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Differential effects of a reading strategy intervention program for migrant children in migrant schools in China

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Background: There are over 14 million migrant children in the compulsory education system in China and the number has been increasing rapidly. However, the quality of education in schools for migrant children is often poor. Meanwhile, numerous studies indicated the importance of reading skills developed by the end of third grade. Few studies, however, have investigated the early reading development of migrant children in migrant schools in China. In the current study, we examined, with a randomized control trial design, the effects of reading strategy instruction *via* teacher professional development for migrant children in migrant schools.

Method: A total of 1,679 students from 47 third-grade classes in 13 migrant schools for migrant children in Beijing, China, participated in the study. The intervention was composed of teacher professional development on reading strategy. Students in both treatment and control conditions received books for independent reading.

Results: The program resulted in a higher overall reading performance for students in the treatment classes than those in the control classes, with the difference larger in inferential comprehension and for students who did not live in Beijing before starting elementary school (which we speculate captures the degree of family mobility and the rural–urban gap in the access to educational resources).

Conclusion: The results suggest that a reading strategy instruction *via* teacher professional development may promote the reading development of migrant children in migrant schools in China.

KEYWORDS

reading development, reading, intervention, teacher professional development, randomized control trial, migrant children in China

Implications for practice

What is already known about this topic

- Increasing access to books has mixed effects on children's reading skills.
- Employing appropriate reading strategies during reading is important.

What this paper adds

- Instruction on reading strategies in addition to access to books results in positive impact on Grade 3 migrant students in China.
- Effects are particularly pronounced on higher-order reading comprehension.

Implications for theory, policy or practice

- In addition to increasing access to books, teach students reading strategies.
- This might be particularly important for students from disadvantaged and marginalized backgrounds.

Introduction

Reading skill development in early elementary grades is of vital importance. Reading lays a foundation for learning content areas such as mathematics, science, and social studies. It is, therefore, closely linked to academic success and thus to life success, given the essentiality of a college degree in the current society (Lesaux et al., 2010; Hernandez, 2011; National Center for Education Statistics, 2011; Sparks et al., 2014). A few studies have emphasized the importance of reading at grade level by third grade. Students below grade level in third grade are more likely to experience learning difficulties and behavioral problems at school and have lower probabilities of graduating from high school and attending college than their more capable peers (Lesaux et al., 2010; Lesnick et al., 2010). This is likely due to the transition from learning to read by the end of third grade to reading to learn from the beginning of fourth grade. The demands for comprehending the written material substantially increase in upper elementary grades, making it more difficult for struggling readers to succeed at school (Annie E. Casey Foundation, 2010). It may explain why remedial programs for struggling readers are more successful if implemented before third grade (e.g., Foorman et al., 2003; Annie E. Casey Foundation, 2010; Sparks et al., 2014) and it is critical to support language and reading development in primary grades.

Despite the significance of early reading development, reading resources tend to be inadequate in developing countries, or at least for children in certain regions of these countries. Take China as an example. Studies found that, while about two-thirds of the families in large cities bought about 10 children's books each year and children in cities, on average, read over 10 books each year (Li, 2016), only about 30–40% of the families in rural China had 10 or more children's books at home and less than 1% had 25 or more (Gao et al., 2018; Yi et al., 2019; Wang N. et al., 2020). What makes the matter even worse is that children in remote rural areas in China have little access to public libraries and bookstores, which further restricts their reading resources (Wang H. et al., 2020; Wei, 2021). In fact, three-fourths of the rural children surveyed in a study listed "limited reading resources" as a barrier to independent reading. In contrast, only about one-third of the urban children made the same claim (Wei, 2021). Not surprisingly, children in rural areas have been found to be low in reading achievement. Researchers assessed rural primary school fourth-graders/rising fifth-graders with items from the Progress in International Reading Literacy Study (PIRLS) test and found that rural primary schoolers on average scored lower than the PIRLS participants from all 44 countries and regions (Wang N. et al., 2020; Gao et al., 2021, 2022).

These previous studies in China are predicated on the hypothesis that reading volume or quantity is important to students' reading skills because reading experience provides an opportunity to practice reading (e.g., decoding) and helps gain world and content knowledge, both of which are essential for reading skills. However, studies examining the effects of increasing reading experience and opportunity have produced mixed results (see Allington and McGill-Franzen, 2021 for a review). For instance, programs that provided both reading materials and teacher professional development in reading instruction produced positive effects on students' reading achievement in the Philippines and Rwanda (Abeberese et al., 2014; Friedlander et al., 2019). Similarly, a summer reading program conducted in the United States improved students' performance on the year-end state reading test, although not their performance on the reading assessments administered in the fall semester immediately after the summer vacation (Stein, 2017). Yet another program implemented in the United States exerted no overall effect, but a more nuanced analysis indicated that it produced positive effects for high-poverty schools and negative effects for moderate-poverty schools (White et al., 2014). A meta-analysis of 67 studies conducted in low- and middle-income countries indicates an overall positive effect of explicit and systematic literacy interventions, including increased access to reading materials, on reading skill development (Kim et al., 2020).

Reading intervention programs implemented in China have also delivered mixed results. For example, Gao et al. (2018), using a matching method, found that a program combining an in-class library with high-quality teacher training ("focus[ing] on instructing students on how to read independently") improved not only students' reading skills (measured with reading items adopted from PIRLS and translated into Chinese) but also their mathematics and Chinese language arts test scores (assessed with standardized mathematics and Chinese language arts tests developed by the researchers with assistance from local educators); in contrast, a program that provided only books and a program that combined an in-class library with low-quality teacher training ("focus[ing] primarily on how to instruct Chinese language classes in the manner mandated by the national curriculum") exerted no effects (p. 114). Using a randomized control trial, Yi et al. (2019) found that an in-class library program had no effect on students' reading or academic achievement, but it improved their reading habits and their attitudes toward reading though decreasing their reading confidence. Also employing a randomized control trial, Guo et al. (2021) found that providing free books for summer reading improved students' word reading performance and summer reading amount but not their reading comprehension performance. The program was particularly beneficial to low-performing students and students who had parents with limited education.

Intervention programs targeted at socioeconomically disadvantaged children in China have mostly been implemented in rural areas; very few are intended for migrant children, i.e., children who moved to cities from rural areas along with their parents. There are more than 14 million migrant children in the compulsory education system in China, with the number increasing every year (Ministry of Education of the People's Republic of China, 2018, 2019, 2020, 2021). It is difficult for these children to enter local public schools because of the unique household registration (*hukou*) system in China; many of them can only go to private schools specifically for migrant children (i.e., "migrant schools"). Migrant schools in China in general are characterized by poor educational resources and inferior teaching quality, many staffed with "under-qualified and unmotivated teachers with high job turnover" (Lai et al., 2015, p. 36). As a result, children in these schools do not perform as well as local children, migrant children in urban public schools, or even children in rural public schools (Chen and Feng, 2013; Lai et al., 2014; Afridi et al., 2015; Lv and Wang, 2017; Wang et al., 2017).

Many prior reading interventions focused on increasing students' access to books (see above). However, although access to books is necessary, it may be insufficient for improving students' reading skills if

it is not accompanied by quality reading experiences. One of the consistent results in the field of reading is that students' knowledge of how to read (reading strategies) is important to their reading skills (see Shanahan et al., 2010 for a review). For example, using graphic organizers and understanding text structure (e.g., characters, problems, and solution) support students' comprehension (e.g., Kim et al., 2004; Bogaerds-Hazenberg et al., 2021). Strategies of activating background knowledge, questioning, summarizing, searching for and organization information can help reading comprehension (Guthrie et al., 2004; Guthrie and Klauda, 2014). Therefore, in the current study, we examined whether instruction on reading strategies and reading activities makes a difference over and above access to books for migrant children in China.

Extant literature suggests that the impact of reading interventions is not uniform, but instead is moderated by factors such as parental education level, prior reading performance, and urbanicity of the area where the intervention was implemented (Kim et al., 2020; Guo et al., 2021). Research has found that intervention results tend to be larger for students with lower academic performance, and lower performance has been found to be associated with biological sex, parental education, access to books, and family mobility (Zhang and Guo, 2011; Kim and Quinn, 2013; White et al., 2014; Guo et al., 2021).

Research examining differential impact has mostly focused on students' demographic backgrounds (e.g., differential effect as a function of biological sex, parent education, prior achievement), as described in the preceding paragraph. In the present study, we extend previous studies by examining the impact of intervention on different types of reading comprehension. Reading comprehension is widely classified as shallow/literal comprehension and deep/inferential comprehension. Shallow/literal comprehension refers to recall or retrieval of explicitly presented information whereas deep/inferential comprehension refers to understanding of the text including inferring, interpreting, and evaluation information (Mullis and Martin, 2019). Not surprisingly, there are different types of items in reading comprehension tasks that are designed to tap into literal and inferential comprehension, and those are widely classified into literal, inferential, and evaluative ones. These types are aligned with the PIRLS Framework for Assessing Reading Achievement (Mullis and Martin, 2019). These represent different levels of cognitive demands placed on the reader and varying levels of interaction with the text required of the reader (Herber, 1970). For literal comprehension, a reader simply needs to recall information explicitly stated in the passage (Carnine et al., 2010). For inferential comprehension, a reader needs to infer information that is not explicitly stated in the text, including interpreting the author's meaning, inferring meaning by relating what they have read in the text to their prior knowledge and experiences, and establishing relationships between elements in the text by "reading between the lines" and connecting information dispersed throughout the text (Vacca et al., 2009; Carnine et al., 2010; Basaraba et al., 2013; Kim and Petscher, 2021). For evaluative comprehension, a reader needs to move beyond the text and evaluate it critically (Rupley and Blair, 1983; McCormick, 1992; Basaraba et al., 2013; Mullis and Martin, 2019). Literal comprehension is indispensable as it establishes foundational understanding of the texts for higher-order comprehension such as inferential and evaluative comprehension (Basaraba et al., 2013). However, literal comprehension relies on recall while it is higher-order inferential and evaluative comprehension that are essential for deep comprehension of texts and learning. Therefore, investigation into students' performance on different types of reading comprehension would provide more nuanced information on the impact of a reading intervention program.

Present study

Few studies examine reading skill development in early elementary grades in migrant schools of China. This omission is regrettable, in view of the ample evidence supporting the significance of reading development in the early stage. The study also addresses a theoretical gap in the literature, where much of understanding of reading development is based on languages with alphabetic writing systems (Share, 2021; but also see rapidly growing literature on reading development in Chinese). In the present study, we investigated the impact of reading intervention programs for migrant children in migrant schools using an RCT design (please see "Participants" in the Methods section for detail). Beyond the examination of the main effect of the reading intervention, we investigated whether the reading intervention had differential impacts as a function of types of reading comprehension skills and student' demographic backgrounds.

We addressed the following research questions:

1. Do students who participate in the reading strategy instruction program have higher reading comprehension skills than their peers who do not participate in the program?
2. Does the reading strategy instruction program cause a difference between the two groups of students in reading performance on different types of comprehension?
3. Does the reading strategy instruction program benefit some subgroups of students more than others?

Method

Participants

We conducted a randomized control trial in the third-grade classes of 13 migrant schools for migrant children in Beijing, China. A total of 1,679 students from 47 classes participated in the study. Within each of the migrant schools, the rising third-grade classes were randomly assigned (i.e., the participants were randomly assigned in clusters at the class level) to either the treatment group or the control group, with the Chinese language arts teachers of the treatment classes receiving training in reading instruction. Altogether, 931 students in 27 classes were assigned to the treatment group, and 748 students in the other 20 classes served as the control, all with parental consent. A total of 23 teachers in the treatment condition received training. Four teachers each taught two treatment classes, and five other teachers each taught a control class as well as a treatment class. We reiterated the importance of keeping the control classes unaffected by the program for an unbiased estimate of the program impact, and the five teacher trainees did not instruct the control classes how to read the two books. However, given that five teachers taught classes across treatment conditions, potential spillover effect was examined (see the Results section).

Intervention

The intervention focused on reading comprehension strategies that students can use during reading (see the literature review above). The teachers in the treatment condition received two sessions of teacher professional development that lasted about 2 h per session, once in the fall semester and once in the spring semester. The training was conducted

by a teacher with years of teaching experiences in a public elementary school in Beijing. She had directed or participated in various projects that promoted the thematic approach or the whole book approach to reading instruction. The trainer informed teachers of the importance of independent reading to reading skill development and academic success. Then she introduced comprehension strategies that young readers could apply in independent reading (e.g., guessing what the book is about on the basis of information such as the book title, checking to see whether one's guesses are right or wrong, slowing down and re-reading if necessary when the text becomes difficult, stopping from time to time to think what one is reading, using context clues to understand what one is reading, finding relationships among ideas in the text, and integrating what one knows with what one is reading for a better understanding). After that, she provided, for each book to be used, a list of recommended activities that teachers could employ to encourage independent reading after class, applying comprehension strategies (e.g., having students each create a diagram to display the plot of a story, asking students to identify the problems and the solutions in a story, giving students the beginning of stories and asking them to guess how each story will develop and then read to check whether their guesses are right). During each training session, the trainer used one of the books recommended for that semester by the Ministry of Education in China. The Ministry of Education recommends books for independent reading each semester for each grade, with a list of the books printed on a page entitled "Happy Reading (kuai le du shu ba)" in the textbook for the grade. These books, however, were usually ignored in migrant schools, because they were recommended, but not compulsory, reading. We chose books from the Ministry of Education recommendation list because these books might be perceived with authority by the principals of the migrant schools. Students in both treatment and control conditions received books for independent reading.

After the teacher training session, third-grade students in the participating schools across the treatment conditions were each provided with a copy of the book chosen for the semester. The books were *Andersen's Fairy Tales* for the fall semester and *Ancient Chinese Fables* for the spring semester. Then teachers of the treatment condition spent two periods of the Chinese language class (a total of 70–80 min) each semseter instructing students on how to read the book. In contrast, students in the control classes received business-as-usual instruction, i.e., instruction focusing on the textbook, with no instruction on independent reading. For each unit in the textbook, the teacher would usually first go over the text with the students, analyzing the text and directing students' attention to words, phrases, and rhetorical devices that the teacher considered important. After this, the teacher would choose tasks from a textbook companion workbook for homework assignments. Example tasks in the workbook include choosing the correct pronunciation for Chinese characters or the correct meaning for words to answering comprehension questions (typically sentence completion questions) related to the text. The control group students in this study were similar to children in the treatment group of some previous research, provided with free books but not extra instruction (e.g., Allington et al., 2010; Guo et al., 2021).

Measures

The third-grade students took a reading comprehension test and a demographic background survey toward the end of the academic year, i.e., spring semester. We would have administered a pre-test of reading comprehension at the beginning of the school year, but were not allowed to enter the schools due to the COVID-19 pandemic. The survey enabled us to examine whether the two groups of students were comparable on personal and family background characteristics.

Chinese reading comprehension

Chinese Reading comprehension was measured by an experimental task that was composed of two parts. In the first part, students read three short passages and answered multiple-choice questions, sentence completion questions (e.g., "According to the passage, Chinese people like drinking tea because _____"), and short answer questions (e.g., "Who gave the little grass help during its growth?"). This part contained 16 items, with each item worth 2–6 points (depending on the length and the difficulty of the answer needed) and a total of 48 points. The first two passages were fictional while the third one was non-fictional. The students could refer to the text when answering the questions since each text was printed on the same page as the corresponding items. In the second part, students answered multiple-choice questions and sentence completion questions related to the two books provided to all the participating students. For example, for one sentence completion item, students were asked to write down the idiom (derived from a Chinese fable story) that is similar in meaning to another fable story, with the latter presented in a picture. The second part contained six items, which were worth a total of 20 points. For this part, the students could not refer to the two books. The Cronbach's alpha estimate for the reading comprehension test (with a total of 22 items) was 0.82.

Students' responses were given full, partial, and no credit depending on the accuracy. For instance, the correct answer for one part of a sentence completion item is "giving a loud cry (da hou)," which can be found in the text. Students were given full credit (2 points) for this answer, but only partial credit (1 point) for an answer like "crying (jiao sheng)," which also appears in the text but is a less accurate answer. Answers completely irrelevant [e.g., "fleeing (tao zou)" received no credit]. Trained research assistants scored the responses, and they were blind to students' treatment conditions.

The type of reading comprehension items was determined by the first two authors of this article. The first author is an expert on English as a foreign language, and the second author is an expert on reading development and instruction. The two authors discussed and classified the items in the reading comprehension task. Of the 22 items, 18 items were classified as literal (7 items), inferential (8 items), and evaluative (3 items) comprehension, respectively, totaling 20, 25, and 9 points, respectively; the other four items (all in the second part of the reading comprehension task, totaling 14 points) were classified as book recall items because they required information from the two books provided (e.g., determining which one of four fairy tales were written by Andersen, or writing down four four-word idioms originating from Chinese fable stories in response to pictures depicting the four stories).

Demographic background survey

A survey was administered to students prior to the reading comprehension test. The questionnaire asked for information about students' date of birth, gender, paternal education, the place where they had lived before they started school, and the number of books (and in particular children's books) at home. We included place of stay prior to elementary school as well as the factors commonly found to be associated with school performance since we suspected that this factor might also contribute to students' early elementary school performance: it could reflect the degree of family mobility and the rural–urban gap in the

access to educational resources. The questions for both number of books and number of children's books were multiple choice questions, with several categories as the answer options, since it would have been difficult for third-graders to give the exact numbers. All questions and answer options were read in class to ensure that the students understood, and explanations were provided where necessary.

Data analytic strategy

For research question 1, we employed simple ordinary least square (OLS) regression, with the reading test score as the outcome. The key predictor was treatment status (*Treated* = 1). Suspecting that the treatment might impact the control classes taught by the five teacher trainees who each taught a treatment class and a control class, we also estimated the treatment effects separately for the 10 classes that they taught and the other 37 classes. For all analyses, we controlled for the school fixed effects, and clustered standard errors at the school level to account for the potential error correlation within each school.

For research question 2, we first ran OLS regression similar to that for research question 1, this time with the scores for different types of comprehension items as the outcomes. As stated earlier, the types of comprehension in this study include book recalling as well as literal, inferential, and evaluative comprehension. Then we further examined whether the intervention might have a differential impact as a function of different types of comprehension. We generated a categorical variable for the four types of comprehension (literal, inferential, evaluative, and book recalling). The key predictor was the interaction term between *Treated* and the categorical variable.

For research question 3 (possible heterogeneous effects as a function of demographic characteristics), we examined whether the program affected socioeconomically disadvantaged students (in terms of paternal education, number of books at home, and place of stay before starting school) differently than their peers and whether the program had different effects on male and female students. For each possible heterogeneous effect, we added, to the simple OLS regression for RQs 1 and 2, the interaction term between *Treated* and the corresponding variable (e.g., a dichotomous variable indicating whether one's father had less than elementary education). Again, for all analyses, we controlled for the school fixed effects, and clustered standard errors at the school level.

Results

We examined whether the treatment and control groups were equivalent on demographic characteristics and found the two groups comparable. As can be seen from Table 1, the two groups were not statistically significantly different in student or family characteristics.

Research question 1: Overall reading performance

The treatment group ($M = 38.53$, $SD = 11.82$) slightly outperformed the control group ($M = 36.58$, $SD = 12.01$). Regression results support the same conclusion. Students in the treatment classes, on average, scored 2.2 more points (out of 68) higher than those in the control classes, and the difference was marginally significant ($p < 0.10$; Column 1, Table 2). The effect size was about 0.18. The results also show that the treatment effect was smaller for the 10 classes taught by the five teacher trainees who each taught a treatment class and a control class (Column 2) than that for all classes, whereas the effect for the other 37 classes was larger, at about 2.7 points ($p = 0.10$; Column 3). The results suggest a possible spillover effect for the five control classes taught by the teacher trainees even though these teachers did not spend time in class instructing students how to read the books provided. Therefore, the test results for all classes provide a lower bound of the treatment effects.

TABLE 1 Descriptive statistics for the treatment and the control groups.

	Treatment group (*N*=931)	Control group (*N*=748)	Difference
Age (years)	8.823	8.815	0.008
Male	0.541	0.524	0.017
Lived in Beijing before starting school	0.806	0.828	−0.022
Father not completed elementary education	0.050	0.058	−0.007
Father not completed high school	0.207	0.188	0.018
Number of books at home			
0–10	0.087	0.078	0.009
11–25	0.201	0.209	−0.008
26–50	0.270	0.263	0.007
51 and more	0.442	0.450	−0.008
Number of children's books at home			
0–10	0.254	0.278	−0.024
11–20	0.271	0.254	0.016
21–40 and more	0.188	0.183	0.006
41 and more	0.287	0.285	0.002

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

10.3389/feduc.2023.1066609

TABLE 2 Effects of the reading instruction program on reading comprehension performance (robust standard errors in parentheses).

Variable	(1) All 47 classes	(2) 10 classes taught by teachers teaching across treatment conditions	(3) Other 37 classes
Treated	**2.211***	0.473	**2.679***
	(1.205)	(1.246)	(1.492)
Age	−0.506	−0.556	−0.473
	(0.490)	(1.129)	(0.577)
Male	−2.359***	−3.585***	−1.979**
	(0.509)	(0.332)	(0.765)
Father not completed elementary education	−1.390	2.783*	0.978
	(1.684)	(0.709)	(2.196)
Lived in Beijing before starting school	1.602**	0.655	1.859**
	(0.607)	(1.528)	(0.751)
Number of books at home[a]			
11–25	5.010***	5.225**	4.839**
	(1.180)	(0.815)	(1.566)
26–50	4.128**	4.708	3.901*
	(1.725)	(2.944)	(2.021)
51 and more	5.715***	7.884*	4.922**
	(1.342)	(1.881)	(1.689)
Number of children's books at home[b]			
11–20	0.384	0.319	0.469
	(0.828)	(0.482)	(1.106)
21–40	1.126	0.844	1.232
	(1.101)	(1.784)	(1.414)
41 and more	2.018*	0.168	2.626*
	(1.122)	(1.123)	(1.181)
School fixed effects	YES	YES	YES
Observations	1,588	375	1,213
R-squared	0.106	0.087	0.113

[a]The omitted category is "0–10." [b]The omitted category is "0–10." *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. The bold values highlight the major results that are statistically significant.

Research question 2: Differential effects as a function of different types of reading comprehension

On average, students in the treatment classes scored about 1 point higher on items assessing inferential comprehension, out of a total of 22 points ($p < 0.05$; Column 2, Table 3); and about 0.6 point higher on items measuring book recalling, out of a total of 14 points ($p < 0.10$; Column 4). Students in the treatment classes also outperformed the control classes on items assessing literal and evaluative comprehension, but the score differences did not reach conventional statistical significance. The effect sizes for literal, inferential, evaluative, and book recalling items were 0.11, 0.19, 0.11, and 0.20, respectively.

A comparison of the differences in scores between the treatment and control groups across the comprehension item types supports the same conclusion. As can be seen from Table 4, the score differences between the two groups were larger for inferential comprehension and book recalling items than for literal comprehension items, the omitted category of items (Rows 1 and 3), though only the difference between inferential and literal comprehension items was statistically significant. The results suggest that the reading program had a significantly larger impact on inferential comprehension than on literal comprehension.

Research question 3: Heterogeneous effects as a function of demographic backgrounds

This sub-section presents the results of possible heterogeneous effects of the reading instruction program as a function of demographic backgrounds: biological sex (Panel A), parental education (father's highest education; Panel B), lived in Beijing before starting school (Panel C), and number of books and number of children's books at home (Panels D and E, respectively). We found that the reading program had a statistically significantly larger impact for children who did not live in Beijing before starting elementary school than for their peers (Panel C, Table 5), narrowing the achievement gap between children who lived, and those who did not live, in Beijing prior to elementary school. This

TABLE 3 Effects of the reading instruction program on students' reading skill development for different comprehension item types (robust standard errors in parentheses).

Variable	(1) Literal (total=20)	(2) Inferential (total=25)	(3) Evaluative (total=9)	(4) Book-recalling (total=14)
Treated	0.487	**0.939****	0.187	**0.598***
	(0.443)	(0.394)	(0.183)	(0.315)
Control variables[a]	YES	YES	YES	YES
School fixed effects	YES	YES	YES	YES
Observations	1,590	1,589	1,588	1,589
R-squared	0.078	0.105	0.070	0.073

[a]The control variables are the same as those in Table 2. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. The bold values highlight the major results that are statistically significant.

TABLE 4 Differential effects of the reading instruction program on different comprehension item types (robust standard errors in parentheses).

	Reading comprehension task
Treated*Inferential	**0.546****
	(0.202)
Treated*Evaluative	−0.166
	(0.284)
Treated*Recalling	0.233
	(0.295)
Treated	0.399
	(0.417)
Inferential[a]	1.856***
	(0.248)
Evaluative[a]	−11.32***
	(0.350)
Recalling[a]	−8.027***
	(0.463)
Control variables[b]	YES
School fixed effects	YES
Observations[c]	6,356
R-squared	0.696

[a]The omitted category is literal comprehension. [b]The control variables are the same as those in Table 2. [c]The observations are the number of participants (1589) times the four types of comprehension. For this analysis, we reshaped the data structure such that each participant had four rows of data, one for each comprehension type. This structure allows for the analysis of interaction between treatment status and comprehension type. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. The bold values highlight the major results that are statistically significant.

was true of the students' overall performance and of their performance on literal and inferential comprehension items. The effect sizes in the overall performance for students who did not live in Beijing prior to elementary school and those who lived in Beijing were 0.299 and 0.151, respectively, with a difference of 0.148 in the effect size for the two subgroups of students. No other differential effect of the program was detected (Panels A, B, D, and E).

Discussion

With a randomized control trial, we examined the effects of a reading strategy instruction program on reading skill development for third-grade migrant children in migrant schools in Beijing, China. We randomly assigned classes to the treatment group and the control group. Each semester, the Chinese language arts teachers in the treatment classes received two-hour training in reading instruction and then spent 70–80 min in class instructing students how to read a book provided, for two consecutive semesters. In contrast, the teachers of the control classes would teach business-as-usual. Students in these classes also received the same book each semester and therefore, the only difference between the conditions was the reading strategy instruction. Overall, students in the reading strategy instruction condition performed higher than those in the business-as-usual condition. Interestingly, what drove the differences in the overall reading performance was students' performance on inferential comprehension. In addition, the effects were significantly larger for students who did not live in Beijing prior to starting elementary school than for their peers.

The treatment group outperformed the control group in the overall reading comprehension by 0.18 standard deviation. Direct comparison of this effect size to other interventions is difficult due to differences in study populations, contexts and settings, duration, and target intervention. For example, many studies in developing countries had multi-component interventions where multiple skills were addressed (e.g., word reading, emergent literacy skills in addition to reading comprehension; see a meta-analysis by Kim et al., 2020). With this caveat in mind, the effect size of the present study is in line with previous reading comprehension interventions. For example, a 31-day reading program implemented in the Philippines, which provided both reading material and teacher training, yielded an effect size of 0.13 (Abeberese et al., 2014). A two-year intervention program implemented in rural Rwanda compared the school-only and lifewide-learning approaches to supporting early-grade learning (with the latter approach including a community component) and found an effect size of 0.21 for the former and 0.33 for the latter (Friedlander et al., 2019). Meta-analyses also produced similar results: Kim and Quinn (2013) found a mean size of 0.23 for effects of summer reading programs on reading comprehension in the United States and Canada; McEwan (2015) a mean effect size of 0.12 for teacher training in developing-country elementary schools; and Kim et al. (2020) a mean effect size of 0.25 for literacy interventions on reading comprehension in low- and middle-income countries. The program reported in this study was fairly effective considering the facts that it did not require extensive amount of teachers' time in either training or in-class reading instruction and that the study included a rigorous comparison where students in the comparison condition received books.

It is a highly encouraging finding that the treatment classes performed significantly better than the control classes on inferential comprehension although the two groups' performance was comparable

TABLE 5 Differential effects of the reading instruction program for subgroups of students (robust standard errors in parentheses).

	(1) Overall (total=68)	(2) Literal (total=20)	(3) Inferential (total=25)	(4) Evaluative (total=9)	(5) Recalling (total=14)
Panel A: Male students					
Treated*Male	0.952	0.591	0.142	0.179	0.0389
	(1.100)	(0.435)	(0.423)	(0.199)	(0.306)
Treated	1.705	0.173	0.863	0.0923	0.577
	(1.176)	(0.360)	(0.485)	(0.112)	(0.379)
Male	−2.888***	−1.285***	−0.992***	−0.318*	−0.289
	(0.868)	(0.371)	(0.294)	(0.151)	(0.189)
Control variables[a]	YES	YES	YES	YES	YES
School fixed effects	YES	YES	YES	YES	YES
Observations	1,588	1,590	1,589	1,588	1,589
R-squared	0.106	0.079	0.105	0.071	0.073
Panel B: Father not completed elementary education					
Treated*Father less than elementary edu.	−0.678 (2.730)	0.045 (1.370)	−0.954 (0.923)	0.167 (0.310)	0.063 (0.511)
Treated	1.572	0.530	0.040	0.345	0.657
	(3.305)	(1.490)	(1.058)	(0.454)	(0.686)
Father less than elementary edu.	−1.035	−0.521	−0.477	−0.004	−0.031
	(2.358)	(0.924)	(1.035)	(0.167)	(0.477)
Control variables[a]	YES	YES	YES	YES	YES
School fixed effects	YES	YES	YES	YES	YES
Observations	1,588	1,590	1,589	1,588	1,589
R-squared	0.106	0.078	0.106	0.071	0.073
Panel C: Lived in Beijing before starting school					
Treated*Lived in Beijing before school	**−2.519****	**−0.887***	**−1.311****	−0.161	−0.144
	(1.150)	(0.432)	(0.588)	(0.228)	(0.263)
Treated	4.285**	1.218	2.018**	0.320	0.716
	(1.877)	(0.727)	(0.781)	(0.208)	(0.456)
Lived in Beijing before school	3.083**	1.322**	1.252**	0.173	0.335
	(1.011)	(0.483)	(0.469)	(0.139)	(0.229)
Control variables[a]	YES	YES	YES	YES	YES
School fixed effects	YES	YES	YES	YES	YES
Observations	1,588	1,590	1,589	1,588	1,589
R-squared	0.108	0.079	0.108	0.071	0.073
Panel D: Number of books at home					
Treated*Book11–25	−1.446	−1.152	−0.298	−0.0277	0.0328
	(1.501)	(0.690)	(0.819)	(0.278)	(0.582)
Treated*Book26–50	0.288	−0.364	0.260	0.127	0.257
	(1.942)	(0.804)	(0.798)	(0.366)	(0.668)
Treated*Book51–	−0.904	−0.722	−0.199	0.0359	−0.0129
	(1.213)	(0.631)	(0.644)	(0.230)	(0.358)
Treated	2.829	1.140	1.018	0.143	0.527
	(1.602)	(0.785)	(0.764)	(0.189)	(0.456)
Book11–25[b]	5.813***	2.516***	2.543***	0.0610	0.693*
	(1.198)	(0.491)	(0.744)	(0.205)	(0.380)
Book26–50[b]	3.964*	1.635**	1.700	0.152	0.478

(Continued)

TABLE 5 (Continued)

	(1) Overall (total=68)	(2) Literal (total=20)	(3) Inferential (total=25)	(4) Evaluative (total=9)	(5) Recalling (total=14)
	(1.943)	(0.627)	(1.027)	(0.259)	(0.440)
Book51-[b]	6.221***	2.373***	2.786***	0.267	0.794
	(1.615)	(0.586)	(0.834)	(0.184)	(0.470)
Control variables[a]	YES	YES	YES	YES	YES
School fixed effects	YES	YES	YES	YES	YES
Observations	1,588	1,590	1,589	1,588	1,589
R-squared	0.107	0.079	0.106	0.071	0.073
Panel E: Number of children's books at home					
Treated*CBook11–20	0.831	0.191	0.599	0.107	−0.0653
	(1.219)	(0.545)	(0.501)	(0.217)	(0.373)
Treated*CBook21–40	0.131	0.129	0.505	−0.224	−0.287
	(1.635)	(0.581)	(0.607)	(0.229)	(0.546)
Treated*CBook41-	0.563	0.226	0.301	0.0476	−0.00476
	(1.462)	(0.502)	(0.596)	(0.268)	(0.407)
Treated	1.810	0.349	0.605	0.186	0.669*
	(1.296)	(0.616)	(0.455)	(0.131)	(0.307)
CBook11–20[c]	−0.070	−0.162	−0.110	0.0500	0.152
	(0.946)	(0.353)	(0.433)	(0.149)	(0.256)
CBook21–40[c]	1.070	0.0158	0.166	0.343	0.544
	(1.646)	(0.499)	(0.629)	(0.296)	(0.462)
CBook41-[c]	1.720	0.115	0.322	0.370**	0.906**
	(1.113)	(0.598)	(0.297)	(0.163)	(0.410)
Control variables[a]	YES	YES	YES	YES	YES
School fixed effects	YES	YES	YES	YES	YES
Observations	1,588	1,590	1,589	1,588	1,589
R-squared	0.106	0.078	0.106	0.072	0.073

[a]The control variables are all those in Table 2 except the one that forms an interaction term with *treated*. [b]The omitted category is Book1–10. [c]The omitted category is CBook1–10. CBook, Children's Book. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. The bold values highlight the major results that are statistically significant.

on literal comprehension. This indicates that the treatment classes outperformed the control classes on higher-level comprehension of making inferences about meanings not explicitly stated. Inferential comprehension is generally more cognitively demanding than literal comprehension and is a more advanced comprehension (Kintsch and Rawson, 2005; Nation, 2005; Basaraba et al., 2013). The importance of inference making in successful comprehension is highlighted in theoretical models of reading comprehension (e.g., Kintsch and Rawson, 2005; Perfetti and Stafura, 2014; Kim, 2020) and associated large body of literature (e.g., see Cain and Oakhill, 2007 for a review). The larger impact on inferential comprehension by the intervention suggests that beyond support for access to book, it is important to provide reading instruction on reading strategies during independent reading. These results are in line with previous evidence that reading strategy instruction improves students' reading comprehension skills (Shanahan et al., 2010), but also show that what drives the improvement of reading comprehension is higher-order inferential comprehension at least for third grade students from migrant families in China.

Another notable finding is that the program had a differential effect as a function of whether students live in Beijing or not before they started elementary school. Children who did not live in Beijing prior to elementary school benefited more from the intervention. These results might be because these students' families had been more mobile than their peers', and family mobility was negatively associated with children's reading performance, probably because constant mobility interrupted children's learning and forced them to keep adjusting to new environments (Zhang and Guo, 2011). Alternatively, these findings may be because these children's place of stay had been less educationally favorable than Beijing, as children in remote rural areas tend to have very limited access to reading resources (Wei, 2021). No matter what the reason may be, these children were likely to have a lower starting point in reading. In fact, regression results indicate that living in Beijing prior to elementary schools was positively associated with reading performance (Table 2). The results are encouraging that the program narrowed the reading achievement gap between the two groups of students. This is consistent with prior findings that intervention programs tended to produce greater effects for students at a disadvantage, in terms of socioeconomic status and prior performance (Kim and Quinn, 2013; White et al., 2014; Guo et al., 2021). Future studies are needed to find the mechanism explaining the differential effects.

Another unique aspect of the study is an explicit examination of a potential spillover effect, and we found evidence of some spillover effects. The treatment effects were smaller for the classes taught by the five teacher trainees who each taught a treatment class and a control class even though

they did not instruct their control classes how to read the two books provided. These teacher trainees might intentionally or unintentionally have introduced reading strategies and employed teaching activities that they had learned from the training. As a result, positive reading behaviors might have also been encouraged in the control classes that they taught. The observed spillover effect is a concern for RCTs. On the other hand, however, the results also suggest students may benefit from their teachers' training in reading instruction even when teachers do not allot in-class time to specifically and formally focus on reading instruction.

This study has other limitations. One notable limitation is that, as stated earlier, we could not administer pre-test at the beginning of the school year because of the COVID-19 pandemic. As a result, we could compare the treatment group and the control group only on personal and family characteristics but not on reading skills before the program was implemented. Although it is not highly unusual for RCTs not to include pretests, future research could replicate this study with a pre-test component.

To our knowledge, this is one of the first studies to explore the possible effects of reading programs on the early reading development of migrant children in migrant schools in China. Reading strategy instruction made a difference in overall reading performance and, in particular, performance in inferential comprehension. The findings are encouraging for researchers and practitioners intending to foster the reading development of migrant children in migrant schools, especially migrant schools located in large cities. Explicit reading strategy instruction supported by teacher professional development in addition to access to books can be a potential way to improve the reading skills of migrant children in migrant schools, an important segment of the population in China.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval was not required for the study involving human participants in accordance with the local legislation and institutional requirements. The research was conducted with full cooperation from the schools involved. Written informed consent to participate in the study was provided by the participants' legal guardians/next of kin.

Author contributions

QG obtained the grant and designed the study with the co-authors, and conducted data analysis. Y-SK made contributions to conceptualization and writing. YL, YP, WS, JY, and LY contributed to conceptualization, implementation, data collection, and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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