoids generating implausible values for ordinal questionnaire items (Austin & van Buuren, 2025). Multiple imputation was conducted under a missing-at-random assumption conditional on the observed variables included in the imputation model (White et al., 2011). The imputation model included all variables used in the substantive analyses, all item-level indicators

used to construct the motivational and instructional variables, gender, ESCS, immigration background, the ten reading plausible values, and the student final weight. Following recommendations for inclusive imputation models, two auxiliary variables were added to improve the prediction of missing questionnaire responses: the mean of the ten reading plausible values and the log-transformed student final weight (Collins et al., 2001; White et al., 2011). The mean reading plausible value was used only as an auxiliary predictor in the imputation model and was not used as the outcome variable in the inferential models. Country identifier, raw weights, and individual reading plausible values were retained for analysis but were not imputed.

Following the practical guideline proposed by White et al. (2011), the 9.14% proportion of cases with at least one incomplete analytical variable indicated that approximately 10 imputations would constitute a reasonable minimum. Because increasing the number of imputations reduces Monte Carlo variation in pooled standard errors, confidence intervals, and *p* values (Bodner, 2008), the number of imputations was set substantially above the approximate minimum. The value of 60 was not derived mechanically from the 9.14% missingness rate; it was selected as a conservative and computationally feasible design choice to reduce Monte Carlo variation across the repeated plausible-value and hierarchical-model analyses.

For descriptive statistics and reliability coefficients, estimates were summarized across imputed datasets descriptively. For multilevel fixed effects, regression coefficients and standard errors were first pooled across imputed datasets using Rubin's rules (Little & Rubin, 2002; Rubin, 2018). Plausible-value estimates were then combined so that both missing-data uncertainty and plausible-value uncertainty were reflected in the final standard errors and confidence intervals.

Reliability analysis

Following the reliability-analysis procedure described by Demir (2020), internal consistency was evaluated for each multi-item scale using Cronbach's alpha within each completed dataset. For the instructional constructs, internal consistency was evaluated using the student-level item responses before the resulting composite scores were aggregated to the country level. The resulting coefficients were then summarized descriptively across imputations to describe scale consistency.

Multilevel hierarchical linear modeling

A two-level hierarchical linear modeling framework was used because high-achieving students were nested within country groups. The Level-1 units were high-achieving students, and the Level-2 units were country groups identified by CNTRYID (OECD, 2018). This specification allowed the models to estimate within- and between-country variation among high-achieving readers.

Each of the four model specifications was estimated separately for the ten reading plausible values in every completed dataset. The resulting estimates were pooled first across imputations and then across plausible values, following the procedure described above. Thus, the inferential results incorporated both missing-data and plausible-value uncertainty without averaging the plausible values into a single score (Aparicio et al., 2022; Rubin, 2018). Across the four specifications, this procedure involved 2,400 model fits.

Following a sequential model-building strategy (Garson, 2013; Nezlek, 2023), four models were specified. Model 0 was an unconditional model used to estimate the intraclass correlation coefficient and partition reading-literacy-score variance between students and country groups. Model 1 introduced gender, ESCS, and immigration background. Model 2 added enjoyment of reading and reading self-efficacy. Model 3 added the country-level aggregates of adaptive instruction, teacher support, teacher enthusiasm, teacher feedback, teachers' stimulation of reading engagement, and teacher-directed instruction.

The final model results were reported using standardized estimates. Standardized versions of

the reading plausible values were created within each imputed dataset, and the hierarchical linear models were re-estimated using these standardized outcomes. Continuous coefficients therefore indicate the expected standard-deviation change in reading literacy scores associated with a one-standard-deviation difference in each predictor, holding other predictors constant (Luke, 2019). For categorical variables, standardized estimates indicate standardized differences relative to the reference category (Peugh, 2010).

Model comparison was conducted descriptively by refitting the same sequence with maximum-likelihood estimation. Akaike information criterion (AIC) and Bayesian information criterion (BIC) values were calculated for each fitted model and then averaged across imputations and plausible values. Lower values indicated comparatively better fit, with AIC placing less emphasis on parsimony than BIC (Akaike, 1998; Vrieze, 2012). Because the indices were averaged across the completed datasets and plausible values, they were interpreted as descriptive model-comparison indicators rather than as single-sample likelihood tests.

A missingness-pattern sensitivity analysis was conducted to examine whether the findings were robust to pre-imputation missingness patterns (Wang & Daniels, 2011). Missingness patterns were defined according to the number of missing responses across the 33 questionnaire items used to construct the student-level motivational and country-level instructional variables before imputation. Students were classified as complete cases (0 missing responses), low-missingness cases (1–2 missing responses), moderate-missingness cases (3–9 missing responses), or high-missingness cases (10 or more missing responses).

Indicators representing these categories, together with their interactions with enjoyment of reading and reading self-efficacy, were added to the full model to examine whether the focal associations changed after adjustment for pre-imputation missingness patterns.

Random-slope models were estimated as robustness checks to examine whether the associations between the focal student-level predictors and reading literacy scores varied across country groups (M. D. Bates et al., 2014). Random slopes were tested separately for enjoyment of reading, reading self-efficacy, and ESCS by allowing each association to vary across CNTRYID while retaining the fixed-effect structure of the full model. Each random-slope specification followed the same estimation and pooling procedure used for the main models. The random-slope models were examined to determine whether the pooled fixed-effect conclusions remained stable when the focal student-level associations were allowed to vary across country groups.

Results

Descriptive statistics

The final analytic sample consisted of 19,932 high-achieving students nested within 79 country groups. The weighted mean reading literacy score across plausible values was 623.71 (SD = 70.47). The weighted mean of ESCS was 0.41 (SD = 0.87), indicating that the high-achieving students were socioeconomically above the OECD-centered reference point on average. The mean scores were 3.17 (SD = 0.65) for enjoyment of reading and 3.25 (SD = 0.46) for reading self-efficacy. Table 2 pre-

Table 2. Descriptive statistics and reliability estimates

Variable	Level in analysis	Mean	SD	Min	Max	Mean α
Reading literacy scores (PV1–PV10)	Student level	623.71	70.47	441.66	928.69	—
ESCS	Student level	0.41	0.87	-4.84	3.35	—
Enjoyment of reading	Student level	3.17	0.65	1.00	4.00	.85
Reading self-efficacy	Student level	3.25	0.46	1.00	4.00	.77
Adaptive instruction	Country aggregate	2.72	0.20	2.28	3.16	.74
Teacher support	Country aggregate	3.21	0.22	2.68	3.69	.86
Teacher enthusiasm	Country aggregate	3.02	0.16	2.60	3.41	.88
Teacher feedback	Country aggregate	2.35	0.24	1.80	2.88	.86
Stimulation of reading engagement	Country aggregate	2.83	0.23	2.25	3.36	.82
Teacher-directed instruction	Country aggregate	2.95	0.23	2.50	3.55	.75

sents the descriptive statistics and internal consistency estimates for the student-level and country-level variables.

Student-level statistics are based on the weighted analytic sample of 19,932 students. Country-aggregate statistics are based on 79 country groups. Reliability estimates are descriptive summaries across the imputed datasets. For the instructional constructs, internal consistency was calculated from student-level item responses before aggregation to the country level. A dash indicates that internal consistency was not applicable. The student-level motivational variables yielded mean alpha coefficients of .85 for enjoyment of reading and .77 for reading self-efficacy. The instructional variables yielded mean alpha coefficients ranging from .74 for adaptive instruction to .88 for teacher enthusiasm. The weighted categorical distribution showed that female students represented 60.1% of the analytic sample, whereas male students represented 39.9%. For immigration background, native students represented 88.0% of the weighted sample, second-generation immigrant students represented 5.0%, and first-generation immigrant students represented 7.0%.

Multilevel hierarchical linear modeling results

All four multilevel hierarchical linear models converged successfully. The unconditional model showed substantial between-country variation in reading literacy scores among high-achieving readers. The mean country-level variance was 3420, the residual variance was 1424, and the intraclass correlation coefficient (ICC) was .706. Thus, approximately 70.6% of the variance in reading literacy scores was located between country groups before predictors were introduced. Table 3 presents the ICCs, variance-reduction indices, and descriptive model-fit comparisons across the four hierarchical linear models.

After gender, ESCS, and immigration background were introduced in Model 1, the ICC declined slightly from .706 to .698. Adding enjoyment of reading and reading self-efficacy in Model 2 reduced the residual variance by 2.2% relative to the unconditional model but did not produce a meaningful additional reduction in country-level variance. Model 3, which included the country-level instructional indicators, reduced the country-level variance from 3420 to 1936, corresponding to a 43.4% reduction relative to the unconditional model. The ICC consequently declined to .582.

Table 3. Intraclass correlation coefficients, variance reduction, and model fit across hierarchical linear models

Model	ICC	Country-variance reduction	Residual-variance reduction	ΔAIC	ΔBIC
M0 Null model	.706	0.0%	0.0%	483.0	400.0
M1 Controls	.698	4.8%	1.3%	230.0	179.0
M2 Student-level motivational resources	.701	4.6%	2.2%	35.4	0.0
M3 Full reading-motivation model	.582	43.4%	2.2%	0.0	12.0

Note. *ICC = intraclass correlation coefficient; AIC = Akaike information criterion; BIC = Bayesian information criterion. ΔAIC and ΔBIC are reported relative to the best-fitting model under each criterion. Lower values indicate better relative fit.*

The AIC comparison favored the full model, whereas BIC favored the more parsimonious student-level motivational-resources model. Because the full model contained all focal predictors required to test the study hypotheses, it was retained as the hypothesis-testing model. The averaged model-fit indices were interpreted descriptively rather than as single-sample likelihood tests.

Fixed effects and hypothesis testing

The pooled standardized fixed effects of the full model were examined to test the study hypotheses. Standardized coefficients indicate the expected change in reading literacy scores, in standard-deviation units, associated with a one-standard-deviation difference in a continuous predictor, holding the other variables constant. For categorical predictors, the coefficient represents the standardized difference from the reference category. Because these estimates are conditional fixed effects from the full hierarchical linear model, they should not be interpreted as zero-order correlations or causal effects.

Table 4. Pooled standardized fixed effects for the full hierarchical linear model

Predictor	β	SE	z	p	95% CI
ESCS	.062	.006	10.20	< .001	[.050, .074]
Male	.013	.013	1.00	.316	[-.012, .038]
Second-generation immigrant student	.018	.029	0.64	.520	[-.038, .075]
First-generation immigrant student	.067	.038	1.73	.083	[-.009, .141]
Enjoyment of reading	.037	.006	5.99	< .001	[.025, .049]
Reading self-efficacy	.027	.007	3.84	< .001	[.013, .041]
Adaptive instruction	.394	.123	3.20	.001	[.153, .635]
Teacher support	-.346	.135	-2.56	.010	[-.610, -.082]
Teacher enthusiasm	.029	.105	0.28	.784	[-.177, .235]
Teacher feedback	.081	.099	0.82	.415	[-.114, .275]
Stimulation of reading engagement	.116	.112	1.03	.303	[-.104, .336]
Teacher-directed instruction	-.541	.111	-4.87	< .001	[-.758, -.323]

Note. *Reference categories were female for gender and native student for immigration background. β: standardized coefficient; SE: standard error; CI: confidence interval.*

Table 4 presents the pooled standardized coefficients, standard errors, confidence intervals, and significance levels. In the full hierarchical linear model, ESCS had a positive conditional fixed effect on reading literacy scores, β = .062, p < .001. Male students did not differ significantly from female students after the other predictors were held constant, β = .013, p = .316. Neither second-generation immigrant status, β = .018, p = .520, nor first-generation immigrant status, β = .067, p = .083, had a statistically significant fixed effect relative to native-student status.

The results supported H1 and H2 because enjoyment of reading, β = .037, p < .001, and reading self-efficacy, β = .027, p < .001, showed positive and statistically significant conditional associations with reading literacy scores. H3 was also supported because adaptive instruction showed a positive country-level conditional association, β = .394, p = .001.

H4 and H8 were supported in a negative direction. Teacher support was negatively associated with reading literacy scores, β = −.346, p = .010, and teacher-directed instruction was negatively associated with reading literacy scores, β = −.541, p < .001. These coefficients represent conditional country-level associations after the other instructional indicators were held constant and should not be interpreted as evidence that teacher support or instructional structure is inherently detrimental. H5, H6, and H7 were not supported because teacher enthusiasm, teacher feedback, and stimulation of reading engagement did not have statistically significant fixed effects in the full model.

Missingness-Pattern Sensitivity Analysis

A missingness-pattern sensitivity analysis was conducted to evaluate whether the main results were sensitive to pre-imputation missingness patterns. Of the 33 focal questionnaire items, 18,368 students (92.15%) had no missing responses, 621 students (3.12%) had 1–2 missing responses, 128 students (0.64%) had 3–9 missing responses, and 815 students (4.09%) had 10 or more missing responses. Table 5 presents the resulting missingness-pattern distribution. All sensitivity models converged successfully.

Table 5. Pre-imputation missingness-pattern distribution

Missingness pattern	N	Percent
Complete	18,368	92.15
Low missingness	621	3.12
Moderate missingness	128	0.64
High missingness	815	4.09

Adding the missingness-pattern indicators and their interactions with the student-level motivational variables did not alter the substantive interpretation of the full model. Enjoyment of reading, reading self-efficacy, and adaptive instruction remained positive and statistically significant, whereas teacher support and teacher-directed instruction remained negative and statistically significant. Teacher enthusiasm, teacher feedback, and stimulation of reading engagement remained non-significant. Thus, the hypothesis-related conclusions were robust to adjustment for pre-imputation missingness patterns.

Random-slope robustness checks

Random-slope robustness checks were conducted to examine whether the student-level associations varied across country groups. Random slopes were tested separately for enjoyment of reading, reading self-efficacy, and ESCS while the fixed-effect structure of the full model was retained. All 1,800 random-slope models converged successfully.

The pooled standardized fixed effects remained positive and statistically significant across the corresponding random-slope specifications: β = .036 for enjoyment of reading, β = .024 for reading self-efficacy, and β = .055 for ESCS. These estimates were similar to those obtained from the main random-intercept model. The positive student-level associations supporting H1 and H2 therefore remained stable when their slopes were allowed to vary across country groups.

Discussion

The findings indicate that reading-related motivational resources and instructional conditions differentiated reading literacy scores within an already high-performing group, although their contributions varied across constructs and analytical levels. Enjoyment of reading and reading self-efficacy showed small positive student-level associations. At the country level, adaptive instruction showed a positive association, teacher support and teacher-directed instruction showed negative conditional associations, and the remaining instructional indicators were not statistically significant in the full model. Because the study was cross-sectional and the instructional variables were aggregated to the country level, these estimates represent conditional statistical associations rather than causal or classroom-level effects (Van Der Stede, 2014).

This multilevel pattern is consistent with the SDT-based distinction established in the theoretical framework. Enjoyment of reading most directly reflects interest and inherent satisfaction, whereas reading self-efficacy represents a competence-related motivational belief. The instructional indicators, by contrast, describe external conditions that may support or constrain autonomy, competence, relatedness, and engagement without directly measuring students' extrinsic regulation (Ryan & Deci, 2020; Svrcek & Abugasea Heidt, 2022). The results also reinforce the view that high-achieving readers are not motivationally or instructionally homogeneous and that the conditions associated with their performance may differ from those observed in broader or lower-achieving populations (Qian et al., 2025; Ziernwald et al., 2022).

Student-level motivational resources

The findings supported H1 and H2. Enjoyment of reading was positively associated with reading literacy scores among high-achieving students, indicating that students who experienced reading as more interesting and personally rewarding tended to show slightly higher reading performance than their peers within the same country context. This result is consistent with SDT's conceptualization of intrinsic motivation as engagement based on interest and inherent satisfaction (Arens & Möller, 2025; Ryan & Deci, 2020). In the reading domain, enjoyment may encourage students to interact with texts more frequently, sustain attention during demanding reading tasks, and approach reading as a meaningful activity rather than merely a school requirement (Cheema, 2018; Ma et al., 2023).

The finding also corresponds with meta-analytic evidence linking reading motivation to reading performance and with longitudinal evidence indicating reciprocal relations between reading performance and intrinsic reading motivation (Hebbecker et al., 2019; Toste et al., 2020). Broader reading-motivation research similarly shows that interest, enjoyment, involvement, and other intrinsic dimensions are more consistently connected with engaged reading than externally regulated reasons for reading (Schiefele et al., 2012; Van Der Sande et al., 2023). In the present study, however,

the standardized coefficient was small. Given the restricted performance range of the sample, enjoyment should therefore be interpreted as differentiating reading literacy scores within the high-achieving group rather than as explaining why these students became high achievers.

Reading self-efficacy was also positively associated with reading literacy scores, supporting H2. This finding indicates that students who perceived themselves as more capable readers tended to attain slightly higher scores than their high-achieving peers with comparatively weaker competence beliefs. The result is consistent with SDT's competence dimension because perceived capability may support persistence, effort regulation, and engagement when academic tasks become demanding (Ryan & Deci, 2020; Yeh et al., 2023).

Reading-specific studies have similarly linked self-efficacy and perceived reading competence with reading engagement, strategy use, and performance (Chen et al., 2021; Toste et al., 2020; Urfali Dadandi & Dadandi, 2022). Nevertheless, the association was again modest. Reading self-efficacy consequently appears to be a supplementary motivational resource rather than a comprehensive explanation of performance differences among advanced readers. The result also supports treating self-efficacy as a competence-related component of motivational functioning rather than as identical to intrinsic motivation itself.

Extrinsic motivational background

The strongest positive contextual finding was observed for adaptive instruction, supporting H3. Country-level aggregates of adaptive instruction were positively associated with reading literacy scores among high-achieving readers. Adaptive instruction can respond to students' readiness, provide appropriate challenge, and create opportunities for extending existing competence (Reis & Fogarty, 2022; Wang et al., 2023). From an SDT perspective, such instruction may support competence by matching task demands and guidance to students' needs, while also supporting autonomy when responsiveness replaces rigid or uniformly prescribed instruction (Ryan & Deci, 2020; Wong & Wong, 2021).

For high-achieving readers, this interpretation is particularly relevant because instruction designed around average performance may not offer sufficient extension or complexity (Reis & Fogarty, 2022). The result is also consistent with PISA-based evidence that the contribution of instructional practices differs across educational systems and that responsive practices can be associated with reading performance in high-performing contexts (Ho & Gan, 2023). However, the present coefficient was estimated from country-level aggregates. It therefore indicates that countries in which high achievers reported comparatively more adaptive instruction also tended to show higher scores after the other predictors were controlled; it does not demonstrate that an individual teacher's adaptive practice caused an individual student's higher performance.

In contrast, teacher support showed a negative conditional association, supporting H4 in a direction that differed from the generally positive role attributed to support in SDT and in broader PISA populations. Teacher support is commonly expected to contribute to relatedness and competence by helping students feel assisted, understood, and able to manage learning demands (Banerjee & Halder, 2021; Ryan & Deci, 2020). PISA reporting has likewise documented positive associations between perceived teacher support and reading performance in general student populations (OECD, 2019d).

The present result should not be interpreted as evidence that teacher support is detrimental. Because the instructional indicators were entered simultaneously, the coefficient represents the country-level association of teacher support after shared variation with adaptive instruction, enthusiasm, feedback, stimulation, and teacher-directed instruction was controlled. Moreover, the PISA items primarily reflect the availability of general assistance rather than the intellectual depth, autonomy support, or advanced challenge provided to high-achieving readers. The negative coefficient may therefore reflect the relative configuration of

instructional conditions across countries rather than a negative total effect of supportive teaching. From an SDT perspective, support is most likely to sustain advanced engagement when it is both competence-supportive and autonomy-supportive and when it is accompanied by appropriate challenge (Ryan & Deci, 2020; Svrcek & Abugasea Heidt, 2022).

Teacher enthusiasm, teacher feedback, and stimulation of reading engagement did not show statistically significant conditional associations, and H5–H7 were therefore not supported. Considered together, these findings do not imply that the three practices are motivationally irrelevant. Teacher enthusiasm and stimulation of engagement have been associated more consistently with enjoyment, interest, and engagement than with direct achievement differences (Lazarides et al., 2018; OECD, 2019d; Shao, 2023; Zhang & Zhu, 2025). Similarly, feedback may contribute to reading performance indirectly through competence beliefs, reading enjoyment, or classroom conditions, and its value may depend on its specificity and informational quality rather than its reported frequency alone (Carless & Winstone, 2023; Ma et al., 2022, 2023; Zhang et al., 2024). Their non-significant coefficients in the present model therefore indicate only that these country-level aggregates did not explain unique variation in reading literacy scores after the remaining predictors were controlled. They do not rule out indirect, student-level, or context-dependent contributions.

Teacher-directed instruction showed a negative conditional association, supporting H8. This result is consistent with the theoretically ambivalent position of directive instruction. Clear goals, monitoring, summaries, and explicit expectations may provide productive structure and support competence (Schweder et al., 2026; Schweder & Raufelder, 2022). At the same time, strong direction may constrain autonomy when students experience it as controlling or when it limits opportunities for independent interpretation (Ho & Gan, 2023; Ryan & Deci, 2020).

For advanced readers, the distinction between supportive structure and controlling direction may be especially important because these students may require both clear expectations and substantial opportunities for self-regulated engagement with complex texts. Nevertheless, the coefficient remains a conditional country-level estimate. It should not be interpreted as showing that explicit teaching or structure is inherently harmful. Rather, countries characterized by comparatively stronger teacher-directed instruction showed lower reading scores among high achievers after the other instructional indicators were held constant. Further research is needed to determine whether this pattern reflects autonomy restriction, differences in curricular organization, compensatory teaching practices, or other system-level conditions.

Overall, the findings support a differentiated rather than uniformly positive account of reading-related motivation and instruction. Student-level enjoyment and self-efficacy explained modest within-country variation, whereas the instructional indicators primarily differentiated country contexts. Adaptive instruction was the most consistent positive contextual indicator, but the mixed coefficients for the remaining variables show that a generally supportive or engaging climate is not equivalent to instruction that extends advanced reading competence. SDT offers a useful interpretive framework for this pattern because it distinguishes support for autonomy, competence, and relatedness from the mere presence or frequency of external instructional practices. However, the present analyses did not directly test psychological-need satisfaction, internalization, or mediation. The results should therefore be understood as SDT-informed evidence about multilevel motivational conditions rather than as a direct test of the full motivational process proposed by the theory.

Conclusion

High-achieving readers continued to differ in reading literacy scores according to both student-level motivational resources and country-level instructional conditions. Enjoyment of reading and reading self-efficacy showed modest positive associations, while adaptive instruction was the clearest

positive contextual indicator. Teacher support and teacher-directed instruction showed negative conditional associations, and the remaining instructional variables did not explain unique variation in the full model. The study therefore demonstrates the value of distinguishing students' motivational resources from the broader instructional conditions in which reading occurs. It also indicates that advanced performance cannot be explained by motivation or instructional positivity in general; the form, level, and configuration of the relevant conditions must be considered. These findings are associational and should not be interpreted as evidence of causal instructional effects.

Limitations

Several limitations should be considered when interpreting the findings. First, the analysis was limited to the PISA 2018 cycle, in which reading was the major assessment domain (OECD, 2019a). Although this provided a strong basis for examining reading-related motivational and instructional variables, it restricted the temporal scope of the study. The findings therefore cannot establish whether the observed patterns are stable across PISA cycles or over time. In addition, the cross-sectional design precludes conclusions about the temporal or causal ordering of motivation, instructional experiences, and reading literacy scores.

Second, the high-achieving group was defined conservatively by requiring students to fall within the country-specific highest 10% for all ten reading plausible values. This criterion reduced classification instability but produced a particularly selective subgroup. Alternative definitions based on individual plausible values, average proficiency estimates, proficiency levels, or other percentile thresholds could yield different samples and patterns of association (Ziernwald et al., 2022).

Third, the study employed a two-level structure in which students were nested directly within country groups. School-level clustering was not modeled separately, and the instructional indicators were aggregated from student reports to the country level. Consequently, the country-level coefficients describe differences among national or country-group contexts and cannot be interpreted as effects of individual teachers, classrooms, or schools. The limited number of Level-2 units also requires caution when interpreting the magnitude of country-level coefficients.

Fourth, the models included selected reading-related motivational and instructional variables rather than a complete ecological account of reading literacy. Cognitive and linguistic skills, home literacy resources, school composition, curriculum, digital reading practices, language background, and national policy conditions may be associated with both the selected predictors and reading performance (OECD, 2019b, 2019c). Unobserved confounding and omitted contextual variables may therefore have influenced the estimated associations (Andrade, 2024).

Fifth, all motivational and instructional indicators were based on student self-reports. Such responses may be influenced by social desirability, reference-group effects, culturally patterned response styles, and differences in how students interpret the same categories (Bauhoff, 2023). Item wording, grammatical structure, translation, and linguistic complexity may introduce additional construct-irrelevant variation across languages and education systems (Lynch & Zumbo, 2026). The study did not directly test cross-country measurement invariance or differential item functioning for the reconstructed composites.

Finally, the study was grounded in SDT. This framework offered a coherent basis for distinguishing student-level motivational resources from motivationally relevant instructional conditions, but it also shaped the selection and interpretation of variables (Ryan & Deci, 2020). Other theoretical perspectives, such as expectancy-value theory, achievement goal theory, reading engagement theory, ecological models of educational achievement, or sociocultural approaches to literacy, may emphasize different mechanisms. Therefore, the findings should be read as theory-guided evidence rather than as an exhaustive explanation of high-achieving readers' performance.

Implications

The findings offer implications for students, teachers, and policymakers. Because the study was observational and the instructional predictors were analyzed at the country level, these implications should be interpreted as evidence-informed directions rather than causal prescriptions.

For students, the findings suggest that high reading achievement should not be understood only as a matter of already established reading ability. Enjoyment of reading and reading self-efficacy were both positively associated with reading literacy scores, indicating that interest and confidence remain relevant even within a high-achieving group. Learning environments may therefore be strengthened by preserving opportunities for high-achieving readers to engage with challenging and personally meaningful texts and to develop well-calibrated confidence in their ability to interpret complex material. Because the coefficients were modest, these motivational resources should be regarded as complements to, rather than substitutes for, strong linguistic, cognitive, and strategic reading development (Ryan & Deci, 2020; Toste et al., 2020).

For teachers, the positive country-level association of adaptive instruction is consistent with providing high-achieving readers with differentiated texts, open-ended interpretive tasks, strategy-based activities, and opportunities for independent textual analysis. However, the negative conditional coefficients for teacher support and teacher-directed instruction should not be interpreted as reasons to reduce support, structure, or explicit teaching. Rather, they highlight the importance of examining how these practices are delivered and whether they are combined with autonomy support, appropriate challenge, and intellectual extension. Support, feedback, enthusiasm, and stimulation of engagement may be particularly valuable when they are specific to advanced learning needs rather than general in form (Carless & Winstone, 2023; Reis & Fogarty, 2022).

For policymakers, the findings suggest that reading policy should address enrichment as well as remediation. High-achieving readers may require curricula and assessment systems that provide sustained access to complex texts, higher-order interpretation, evaluation, and critical engagement. Professional development may also help teachers differentiate reading instruction without replacing autonomy with excessive direction. Nevertheless, the country-level associations should be used to identify promising system characteristics for further investigation rather than to prescribe individual classroom practices directly (OECD, 2019d).

Future Research

Future research can extend the present study in several directions. First, subsequent studies may examine whether the associations identified in this study are replicated across other PISA cycles. This would clarify whether the observed motivational and instructional patterns are stable over time or specific to the 2018 reading-focused cycle.

Second, future studies may compare high-achieving and low-achieving readers within the same analytical framework. Such comparisons may clarify whether enjoyment of reading, reading self-efficacy, adaptive instruction, teacher support, feedback, and teacher-directed instruction operate differently across achievement strata. Such comparisons would be especially useful for determining whether high and low achievers require distinct motivational and instructional explanations.

Third, future research may include broader ecological predictors of reading achievement. The present study focused on reading-related motivational variables and student-reported instructional climate, but reading achievement may also be shaped by family resources, home literacy environment, school composition, curriculum structure, language background, digital reading practices, and national education policies (Göktentürk et al., 2023). Including these variables may provide a fuller explanation of variation among high-achieving readers.

Fourth, future studies may examine the mechanisms through which instructional climate relates to high-achieving readers' performance. In the present study, adaptive instruction was the clearest positive contextual predictor, whereas teacher support and teacher-directed instruction showed negative conditional associations. Future research could test whether these relationships are mediated by students' perceived autonomy, competence, reading engagement, or reading self-efficacy. Such analyses would clarify whether instructional climate relates to achievement directly or through motivational and self-regulatory processes.

Finally, future research may benefit from mixed-method or qualitative designs (Creswell & Creswell, 2017). Large-scale assessment data make it possible to examine broad cross-national patterns, but they cannot fully explain how high-achieving readers experience classroom instruction, feedback, support, or reading challenge in everyday learning environments. Interviews, classroom observations, teacher diaries, and student reading portfolios could provide richer evidence about how adaptive instruction and autonomy-supportive reading practices are enacted in real classrooms.

Declarations

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Ethical Approval: Ethical committee approval was not required for this study because This study is based on the PISA 2018 dataset made publicly available by the OECD. Since the data used in the study were anonymized secondary data, no data were collected directly from human participants by the researchers, and no procedure requiring ethics committee approval was conducted. It is hereby declared that scientific and ethical principles were observed throughout the preparation of this study and that all works utilized have been indicated in the references.

Data Availability: The data that support the findings of this study are openly available in PISA 2018 Database at https://www.oecd.org/en/data/datasets/pisa-2018-database.html.

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