



Research article

The effect of instructional quality on reading achievement: The mediating role of reading engagement in China (B-S-J-Z) and the UK

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ABSTRACT

The present study aims to explore the mediating role of reading engagement between instructional quality and reading achievement in China (B-S-J-Z) and the UK, and the pedagogical transportation that has been implemented between China and the UK since 2014. Participants in this study were from PISA 2018 where 12,058 students were from China (B-S-J-Z) and 13,818 were from the UK. Structural equation modeling (SEM) was used to explore the relationships among instructional quality, reading engagement, and reading achievement. The effect of classroom management and cognitive activation on reading achievement was significantly mediated by enjoyment of reading in both China (B-S-J-Z) and the UK. Diversity of reading was found to positively mediate the relationships between classroom management and reading achievement, and between cognitive activation and reading achievement in China (B-S-J-Z), in contrast to the mediating role of reading strategy revealed in the UK. The findings have important implications in that educators from China (B-S-J-Z) and the UK should focus on improving students' reading interests, UK teachers may incorporate diverse sources in reading, and Chinese educators may try different reading teaching strategies. Meanwhile, educators and policymakers may give full consideration to implications based on the specific cultural background. Finally, the limitations and future directions are provided.

1. Introduction

Reading literacy is one of the essential core literacy for students to survive in the 21st century [1]. Programme for International Student Assessment (PISA) has brought reading assessment into one of the three evaluation fields since it was initiated in 2000 [2]. With widespread attention, a large body of studies has focused on various aspects of reading such as reading strategies [3], reading attitudes [4], reading engagement [1,5,6], and reading enjoyment [7,8]. Based on PISA 2018 data, the present study explored the mediating role of reading engagement between instructional quality and reading achievement in China (B-S-J-Z) and the UK. The extant research has shown that both instructional quality and reading engagement predict reading achievement directly and that instructional quality predicts reading engagement. Theoretically speaking, the more effective teachers' teaching is, the more activities students are academically engaged in. Ref. [9]. This generates a hypothesis that instructional quality may have an indirect effect on

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student reading achievement through reading engagement, which motivated the present study.

The major goal of the current study is to understand the relationships among instructional quality, reading engagement, and reading achievement in China (B–S–J–Z) and the UK. The mediating role of reading engagement in the association between instructional practices and academic performance has been proved [10]. Few researchers have explored the differences of the relationship in different cultures (e.g., Eastern culture vs. Western culture). This understanding is important for comparative researchers, theoretical researchers and educational practitioners. On the one hand, understanding has been perceived as an important aim for conducting comparative research, as claimed in this field [11]. On the other hand, understanding may provide worldviews for policymakers and reading teachers to comprehend their curriculum deeply and to seek potential ways for international borrowing. In the present study, China (B–S–J–Z) and the UK were selected not only because these two countries have different cultures, but also because both of them were interested in educational exchanges in the past. China and the UK have established extremely close ties on educational exchanges since PISA announced its 2009 score rankings. The UK began to take appropriate measures to improve the quality of local education after witnessing its students' undesirable performance on the PISA test [12]. It has been claimed that disparities in students' achievement between China and England are urgent educational issues for the British government [13]. The Mathematics Teacher Exchange (MTE) programme between England and China-Shanghai, which aims to facilitate cooperation and communication between England and China, was initiated in 2014 [14]. By now, more than 8000 schools in England have adopted China-Shanghai teaching strategies in mathematics classes [15].

In sum, there are two contributions in the current study. One is to explore the mediating role of reading engagement between instructional factors and reading achievement, and the other is to explore the differences in the associations between these factors in China and the UK using PISA 2018 data. The mediating connection among these variables may provide a more integrative view of teaching for reading teachers to improve their teaching effectiveness. These mediating relationships and comparisons are rarely discussed in the international reading literature due to the difficulty of obtaining reliable data from different cultures. The PISA 2018 provides an opportunity for international comparison. Exploring the direct and indirect effects of these variables may help comparative researchers and practitioners in China and the UK gain new understanding of reading education.

2. Literature review

2.1. Instructional quality

Instructional quality has become a hit in numerous research traditions, such as educational effectiveness, educational evaluation, and educational reform research. In general, instructional quality research focuses on three dimensions: classroom management, cognitive activation, and support climate [16–19]. Classroom management refers to dealing with students' disruptive behaviors in class, time spent on task management, and discipline elements. Cognitive activation involves students in instructional activity, evaluating, integrating, and applying knowledge in class. Support climate, or teacher support, refers to the supportive learning environments created by teachers in class, such as offering extra help when needed and respecting students' ideas and questions.

Extant studies have showed that three factors in instructional quality have positive effects on students' reading achievement [20–22]. Freiberg et al. pointed out that the more effective classroom management teachers performed, the higher achievement in reading [20]. Hochweber and Vieluf indicated that classroom management had a positive and significant effect on girls' reading achievement via investigating 10,543 ninth-grade students from Germany [21]. Hu et al. used a longitudinal design to investigate 567 Chinese kindergartners and concluded that teachers' emotional support positively predicted students' reading attitudes, which was in turn positively associated with students' outcomes in reading and vocabulary learning [22]. For students from B–S–J–Z, some researchers have proven the associations between instructional quality and reading achievement. For instance, Ma et al. showed that the effect of student-perceived teacher support on reading literacy was positive and significant [23]. Qian and Lau explored the effects of achievement goals and reading instruction on reading achievement, and found that both classroom management and cognitive activation had positive effects on reading achievement, whereas the relationship between teacher support and reading achievement was insignificant [24]. Gu and Lau found that three factors of instructional quality had positive effects on reading achievement [25].

2.2. Reading engagement

Engagement refers to the degree to which students interact and engage with school and its staff, climate, values, goals, and activities [26]. It is a potential contributor to students' academic retention, sense of fulfillment, academic performance, knowledge acquisition, as well as cognitive, affective, and behavioral constructs [27,28]. As such, being engaged in reading was identified as a potential predictor of reading comprehension and reading performance [1,29]. Taboada et al. argued that reading engagement included not only the process of readers' cognitive purpose (e.g., the use of cognitive strategies), but also the interplay of emotions with the text (e.g., enthusiasm, interest and curiosity) in reading activities [6].

Many researchers have revealed that three main components of reading engagement are cognitive engagement, emotional engagement, and behavioral engagement [30]. In particular, Cheung et al. proposed that three specific dimensions were based on a conceptual model of reading engagement: fondness for reading, aspiration for reading, and good at reading [5]. Fondness for reading was a term meaning enjoyment of reading, which aimed to help students read happily. Aspiration for reading referred to diversity of reading, which aimed to help students read materials from a variety of sources and genres. Reading strategy was related to making use of meta-cognitive reading strategies to help students read skillfully. It emphasized mastery of meta-cognitive reading skills that were recommended by reading experts [5].

Previous studies have shown that these three facets have a positive influence on students' reading achievement [1,8,31]. McGeown et al. argued that enjoyment of reading was correlated with students' reading attainment [8]. Similarly, Hamed et al. reported that enjoyment of reading was a vital predictor of reading performance after investigating 220 foreign language learners in Mashhad [1]. Mol and Bus also demonstrated that students with greater enjoyment of reading tended to gain higher GPA than their peers [32]. Khine et al. found that the relationship between enjoyment of reading and reading achievement was positive via investigating students from China (B-S-J-Z) [33]. With respect to reading diversity, Cantrell et al. noted that students who read more often tended to receive a higher level of reading achievement [34]. A study of Moje et al. revealed that adolescents read what kind of texts and how often they read, and found that students who often read novels outside school tended to receive higher grades [35]. Based on PISA 2009 data, Meng et al. reported that reading strategies were significant predictors of students' reading achievements in the United States and China [31]. Moreover, in Chinese context, Zhang and Sirinthorn revealed that students' meta-cognitive strategy was significantly positively linked with their English reading achievement [36]. Gu and Lau explored the impacts of reading instruction and reading engagement on Chinese (B-S-J-Z) students' PISA reading performance, and found that both reading strategies and enjoyment were positively associated with reading achievement [25].

The direct impact of instructional quality on student engagement has been explored [23,37–39]. For instance, Ho and Lau reported that disciplinary climate significantly predicted enjoyment of reading, the effects of teacher support on enjoyment of reading, diversity of reading, and reading strategy were significant [37]. Näkk and Timoštšuk found that teachers' autonomy-supportive teaching was positively associated with boys' learning engagement [38]. Meanwhile, some researches have indicated that student-perceived teacher support significantly predicted reading enjoyment [23,39].

2.3. The Chinese and British educational environments

In China, education is highly valued under the influence of the Confucian heritage culture (CHC), children are taught to study hard, get high score, follow the teachers' instructions and be proud of their parents [40]. Chinese students tend to have positive attitude and motivation towards learning, and maintain high achievement score in PISA test. In school, most Chinese teachers take grade as the important criteria to evaluate students [41], contributing to competitive learning environment and student performance goal [42], which might undermine students' cognitive and emotional engagement. In addition, according to high student-to-teacher ratio in classroom, students need to follow the rule of classroom management, and have few opportunities to establish meaningful connections with their teachers [43].

However, in the UK, independence and autonomy is highly emphasized influenced by individualism [44]. In western classrooms, student-centered teaching is perceived as a main approach, students are encouraged to discuss and share their ideas with others [31]. Teachers are acted as facilitators and monitors of student learning, not experts. Especially, some teachers adopted cooperative learning in a small group, therefore, students have more opportunities to engage in learning activities, such as discussing and explaining ideas with peers [45]. Additionally, compared with CHC, western culture does not place a high value on academic performance, which might lead to lower grade for British students than Chinese students in large-scale measurements of student achievement (e.g., PISA, TIMSS).

2.4. Theoretical framework and research questions

The theoretical framework of this study is presented in Fig. 1. In this model, we hypothesize that instructional quality has both

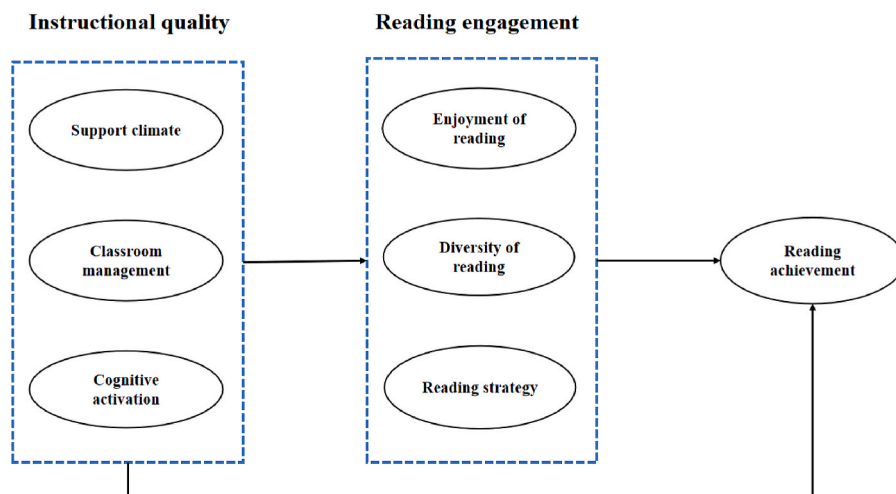


Fig. 1. A comprehensive theoretical framework showing the possible theoretical relations between instructional quality, reading engagement and reading achievement in China and the UK based on PISA 2018 survey.

direct and indirect effects on reading achievement. As reviewed empirically above, both instructional quality and reading engagement have direct effects on reading achievement. Theoretically speaking, instructional quality should have a positive effect on reading engagement. The items in these constructs (e.g., support climate; active cognition) are aligned with the constructivist and situated points of view [46,47], which expected students to become active learners and construct knowledge through social participation. Curriculum documents in both China and the UK reflected these teaching and learning beliefs [48,49]. For instance, the aims of English curriculum in the UK are “to develop their love of literature through widespread reading for enjoyment”, “[to] develop the habit of reading widely and often, for both pleasure and information”, and “[to] use discussion in order to learn” [48]. According to Chinese curriculum standards, “students should learn Chinese actively in class, should learn through social communication, and should construct their knowledge through their own reading” [49]. These statements imply that good teaching should cultivate students’ high motivation for reading and engagement in diverse sources of reading.

There were two research questions to examine in this study: (1) Does instructional quality predict reading achievement directly in China and the UK? (2) Is the relationship between instructional quality and reading achievement mediated by reading engagement in China and the UK? Exploring these relationships is not only to reach the comparative goal of understanding in reading education between two different cultures [11], but also to provide an opportunity for practitioners to potentially adopt teaching strategies from other cultures.

3. Methods

3.1. Materials and methods

3.1.1. Sample

This study used data from PISA 2018. Participants were 15-year-old secondary students from China (B–S–J–Z) and the UK. A total of 12,058 students (5775 females and 6283 males) were from 362 schools in China (B–S–J–Z), and 13,818 students (6996 females and 6822 males) were from 118 schools in the UK. Although Chinese students from Beijing, Shanghai, Jiangsu and Zhejiang participated in the PISA 2018 test, these four regions are economically developed regions in eastern China, with certain cultural similarities and relatively rich educational experience, which can represent the developed regions of China. These participants may represent the upper level of Chinese students with respect to academic performance.

3.1.2. Measures

The scales used in this study were instructional quality, reading engagement, and reading achievement from PISA 2018 student questionnaire.

3.1.2.1. Instructional quality. Researchers have assumed that the construct of instructional quality has three essential factors: support climate, cognitive activation, and classroom management [16,17], according to the PISA 2018 student questionnaire. This construct is rated on a four-point Likert scale from 1 (every lesson) to 4 (never or hardly ever) for support climate and classroom management, and from 1 (never or hardly ever) to 4 (in all lessons) for cognitive activation. To be consistent with the other two dimensions, the ratings of the support climate were inverted in data analysis. Cronbach’s alpha was used to assess internal consistency as estimated for scale reliability (see Table 1).

3.1.2.1.1. Support climate. Support climate was selected from ST100 in the student questionnaire of PISA 2018, which covered teachers’ positive and constructive feedback on students’ learning. Internal consistency coefficients for the scale were high (0.864 – 0.902).

3.1.2.1.2. Classroom management. Classroom management contained five items taken from ST097 in the PISA 2018 student questionnaire; these items incorporated classroom rules and discipline, as well as dealing with disruptions. Internal consistencies for this scale were high (0.894 – 0.906).

3.1.2.1.3. Cognitive activation. Cognitive activation comprised four items from ST152 in the student questionnaire of PISA 2018. The items refer to challenging tasks, solving problems, and the application of concepts, ideas, and prior knowledge. Internal consistencies for this scale ranged from 0.824 to 0.905.

Table 1

Results for descriptive statistic and reliabilities of the scales measuring Instructional quality and Reading engagement

Scale	China		The UK		Total sample	
	M/SD	α	M/SD	α	M/SD	α
Instructional quality						
Support climate	3.39/0.69	0.864	3.26/0.78	0.902	3.32/0.74	0.887
Classroom management	3.42/0.61	0.894	2.97/0.77	0.902	3.18/0.73	0.906
Cognitive activation	3.02/0.76	0.905	2.61/0.74	0.824	2.81/0.78	0.866
Reading engagement						
Enjoyment of reading	3.19/0.55	0.810	2.30/0.78	0.879	2.72/0.82	0.896
Diversity of reading	2.99/0.87	0.650	2.02/0.78	0.682	2.49/0.95	0.732
Reading strategy	4.15/0.99	0.767	3.60/0.92	0.655	3.87/0.99	0.732

3.1.2.2. Reading engagement. As a key factor contributing to students' reading performance, reading engagement has been supported by a number of studies [50]. Reading engagement was divided into three dimensions: emotional, behavioral, and cognitive dimensions. Enjoyment of reading, diversity of reading, and reading strategy from PISA 2018 student questionnaire tied in well with the theoretical framework. The rates of enjoyment of reading were given on a four-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). A 5-point Likert scale ranging from 1 (never or almost never) to 5 (several times a week) was used for diversity of reading, and a 6-point Likert scale ranging from 1 (not useful at all) to 6 (very useful) was used for reading strategy. To be consistent with other two dimensions, the ratings of three items (ST160Q01, Q04, Q05) from enjoyment of reading were inversed in data analysis. Scale internal consistency was assessed by Cronbach's alpha (see Table 1).

3.1.2.2.1. Enjoyment of reading. Enjoyment of reading contained five items taken from ST160 in the PISA 2018 student questionnaire. The items meant that to what extent can interest and enjoyment be found in reading. Internal consistencies for this scale were high (0.810 – 0.896).

3.1.2.2.2. Diversity of reading. Diversity of reading comprised five items from ST167 in the student questionnaire of PISA 2018. The dimension referred to students with more concentration involved in reading activity with materials. Internal consistencies for this scale were from 0.650 to 0.732.

3.1.2.2.3. Reading strategy. Reading strategy (6 items) gathered from ST164 in the student questionnaire of PISA 2018 covered deep learning strategies of autonomous learning and a greater understanding of more complex concepts. Internal consistency coefficients for the scale were acceptable (0.655 – 0.767).

3.1.2.3. Reading achievement. The main purpose of PISA 2018 test was to assess 15-year-old students' reading literacy skills. Every student participating in PISA 2018 received ten plausible values in the reading test. These values in reading (PV1READ-PV10READ) were used for the current study.

3.1.2.4. Control variables. According to previous studies, potential variables, such as socioeconomic status (ESCS), and student gender, might influence students' reading achievement [25,51]. Hence, the present study takes ESCS and student gender (ST004) as control variables.

3.2. Data analyses

Data were analyzed via Mplus 8.3. First, the construct of instructional quality and reading engagement was assessed by an exploratory structural equation model (ESEM) for each country and the total sample. ESEM is a new latent variable model for estimating cross-loadings combining exploratory factor analysis (EFA) with confirmatory factor analysis (CFA) [52], which is supported by many researchers for studies on cross-cultural comparisons [53,54]. The model used various goodness-of-fit indices: the comparative fit index (CFI) and Tucker-Lewis index (TLI) were greater than 0.90 (acceptable) or 0.95 (good), and root mean square error of approximation (RMSEA) and standardized root mean square residuals (SRMR) were less than 0.08 (acceptable) or 0.05 (good) [55]. Second, a structural equation model was to explore the direct relations between instructional quality and reading engagement, between instructional quality and reading achievement, and between reading engagement and reading achievement, and the indirect relations between instructional quality and reading achievement via reading engagement. The goodness-of-fit of the model was assessed.

PISA adopts a two-stage sampling design, with students sampled within schools, and schools sampled within countries. Therefore, students' final weights (FSTUWT) and clusters (SCHOOLID) were used to correct for biased standard errors due to clustering of students within schools. The robust maximum likelihood estimation method (MLR) was employed as well. Full information maximum likelihood (FIML) procedure was utilized for the random missing values [56]. Ten plausible values towards reading achievement were calculated using the TYPE = IMPUTATION option in Mplus, which was proven and supported in international large-scale research.

Table 2
Fit statistics of the ESEM model

	χ^2 (df)	CFI	TLI	RMSEA(90%-CI)	SRMR	AIC	BIC
Instructional quality							
China	702.8(42)	0.980	0.964	0.036(0.034,0.039)	0.016	286,188	286,647
The UK	743.2(42)	0.983	0.968	0.035(0.033,0.038)	0.014	352,155	352,620
Total sample	1669.2(42)	0.975	0.953	0.039(0.038,0.041)	0.016	646,933	647,437
Reading engagement							
China	1204.2(73)	0.951	0.919	0.036(0.034,0.038)	0.026	548,436	549,020
The UK	1136.6(73)	0.964	0.940	0.033(0.031,0.035)	0.022	602,866	603,458
Total sample	2328.1(73)	0.969	0.949	0.035(0.034,0.036)	0.024	1,177,460	1,178,103

4. Results

4.1. Exploratory structural equation model

For the construct of instructional quality, the results of 3-factor ESEM in China (B–S–J–Z), the UK, and the total sample were all acceptable according to CFI >0.90, TLI >0.90, RMSEA <0.05, and SRMR <0.05 (see Table 2). In addition, the correlations among factors were 0.296–0.517, showing that three factors were clearly distinguished. Three factors in this construct were well defined based on the standardized target factor loadings ($|\lambda| = 0.681$ to 0.875) (see Table 3).

For the construct of reading engagement, the 3-factor ESEM (enjoyment of reading, diversity of reading, and reading strategy) based on PISA 2018 in China (B–S–J–Z), the UK, and the total sample were explored. The results showed that the models were supported in each sample, that is, CFI, TLI \geq 0.90, and RMSEA, SRMR \leq 0.05 (see Table 2). Four factors were identified on the basis of the standardized target factor loadings ($|\lambda| = 0.357$ to 0.854) (see Table 4). The correlation among factors showed that there was an obvious difference among factors ($\gamma = 0.267$ to 0.501).

Table 3
Factor loadings obtained from the ESEM model of Instructional quality for the total sample

	Support climate	Classroom management	Cognitive activation
Factor loadings			
ST100Q01	0.681^c	0.050 ^c	0.079 ^c
ST100Q02	0.834^c	−0.009	−0.009
ST100Q03	0.875^c	−0.042 ^c	−0.017 ^a
ST100Q04	0.707^c	0.007	0.087 ^c
ST097Q01	0.004	0.768^c	0.033 ^c
ST097Q02	−0.029 ^c	0.824^c	0.008
ST097Q03	−0.018 ^a	0.837^c	−0.026 ^b
ST097Q04	0.045 ^c	0.788^c	0.000
ST097Q05	0.040 ^c	0.794^c	−0.003
ST152Q05	0.025 ^a	−0.001	0.747^c
ST152Q06	−0.054 ^c	0.056 ^c	0.731^c
ST152Q07	0.000	−0.038 ^c	0.857^c
ST152Q08	0.061 ^c	−0.003	0.772^c
Factor correlations			
Classroom management	0.296 ^c		
Cognitive activation	0.517 ^c	0.401 ^c	

^a $p < 0.05$.

^b $p < 0.01$.

^c $p < 0.001$.

Table 4
Factor loadings obtained from the ESEM model of Reading engagement for the total sample

	Enjoyment of reading	Diversity of reading	Reading strategy
Factor loadings			
ST160Q01	0.854^c	0.018 ^a	−0.028 ^b
ST160Q02	0.701^c	0.180 ^c	0.029 ^c
ST160Q03	0.562^c	0.189 ^c	0.126 ^c
ST160Q04	0.798^c	−0.010	0.022 ^b
ST160Q05	0.748^c	−0.053 ^c	−0.072 ^c
ST167Q01	−0.007	0.634^c	0.027 ^a
ST167Q02	0.037	0.511^c	−0.030 ^b
ST167Q03	0.394 ^c	0.470^c	−0.034 ^c
ST167Q04	0.067 ^c	0.522^c	0.067 ^c
ST167Q05	−0.020	0.453^c	0.096 ^c
ST164Q01	−0.039 ^b	0.080 ^c	0.357^c
ST164Q02	−0.010	0.108 ^c	0.419^c
ST164Q03	0.055 ^c	0.024 ^a	0.645^c
ST164Q04	0.001	−0.070 ^c	0.743^c
ST164Q05	0.065 ^c	−0.021 ^a	0.723^c
ST164Q06	−0.068 ^c	0.015	0.453^c
Factor correlations			
Diversity of reading	0.501 ^c		
Reading strategy	0.352 ^c	0.267 ^c	

^a $p < 0.05$.

^b $p < 0.01$.

^c $p < 0.001$.

4.2. Structural equation model

The mean and standard deviation of each variable in two constructs (see Table 1), and the coefficient of different paths of the two groups based on the proposed framework were analyzed (see Fig. 2). The structural equation models were acceptable according to $\chi^2(df) = 4592.43(386)$, CFI = 0.931, TLI = 0.922, RMSEA = 0.031, and SRMR = 0.055 in Chinese (B-S-J-Z) sample, and $\chi^2(df) = 7685.55(386)$, CFI = 0.901, TLI = 0.900, RMSEA = 0.037, and SRMR = 0.077 in the UK sample. The results of the relative direct effects among variables are shown in Table 5, and the results of the indirect effects among variables are shown in Table 6.

The relationships between instructional quality and reading engagement were distinguished between Chinese (B-S-J-Z) sample and the UK sample. For example, support climate was a significant negative predictor of enjoyment of reading and diversity of reading in the UK, however, the associations between support climate and enjoyment of reading, and between support climate and diversity of reading were nonsignificant in China (B-S-J-Z). Support climate was significantly positively correlated with reading strategy in China (B-S-J-Z), whereas support climate was insignificantly associated with reading strategy in the UK. In addition, some similar relationships were existed in the two countries. For instance, classroom management and cognitive activation were significantly positively related to three factors in reading engagement, that is, enjoyment of reading, diversity of reading, and reading strategy.

Similar patterns were found in the relationship between instructional quality and reading achievement in China (B-S-J-Z) and the UK. Classroom management, for instance, significantly predicted reading achievement, and cognitive activation was insignificantly associated with reading achievement. The association between support climate and reading achievement was different in two countries, which was significant and negative in China (B-S-J-Z), whereas insignificant in the UK.

Different patterns of the relation between reading engagement and reading achievement were existed in both countries. The

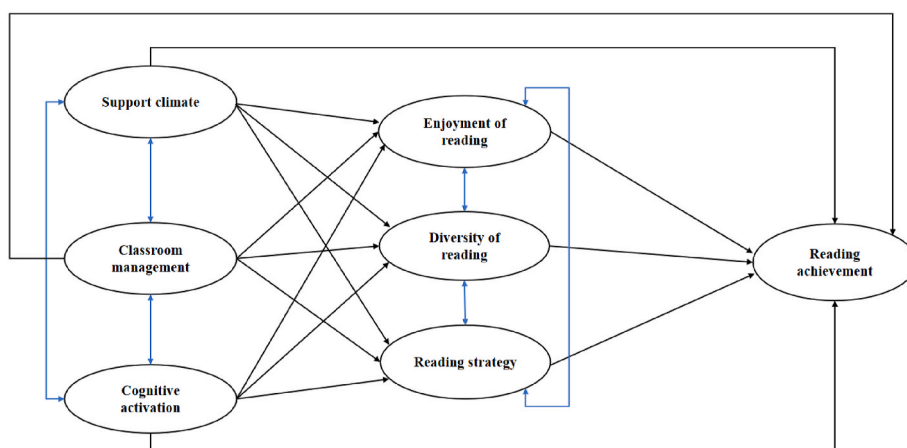


Fig. 2. Structural equation model.

Table 5 Results of direct effects in SEM

Predictor	Outcome	β	
		China	THE UK
Support climate	Enjoyment of reading	-0.012	-0.052 ^a
Classroom management	Enjoyment of reading	0.179 ^c	0.139 ^c
Cognitive activation	Enjoyment of reading	0.291 ^c	0.208 ^c
Support climate	Diversity of reading	0.012	-0.050 ^a
Classroom management	Diversity of reading	0.075 ^c	0.081 ^b
Cognitive activation	Diversity of reading	0.250 ^c	0.312 ^c
Support climate	Reading strategy	0.092 ^c	0.005
Classroom management	Reading strategy	0.069 ^c	0.078 ^c
Cognitive activation	Reading strategy	0.354 ^c	0.299 ^c
Support climate	Reading achievement	-0.051 ^a	0.004
Classroom management	Reading achievement	0.089 ^c	0.128 ^c
Cognitive activation	Reading achievement	0.039	0.016
Enjoyment of reading	Reading achievement	0.303 ^c	0.343 ^c
Diversity of reading	Reading achievement	0.148 ^c	-0.006
Reading strategy	Reading achievement	0.013	0.041 ^a

^a $p < 0.05$.
^b $p < 0.01$.
^c $p < 0.001$.

Table 6
Results of indirect effects in SEM

Predictor	Mediator	Outcome	β	
			China	THE UK
Support climate	Enjoyment of reading	Reading achievement	-0.004	-0.018 ^a
Support climate	Diversity of reading	Reading achievement	0.002	0.000
Support climate	Reading strategy	Reading achievement	0.001	0.000
Classroom management	Enjoyment of reading	Reading achievement	0.054 ^c	0.048 ^c
Classroom management	Diversity of reading	Reading achievement	0.011 ^b	0.000
Classroom management	Reading strategy	Reading achievement	0.001	0.003
Cognitive activation	Enjoyment of reading	Reading achievement	0.088 ^c	0.071 ^c
Cognitive activation	Diversity of reading	Reading achievement	0.037 ^c	-0.002
Cognitive activation	Reading strategy	Reading achievement	0.005	0.012 ^b

^a $p < 0.05$.

^b $p < 0.01$.

^c $p < 0.001$.

association between diversity of reading and reading achievement was significant and positive in China (B-S-J-Z), and the relation between reading strategy and reading achievement was significant and positive in the UK. However, enjoyment of reading significantly and positively predicted reading achievement in two countries.

The results of indirect effects showed that the effect of instructional quality on reading achievement was significantly mediated by enjoyment of reading, excluding the effect of support climate on reading achievement in China (B-S-J-Z). In addition, support climate had negative and significant indirect effect on reading achievement via enjoyment of reading in the UK. Diversity of reading positively mediated the relations between classroom management and reading achievement, and between cognitive activation and reading achievement in China (B-S-J-Z). However, diversity of reading insignificantly mediated the associations between instructional quality and reading achievement in the UK. The indirect effect of cognitive activation on reading achievement was significant via reading strategy in the UK.

5. Discussion

The present study examined the relationships between instructional quality and reading achievement, and the mediating role of reading engagement on the associations between instructional quality and reading achievement in China (B-S-J-Z) and the UK. The main findings are discussed as follows.

5.1. Relationship between instructional quality and reading achievement

The finding that support climate is insignificant associated with reading strategy and reading achievement in the UK is inconsistent with previous studies [17,30,57]. This might be attributed to sample age. For example, Fauth et al. investigated a sample of 1556 German third grade students in 89 classes whose average age was 8.8 years, in contrast to 15 years old in our sample adopted from PISA 2018 data [17]. These 15-year-old adolescents are experiencing specific age stages in which cognitive and meta-cognitive processes can be underpinned as prominent elements in development [58]. Likewise, these students tend to become rebellious and desire to pursue novel things and break through existing rules. As such, support climate such as interactions between teachers and students varied in the age stage. Future research may probe into more complex factors to clarify the controversial issue.

In addition, the present study further confirms that the dimensions of teaching quality play different roles in student achievement. For cognitive activation, only indirect effects were found to predict student reading achievement, which is consistent with the extant studies [17,19,59]. Scherer et al. showed weak association between cognitive activation and achievement in Australia [19]. In a longitudinal study in German primary school, Fauth et al. pointed out that cognitive activation mainly predicted students' development of subject-related interest rather than students' achievement. They also confirmed that classroom management was a significant predictor to students' achievement, which was in accordance with our study [17].

5.2. The mediating role of reading engagement in the relationship between instructional quality and reading achievement

The findings of the mediating role of reading engagement in the association between instructional quality and reading achievement suggested cultural generality and heterogeneity, which was a further improvement compared with previous study [10]. Only the mediating effect of enjoyment of reading showed cultural generality, that is, under the stimulation of teaching, students tend to have higher learning motivation contributing to better academic performance in both eastern and western culture. However, diversity of reading and reading strategy as mediating variables indicated cultural heterogeneity. In eastern culture, instructional practices could influence diversity of reading, and affect students' learning outcome, while in western culture, reading instruction could induce reading strategy, then enhance reading achievement.

The effect of classroom management and cognitive activation on reading achievement was significantly mediated by enjoyment of reading in both China (B-S-J-Z) and the UK. This might indicate that the motivational factor may be cultural-free and benefit most

among three dimensions in reading engagement. Certainly, Ng et al. have claimed that the role of enjoyment of reading was crucial due to students who read derived from personal interest of the topic or reading for enjoyment were more engaged in reading and tended to show a greater extent of commitment and persistence [60]. In China, enjoyment of reading has been highlighted by a number of researchers [61,62]. Especially, the association between enjoyment of reading and reading achievement has been proven in B-S-J-Z [33].

What's more, aside from enjoyment of reading, two other dimensions in reading engagement, diversity of reading and reading strategy, play a mediating role in China (B-S-J-Z) and the UK, respectively. That is, the diversity of reading positively mediated the relations between classroom management and reading achievement, and between cognitive activation and reading achievement only in China (B-S-J-Z), in contrast to the mediating role of reading strategy only in the UK. These results may demonstrate the weakness of reading teaching in China (B-S-J-Z) and the UK. Ideally, reading achievement can be predicted by diversity of reading [34] and reading strategy [31,36]. These insignificant results may also be associated with the specific educational contexts. For instance, the finding of that reading strategy is not a significant predictor of reading achievement may reflect the culture of teaching to the test in China (B-S-J-Z) [63–65]. Being exposed to the pressure of high school or college entrance examinations, Chinese students (B-S-J-Z) rarely discuss reading texts with their peers. Instead, they prefer to work individually and seek reading materials similar to the test and have repetitive practice. However, it is not surprising to understand that reading strategy do enhance reading achievement in the UK may be related to their socio-economic background, as shown by a study of Jerrim [66], who claimed that high reading achievement in England was typically influenced by family background. It means that students with high socioeconomic backgrounds may have chance to share their reading materials with their parents and peers and thus, their reading skills were improved. For diversity of reading, the UK students only received a mean score of 2.02, indicating that the UK participants only read few times a year, whereas Chinese (B-S-J-Z) participants read approximately one time per month.

6. Conclusion and implications

In conclusion, the present study confirmed that (a) classroom management was a positive predictor of reading achievement, while (b) the relation between cognitive activation and reading achievement was insignificant in China (B-S-J-Z) and the UK. For the mediating effect of reading engagement on the relationship between instructional quality and reading achievement, the study demonstrated that (c) the indirect effects of classroom management and cognitive activation on reading achievement via enjoyment of reading were significant in China (B-S-J-Z) and the UK; (d) diversity of reading mediated the link between classroom management and reading achievement, and the relation between cognitive activation and reading achievement in China (B-S-J-Z), (e) while these associations were insignificant in the UK; (f) cognitive activation had an indirect effect on reading achievement via reading strategy in the UK; and (g) while the relationship was insignificant in China (B-S-J-Z).

This study has several implications. First, comparative researchers may pay specific attention to studying the insignificance between variables in this study, for instance, conclusions (b), (e), and (g) are theoretically assumed to be significant, but insignificant in this study. Comparative researchers may adopt different methods (e.g., interviews, observations) to achieve a deep understanding. It is also interesting to see if these insignificances are caused by cultural differences. This is important because a culture-free strategy has the potential for both Chinese (B-S-J-Z) and UK reading teachers. Second, enjoyment of reading plays an important role in the association between instructional quality and reading achievement (see conclusion (c)), thus, teachers in China (B-S-J-Z) and the UK should take motivational factors as priority in their reading instruction in order to improve students' reading achievement. Third, according to conclusion (d), the UK reading teachers may incorporate diverse sources in their teaching and give students more assignments from different sources, which may improve students' reading scores directly or indirectly. Fourth, based on conclusion (f), Chinese (B-S-J-Z) educators should use different reading teaching strategies to identify more suitable reading strategies for Chinese (B-S-J-Z) students to promote the development of their reading skills.

Although the MTE program has been established to import a Chinese way to mathematics teaching for the UK [14], the above findings do not guarantee the effectiveness of Chinese (B-S-J-Z) pedagogy in the UK. On the one hand, language learning heavily relies on specific cultures. Although PISA 2018 data for China are not representative of the overall situation in China, Beijing, Shanghai, Jiangsu, and Zhejiang all come from developed eastern regions with similar cultural backgrounds. Teachers need to pay attention to their own culture when it comes to improving students' reading literacy. On the other hand, there are not enough empirical evidence to compare students' reading literacy among different countries. Our study only serves as a general understanding of reading teaching in comparative education.

7. Limitations and future research

There are several limitations in this study. First, reading engagement and instructional quality were measured by students' self-report, which might have led to bias. Future studies should use multiple methods (e.g., observation or experiment) to measure these variables to reduce measurement errors. Second, our data are cross-sectional and reveal correlations between variables. Future research could use longitudinal data to explore the causal relationships between variables. Third, although some variables related to reading achievement (e.g., ESCS, gender) were controlled for, there are still some variables (e.g., teacher beliefs, school climate, parents' views on education) that might influence reading performance that were not included in the study. In the future, studies can include more potential variables to explore the relationships between instructional quality, reading engagement, and reading achievement. Finally, the generalizability of the findings based on samples from China (B-S-J-Z) and the UK in this study is limited. Future studies can use more countries to examine our findings.

Data availability statement

Data can be downloaded for free from the website (<https://www.oecd.org/pisa/data/>).

Ethics statement

All participants voluntarily participated in PISA. The specific ethics statements have been implemented by the government. Please see more details in the website (<https://www.oecd.org/pisa/pisafaq/>).

CRediT authorship contribution statement

Chen Qiu: Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **Xinling Liu:** Writing – review & editing.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e34896>.

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