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Supporting struggling readers at secondary school: an intervention of reading strategy instruction

Lin Wu[1,2] · Martin Valcke[1] · Hilde Van Keer[1]

Abstract

Reading strategies have been documented as beneficial facilitators for readers to understand text; their potential efficacy, however, has not yet adequately assessed among struggling readers in the context of a large number of students below grade level at secondary schools internationally. Using a pretest–posttest control group experimental design, the present study examined the effects of Chinese reading strategy instruction among struggling readers in grades 7 and 8 in mainland China. A sample of 342 struggling readers from five Chinese secondary schools participated in the intervention study. Students in the experimental condition received explicit teaching of reading strategies, whereas those in the control condition took regular classes. Results showed that the students in the experimental classes significantly outperformed those in the control classes not only in reading comprehension but also in autonomous reading motivation (ARM) and metacognitive awareness of reading strategies (MARS). No significant effects could be found on their controlled reading motivation. Furthermore, ARM and MARS partially mediated the effects of this instruction on reading comprehension. The findings imply that reading strategy instruction can be an effective approach to help struggling readers to improve their reading performance, with ARM and MARS acting as mediators.

✉ Lin Wu
wu.lin@gdei.edu.cn; lin.wu@UGent.be

1 Department of Educational Studies, Ghent University, Ghent, Belgium

2 Present Address: Foreign Language Department, Guangdong University of Education, 351 Xingangzhong Road, Haizhu District, Guangzhou, Guangdong 510303, China

Introduction

Reading comprehension is considered to be a basic learning competence. However, a large number of secondary school students achieved lower than their grade level in this competence in many countries (OECD, 2010, 2016, 2019). Recent research has shown education systems with lower achievers in reading more than 30% of all participating students account for 53% in the Programme for International Student Assessment in the participating countries and economies ($n = 78$) in 2018 (OECD, 2019) Evidence has also shown lower achievers seem to have been struggling with reading comprehension throughout their secondary school years (Edmonds et al., 2009; Potocki et al., 2015; Roberts et al., 2008). To support struggling readers, it is necessary to intervene in their reading comprehension (Baye et al., 2019; Deshler et al., 2007; Ortlieb & Cheek, 2013). Previous research has indicated that reading strategy instruction could improve struggling readers' comprehension (Rupley, 2009; Rupley et al., 2009; Scammacca et al., 2015). However, previous strategy instruction studies seldom involved in struggling secondary students in mainland China. Further, there are relatively few studies on the intervention effects of Chinese reading strategy instruction on struggling secondary students' reading motivation and metacognition, compared with studies on its intervention effects on reading comprehension. Therefore, the present study aimed to examine the direct effects of Chinese reading strategy instruction on struggling secondary students' reading comprehension, reading motivation, and metacognitive awareness of reading strategies (MARS), and the mediating effects of their reading motivation and MARS on the relation between this instruction and reading comprehension in Chinese secondary schools.

Reading strategy instruction

Reading strategies provide pathway for readers to reach text comprehension. Research indicated that proper use of reading strategies could facilitate text comprehension (Hagaman et al., 2012; Klingner et al., 2015; Spörer et al., 2009). In this respect, skilled readers are characterized by better understanding and use of reading strategies (Eurydice, 2011; Van Keer & Verhaeghe, 2005; Westbrook et al., 2019). In contrast, struggling readers cannot discover and employ efficient reading strategies or techniques by themselves (Van Keer, 2004), and they may fail in text comprehension due to lack of knowledge of reading strategies (Daly et al., 2015; Underwood & Pearson, 2004). Consequently, as a promising teaching approach, reading strategy instruction could be presumed to be effective to help struggling readers (Daly et al., 2015; Konza, 2006; Roberts et al., 2013).

Over the past two decades, an approach with several effective reading strategies has been used in a number of studies. Reciprocal teaching, an integration of summarizing, questioning, predicting, and clarifying, has been discovered beneficial to students' reading comprehension (Oczuks, 2003; Okkinga et al., 2018). Similarly, an integration of cognitive strategies, such as activating prior knowledge

and experiences, inferring what is unwritten, monitoring-clarifying in reading, has been regarded as an effective way to promote strategic reading and reading comprehension (McEwan, 2004, 2007). Additionally, Clark and Coan's (2007) study indicated an integration of metacognitive reading strategies (e.g., goal setting) and cognitive reading strategies (e.g., vocabulary recognition) could improve students' reading comprehension. In particular, previous research has found evidence of the effectiveness of this approach of reading strategy instruction on students' reading comprehension in Hong Kong, China (Lau, 2006; Lau & Chan, 2007). However, in mainland China, there is a lack of evidence of the impact of reading strategy instruction (Ding, 2016; Hu, 2016; Zhu, 2019). Although students at secondary schools in some relatively developed provinces or regions of China, such as Jiangsu Province and Shanghai, attained a high level of reading literacy in the Program for International Student Assessment (OECD, 2016, 2019), a large number of students at secondary schools in developing and underdeveloped areas perform poorly in reading literacy and cannot use reading strategies properly (Du & Guo, 2019; Wu, 2017). Therefore, in the current research, we intended to employ reading strategy instruction to improve struggling students' Chinese reading performance in mainland China. Different from existing studies (e.g., Lau, 2017; Lau & Chan, 2007), this study attempted to cultivate the Chinese reading literacy of struggling secondary students by strengthening their comprehensive use of multiple reading strategies and by strengthening the competence of teachers of experimental classes in strategy teaching in the context of Chinese reading curriculum reform in mainland China (Ministry of Education of P. R. China, 2012).

Considering the needs of Chinese students, this study adapted McEwan's (2004, 2007) strategy framework and implemented a new repertoire of seven strategies which had been recognized as effective by researchers: (a) setting reading goals (McEwan, 2004, 2007; Schramer, 2018), which refers to setting goals to monitor the reading process; (b) vocabulary recognition (Ford-Connors & Paratore, 2015; Stahl & Nagy, 2006), referring to strategic use of clues, word parts, and dictionaries to understand word meaning in context and to develop students' interest in words and their motivation to learn; (c) scanning text (Benjamin, 2007; Fauzi, 2018), referring to the quick search for the answers to specific questions or the quick positioning of specific facts; (d) identifying the main idea (Leopold & Leutner, 2012; Rogiers et al., 2020), referring to getting the main ideas or points of texts; (e) searching-selecting (McEwan, 2004, 2007; McEwan-Adkins & Burnett, 2013), namely, searching and selecting appropriate sources and information for text comprehension; (f) summarizing (Jitendra & Gajria, 2011; McEwan, 2004, 2007; McEwan-Adkins & Burnett, 2013; Rogiers et al., 2020), namely, writing a summary statement or paragraph in students' own words; and (g) predicting (Buehl, 2017; McEwan, 2004, 2007; McEwan-Adkins & Burnett, 2013), namely, making inferences based on evidence in texts, students' own experiences, and background knowledge.

Reading motivation

Proactive reading depends on the satisfaction of readers' needs. According to self-determination theory, individual behavior and performance can be explained in terms of innate psychological needs of competence, relatedness, and autonomy (Martela et al., 2018; Ryan & Deci, 2000, 2017). When these needs are satisfied, self-motivation will be possible to take place. Accordingly, students' reading could be self-motivated by autonomy-supportive contexts in which these needs are met, whereas could be hindered by controlling contexts (De Naeghel et al., 2012; Vansteenkiste et al., 2004).

Previous research has reported the positive role of self-motivation in reading comprehension. Students' self-motivation for reading is positively related to their reading achievements (Lin et al., 2012; Nevo & Vaknin-Nusbaum, 2020; Wigfield et al., 2016). It can promote students' active involvement in reading and increase their learning time, which helps to improve their reading comprehension (Guthrie et al., 2013; Retelsdorf et al., 2011). De Naeghel et al. (2012) found that autonomous reading motivation (ARM) was a strong positive correlate of reading comprehension. Conversely, controlled reading motivation (CRM) was presumed to be a negative correlate of reading comprehension.

Furthermore, researchers have found that reading strategy instruction could develop students' motivation to read. Lau and Chan (2003), for instance, demonstrated that it is strongly related to Chinese students' reading motivation and reading comprehension. Similarly, Kennedy's (2018) research suggested that it can develop reading motivation and engagement, which may improve reading comprehension. Nevertheless, there is a need for evidence on the mediating effects of ARM and CRM on the relation between reading strategy instruction and comprehension.

Metacognitive awareness of reading strategies

MARS, which involves in self-monitoring and self-control of reading strategies used in comprehension, can be a cognitive facilitator of students' reading comprehension. Research has shown that MARS is related to reading strategy instruction and reading comprehension (Castellana, 2018; McKeown & Beck, 2009; Sheikh et al., 2019). MARS can help students to use reading strategies successfully and to make necessary adjustments to their strategy use (McNamara & Magliano, 2009), but not all students' metacognitive awareness and skills can grow automatically with age and reading experience (Baker, 2008; Smith et al., 2020). Researchers have suggested that cognitive reading strategy instruction could improve struggling readers' MARS (Lau & Chan, 2007). In addition, researchers have indicated that students' prior knowledge on reading comprehension affects their metacognitive awareness and comprehension of science text and that their metacognitive awareness of science, textual genres, and reading strategies mediates the relationship between their knowledge and text comprehension (Wang & Chen, 2014). However, there is a lack of evidence on the mediating effects of MARS on the relation between reading strategy instruction and reading comprehension. Thus, it is necessary not only to explore

the direct impact of reading strategy intervention on MARS in struggling students, but to assess whether MARS would play a mediating role in this relationship.

The present study

Based on the existing research mentioned above, this study assumed that reading strategy instruction could be related to reading motivation, MARS, and reading comprehension. Further, it could not only improve struggling students' reading comprehension, but also impact on their reading motivation and MARS, which would in turn influence their reading comprehension. We expected that, by intensifying explicit teaching of a repertoire of seven reading strategies (Table 2) in struggling readers, there would be positive effects not only on students' reading comprehension but also on their reading motivation and MARS. Therefore, the present study was guided by the following hypotheses:

Hypothesis 1: Reading strategy instruction helps to improve text comprehension of struggling readers at secondary school.

Hypothesis 2: Reading strategy instruction helps to improve ARM of struggling readers at secondary school.

Hypothesis 3: Reading strategy instruction helps to improve MARS of struggling readers at secondary school.

Hypothesis 4a: ARM moderates the relation between reading strategy instruction and reading comprehension.

Hypothesis 4b: CRM moderates the relation between reading strategy instruction and reading comprehension.

Hypothesis 4c: MARS moderates the relation between reading strategy instruction and reading comprehension.

In contrast to existing studies, which mainly conducted in primary school students or in average secondary school students, we conducted an intervention of seven reading strategies among secondary-level struggling readers in mainland China. These hypotheses reflected the effects of intervention of reading strategy instruction. To attain reliable effects, we used random assignment of students to minimize the possible differences between experimental and control groups at the beginning of the experiment and performed multilevel analysis to eliminate the possible effects of uncontrollable variables in data analysis.

Method

Participants

Participating students, who consented to enter the present study, were randomly selected from five secondary schools in the provinces of Guangdong and Guangxi in south China. We first randomly chose 1322 students in grades 7 and 8 from these schools. Second, we administered a reading comprehension test, which served as a screening test, and selected 342 struggling readers (ages between 13 and 15). Finally, we randomly assigned them to two control classes and two experimental classes at each school. Altogether, 10 experimental classes ($n=168$) and 10 control classes ($n=174$) were set up as shown in Table 1.

Students can be identified as struggling, intermediate, and good readers (e.g., Blomert, 2009; McMaster et al., 2012; Rapp et al., 2007). Struggling readers are students with reading difficulties (Faggella-Luby & Deshler, 2008). In the present study, they were defined as those performing on reading comprehension less than or equal to − 0.75 *SD* below the average (Blomert, 2009) at the screening stage. Thus, struggling readers referred to the students at the lower quarter of grade-level comprehension. They were screened by a standardized grade-level reading comprehension test. However, they were different from those with dyslexia because they could decode Chinese Characters normally.

Twenty teachers were recruited and chosen from the participating secondary schools. They were matched by teaching experience and education degree. One of the paired teachers was assigned to an experimental class and the other to a control class. Altogether, 10 teachers taught 10 experimental classes and the other 10 teachers taught 10 control classes. No teachers and students dropped out of the study. Additionally, there were no differences in the familiarization, because the participating students were familiar with their teachers before the experiment.

Instruments

Data were collected through four instruments: the Self-Regulation Questionnaire: Reading Motivation (SRQ-RM; De Naeghel et al., 2012), the Metacognitive

Table 1 Demographic characteristics of the participating students who were struggling with reading comprehension (N = 342)

Source	Distribution							
	Male		Female		7th graders		8th graders	
	n	%	*n*	%	*n*	%	*n*	%
Experimental group ($n=168$)	88	26	80	23	112	33	56	16
Control group ($n=174$)	102	30	72	21	133	39	41	12
Total	190	56	152	44	245	72	97	28

The students were assigned to 10 experimental classes and 10 control classes at five secondary schools

Awareness of Reading Strategies Inventory: Chinese Version (MARSI-CN; Wu et al., 2012), and two parallel reading comprehension tests from an item bank entitled Reading Tests for Secondary School Students developed by our research team.

One of the main goals of reading teaching is to cultivate the readers' autonomy in learning, and these autonomous readers need to master reading strategies, so it is reasonable to choose a questionnaire based on the theory of self-determination (Ryan & Deci, 2000, 2017), which classified motivation as autonomous and controlled motivation. As one of the most popular motivation theories, the self-determination theory has shown strong explanatory power in the study of language education and reading motivation (Liu et al., 2016). Because the reading motivation questionnaire SRQ-RM developed by De Naeghel et al. (2012) is based on this theory, it is in line with the purpose of this research. This questionnaire is a measure to assess students' reading motivation in two different contexts (academic and recreational). In both contexts, there are two subscales: ARM and CRM. The questionnaire was translated into Chinese following the process of forward- and back-translations and was validated with middle school students ($n = 476$) in China. In the present study, the subscale in the academic context was used. The internal consistency reliability of this subscale was satisfactory (ARM, Cronbach's $\alpha = 0.84$; and CRM, Cronbach's $\alpha = 0.85$), which suggested it could be adopted.

The MARSI-CN was based on the Metacognitive Awareness of Reading Strategies Inventory (MARSI), which was originally developed by Mokhtari and Reichard (2002) as a tool to measure students' awareness and use of reading strategies. The MARSI was translated into Chinese and validated with 2119 students from six middle schools in China (Wu et al., 2012). The internal consistency coefficients for the three subscales of MARSI-CN in the present study were as follows: global strategies, Cronbach's $\alpha = 0.76$; support strategies, Cronbach's $\alpha = 0.66$; and problem-solving strategies, Cronbach's $\alpha = 0.68$. The Cronbach's Alpha internal consistency coefficient of the overall scale was 0.88. Thus, this measure could be accepted as reliable.

The two parallel reading comprehension tests were standardized tests, which were generated from the item bank developed by our research team made up of researchers from [names of universities deleted for review]. One of the two tests was used as pretest, and the other as posttest. The two tests were close in the difficulty of test items ($p = 0.69$ for pretest, $p = 0.70$ for posttest, calculated on classical test theory). The internal consistencies of the pretest and posttest were good (Cronbach's $\alpha = 0.83$ and 0.87, respectively), and so were their test–retest reliabilities ($r = 0.89$, $p < 0.01$; $r = 0.91$, $p < 0.01$, respectively), which were obtained by administering the pretest and posttest to a sample of 60 students four weeks apart.

Procedure

In this study, a randomized pretest–posttest control group design was used with two groups of students (an experimental group and a control group, each containing 10 classes). An intervention of reading strategy instruction was conducted in the experimental classes, whereas conventional reading teaching was provided to the control

classes. The experiment lasted ten weeks. Before and after the intervention, reading comprehension tests, SRQ-RM, and MARSI-CN were delivered to struggling readers.

Reading comprehension tests and questionnaire surveys

Both groups were given a pretest and a posttest to assess students' reading comprehension before and after the intervention. The pretest, which also served as the screening test, was administered to a random sample of 1322 students, from whom 342 struggling readers were selected. The posttest was administered to the struggling readers at the end of the experiment. Meanwhile, they were required to answer the questionnaires SRQ-RM and MARSI-CN at pretest and posttest.

Intervention condition

The students in the experimental group participated in two periods of reading intervention classes (i.e., 80 min) every week. In each class for the first seven of nine units, teachers first explained and exemplified the use of one of the seven reading strategies and then guided the students to practice it by completing reading tasks in the student books which we had developed for this study. They explicitly taught the repertoire of seven strategies as scheduled (Table 2). The intervention concentrated on helping struggling students to become purposeful and active readers. During the intervention, students practiced each strategy at least three times. Furthermore, they were taught to integrate multiple reading strategies in the classes for the last two units.

The teaching materials comprised a student book and a teacher manual. In the student book, descriptive, narrative, and expository texts were compiled into nine units. In every unit, there were three texts of about 500 to 600 words each, accompanying instructions of reading strategy practice and comprehension exercises, tasks, and activities. More particularly, each unit, except for the last two comprehensive ones, focused on a specific reading strategy in the first text and integrated other strategies in the other two texts. The teacher manual included teaching plans for all units and guidelines on how to teach students proper use of reading strategies.

Control condition

In contrast to the experimental group, teachers taught struggling students in the control condition to read Chinese texts with traditional methods in regular classes during the same amount of time. They taught the same texts as those in the experimental condition, using reading activities different from those in the experimental condition. They instructed the students about new words, set phrases, and difficult sentences, analyzed the text structure and the writing style, and asked the students to answer questions. In particular, they concentrated on memorizing vocabulary and answering teacher's questions. There was no reading strategy instruction in

Table 2 A matrix of reading strategies used in the intervention research

Unit	1	2	3	4	5	6	7	8	9
Main goal	Goal setting	Scanning	IMI	SS	VR	Predicting	SUM	Goals setting, scanning, predicting	Comprehensive practice
Sub-goal	SUM	Predicting	VR	Goal setting	Scanning	SS	Scanning	VRIMI, SS	Comprehensive practice
Integrated goal		SUM	SUM	Predicting	IMI	VR	Goal setting	SUM	Comprehensive practice
Text no	1–3	4–6	7–9	10–12	13–15	16–18	19–21	22–24	25–29

IMI identifying the main idea, *SS* searching-selecting, *SUM* summarizing, *VR* vocabulary recognition (e.g., finding meaning of unfamiliar words, idioms or proverbs)

classrooms. To control the possible impact of teacher's and student's expectations on the intervention, we did not disclose whether they were in an experimental or a control class. Moreover, different classes were arranged in different buildings or at least two floors apart and teachers were placed in different offices to avoid teaching exchanges.

The teaching process in the control condition typically went as follows: (1) Teachers proposed questions about a text, (2) they guided students in reading the whole text and finding the answers to the questions, (3) they asked students to read aloud several paragraphs of the text, (4) they taught the new words and set phrases, (5) they explained the text structure to students, and (6) students completed comprehension exercises (Jin, 2002; Xue, 2007).

## Guarantee measures and fidelity of implementation

We ensured the fidelity of implementation by the following methods. First, before the intervention all participating teachers received training on how to carry out their work properly. The teachers who conducted the intervention received a three-hour training on how to implement the intervention with students, using the teaching materials. In contrast, the teachers who taught the control classes received a two-hour training on how to follow the research plan, teaching reading as usual. Second, experts in reading instruction supported teachers during the intervention. We invited ten experts with at least ten years of Chinese teaching and senior professional titles from secondary schools to assist the implementation. They observed classes, completed checklists, and fed back whether teachers had conducted the intervention as described in the teacher manual. The checklist contained four sections: use of the intervention materials, practice of reading strategies, teaching process set by the teacher manual, and student involvement in the classroom. Each sub-checklist contained a scoring column of centesimal system. After class, the experts provided constructive feedback to teachers. Finally, we collected students' reading books each week to monitor the experimental process. When the experiment finished, we randomly chose the reading materials from ten students to assess the fidelity of implementation in each intervention class. Altogether 100 student books were collected to check the completion of reading tasks.

Mean scores of the implementation checklists ($N=40$) indicated a high integrity: 99.28 in the use of the intervention materials, 98.81 in the practice of reading strategies, 97.76 in the teaching processes set by the teacher guidance booklets, and 97.03 in student involvement in the classroom. Percentage of the completion of reading tasks showed that 97.50% of the reading tasks were finished by the sample of students ($n=100$).

Statistical analysis

In statistical analysis, we first evaluated the effects of reading strategy instruction in struggling readers on the four dependent variables (i.e., posttest reading

comprehension, ARM, CRM, and MARS), which were theoretically related to each other. Descriptive statistics were calculated with SPSS 25.0, and then the effects were examined with the Hierarchical Linear and Nonlinear Model (HLM) 7.0 in view of the hierarchical data structure. In the multilevel modeling, the dependent variables were used respectively as functions of instruction condition, whereas student gender, household income, school type, student grade, pretest comprehension, baseline ARM, baseline CRM, and baseline MARS served as explanatory variables. Finally, a path analysis was performed with SPSS AMOS 25.0 to test the mediating effects of reading motivation (ARM and CRM) and MARS on the relation between reading strategy instruction and reading comprehension. Reading strategy instruction (code 1) in the experimental condition was compared with conventional reading teaching (code 0) in the control condition in the path analysis.
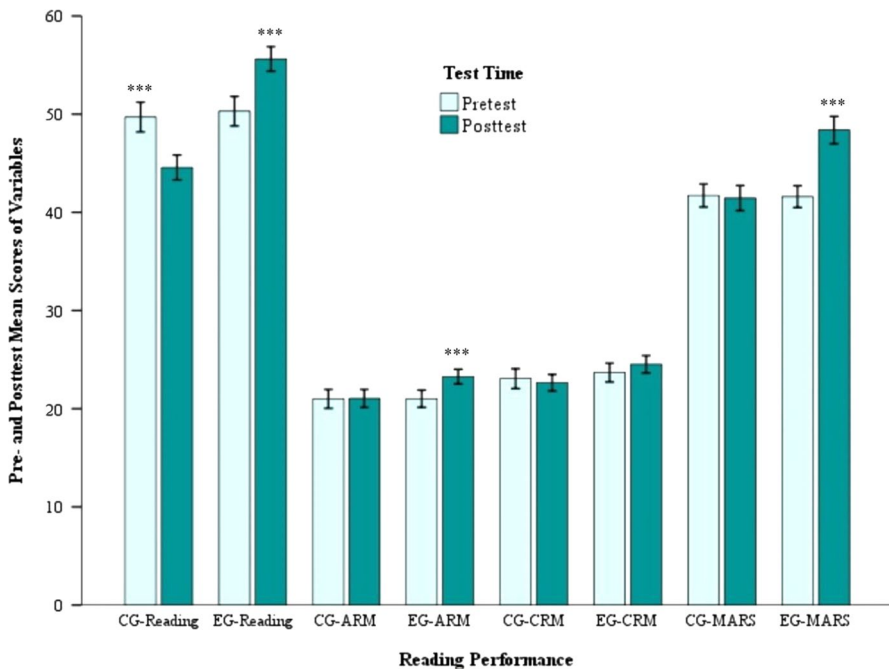
Fig. 1 Pre- and posttest mean scores of the variables were attained at the beginning and end of the experiment, respectively (error bars represent 95% confidence intervals). Experimental group (EG) and control group (CG) are used to distinguish between the two groups. *ARM* autonomous reading motivation, *CRM* controlled reading motivation, *MARS* metacognitive awareness of reading strategies. The significance level of the pre- and posttest mean difference of a variable in the EG or CG is displayed above the error bar. $N = 342$. ***$p < .001$

Table 3 Model estimates in the multilevel analysis of reading comprehension with student- and class-level variables

Parameter	Model 0	Model 1	Model 2
Fixed effects			
Intercept	49.33*** (1.35)	46.11*** (1.43)	46.20*** (1.48)
Level 1			
Gender (female)[a]		1.30 (0.72)	1.29 (0.72)
Household income (high)[b]		1.84* (0.74)	1.83* (0.74)
School[c]		− 2.38 (1.55)	− 2.44 (1.56)
Grade[d]		− 1.64 (1.47)	− 1.82 (1.65)
Pretest comprehension		0.46*** (0.04)	0.46*** (0.04)
Group[e]		9.82* (1.47)	9.07* (3.46)
Level 2			
Pretest comprehension × Group[e]			0.02 (0.10)
Random parameters			
Level 2			
Intercept (σ^2_{u0})	31.33*** (11.47)	7.73*** (3.37)	7.66*** (3.35)
Level 1			
Intercept (σ^2_{e0})	62.62*** (4.93)	40.24*** (3.17)	40.25*** (3.17)
Model fit			
Deviance	2427.72	2261.30	2261.24
χ^2	224.51	80.07	80.39
df	19	19	19
P	< .001	< .001	< .001
Reference		Model 0	Model 1

Standard errors are in parentheses. $N = 342$

*$p < .05$; **$p < .01$; ***$p < .001$

[a]Male is the reference category

[b]Low household income serves as the reference category

[c]School in town acts as the reference category

[d]Grade 7 is the reference category

[e]Control group is the reference category

Results

Pre- and posttest mean scores and results of a *t*-test

Posttest mean scores show that the experimental group scored higher than the control group in reading comprehension, ARM, CRM, and MARS at posttest (Fig. 1). Moreover, independent samples *t*-tests indicate that, at pretest, there were no significant differences between the experimental and the control group in students' reading comprehension, $t(340) = 0.55$, $p = 0.38$; ARM, $t(340) = 0.02$, $p = 0.18$; CRM, $t(340) = 0.88$, $p = 0.38$; and MARS, $t(340) = − 0.14$, $p = 0.89$.

Effects on students' reading comprehension

Three successive models were constructed to assess the effects of the intervention on students' reading comprehension, as shown in Table 3. Model 0, in which no explanatory variables were included, contains only an intercept and variances at the student and the class level. The intercept of 49.33 was the average reading comprehension achievement across all individual students and classes. This model provided the student level variance as 62.62 and the class level variance as 31.33. The intra-class correlation (ICC) at the class level was 0.33. Therefore, 33% of the variance of the reading comprehension measures was the variance between classes, and 67% was the variance within classes between students, which suggested the necessity of a multilevel analysis.

Model 1 shows the effects on reading comprehension when student level variables were added. The model predicted a value of 46.11 for the average reading comprehension achievement across all individual students and classes. Because the main interest of the analysis was the intervention effects, group variable was entered in the model, adjusting for the effects of student gender, household income, school type, student grade, and students' pretest comprehension. Results indicated a significant positive intervention effect of strategy instruction on students' reading comprehension, $t(335) = 6.66$, $p < 0.05$. The effect size of the intervention on students' reading comprehension was large, Cohen's $d = 0.72$. Total variance explained by the variables was 49%. The model fit improved when the student level variables entered as compared with Model 0, deviance $= 2261.30$, $\chi^2 = 80.07$, $df = 19$, $p < 0.001$.

In Model 2, a cross-level interaction between group and students' pretest comprehension at the class level was added. Results showed that there was no interaction between group and students' pretest comprehension at the class level, $t(334) = 0.20$, $p > 0.05$, which indicated that there were no significant effects of students' pretest comprehension at the class level on the relationship between students' posttest reading comprehension and treatment conditions.

Effects on students' reading motivation (ARM and CRM)

The three-step procedure was also implemented to assess the effects on reading motivation, present in Tables 4 for ARM and Table 5 for CRM. As shown in the intercept-only models (i.e., null models), the average ARM and CRM across all individual students and classes were 22.26 and 22.34 respectively. The ICCs at the class level were 0.10 and 0.37, which means 10% of the variance of the ARM measures and 37% of the variance of the CRM measures were the variance between classes, and 90% and 63%, were the variance within classes between students.

Model 1 in Table 4 shows that, adjusting for the effects of student gender, household income, school type, student grade, and students' baseline ARM, there was a significant positive effect of strategy instruction on students' ARM, $t(335) = 1.78$, $p < 0.05$. Nevertheless, the effect size of the intervention was small, Cohen's

Table 4 Model estimates in the multilevel analysis of autonomous reading motivation with student- and class-level variables

Parameter	Model 0	Model 1	Model 2
Fixed effects			
Intercept	22.26*** (0.50)	22.09*** (0.86)	22.10*** (0.83)
Level 1			
Gender (female)[a]		0.48 (0.56)	0.47 (0.56)
Household income (high)[b]		0.78 (0.58)	0.83 (0.58)
School[c]		− 2.17* (0.92)	− 2.31* (0.89)
Grade[d]		0.32 (0.89)	0.28 (0.86)
Baseline ARM		0.33*** (0.05)	0.33*** (0.05)
Group[e]		1.51* (0.85)	1.60* (0.81)
Level 2			
Baseline ARM×Group[e]			− 0.10 (0.05)
Random parameters			
Level 2			
Intercept (σ^2_{u0})	3.13*** (1.61)	1.91*** (1.13)	1.68*** (1.04)
Level 1			
Intercept (σ^2_{e0})	28.32*** (2.23)	24.86*** (1.95)	24.81*** (1.95)
Model fit			
Deviance	2133.84	2085.15	2083.16
χ^2	63.42	49.02	46.30
df	19	19	19
p	< .001	< .001	< .001
Reference		Model 0	Model 1

Standard errors are in parentheses

$N = 342$

*$p < .05$; **$p < .01$; ***$p < .001$

ARM autonomous reading motivation

[a]Male is the reference category

[b]Low household income serves as the reference category

[c]School in town acts as the reference category

[d]Grade 7 is the reference category

[e]Control group is the reference category

$d = 0.19$. There was a significant school effect on students' ARM, $t(335) = - 2.37$, $p < 0.05$, but no interaction effects between group and school could be found at the class level, $t(334) = - 1.77$, $p > 0.05$. Total variance explained by the variables was 15%. As compared with Model 0, the model fit improved when the student level variables entered. Model 2 in Table 4 indicates that there were no cross-level interaction effects between group and students' baseline ARM, $t(334) = - 1.90$, $p > 0.05$, which implied there were no significant effects of baseline ARM at the class level on the relationship between students' ARM and treatment conditions.

Table 5 Model estimates in the multilevel analysis of controlled reading motivation with student- and class-level variables

Parameter	Model 0	Model 1	Model 2
Fixed effects			
Intercept	22.34*** (0.87)	25.47*** (1.04)	25.36*** (1.03)
Level 1			
Gender (female)[a]		− 0.29 (0.50)	− 0.29 (0.50)
Household income (high)[b]		− 0.85 (0.51)	− 0.86 (0.51)
School[c]		− 5.58*** (1.13)	− 5.29*** (1.17)
Grade[d]		− 2.45* (1.07)	− 2.43* (1.05)
Baseline CRM		0.32*** (0.04)	0.32*** (0.04)
Group[e]		1.35 (1.08)	1.28 (1.06)
Level 2			
Baseline CRM × Group[e]			0.11 (0.15)
Random parameters			
Level 2			
Intercept (σ^2_{u0})	13.37*** (4.80)	4.27*** (1.80)	4.08*** (1.74)
Level 1			
Intercept (σ^2_{e0})	22.72*** (1.79)	19.40*** (1.52)	19.41*** (1.52)
Model fit			
Deviance	2083.88	2013.70	2013.20
χ^2	205.04	87.45	81.57
df	19	19	19
p	<.001	<.001	<.001
Reference		Model 0	Model 1

Standard errors are in parentheses

$N = 342$

CRM controlled reading motivation

*$p < .05$; **$p < .01$; ***$p < .001$

[a]Male is the reference category

[b]Low household income serves as the reference category

[c]School in town acts as the reference category

[d]Grade 7 is the reference category

[e]Control group is the reference category

As can be seen from Model 1 in Table 5, there were no significant effects of strategy instruction on students' CRM, $t (335) = 1.26$, $p > 0.05$, adjusting for the effects of student gender, household income, school type, student grade, and students' baseline CRM. The variance explained by the variables was 35%. Model 2 in Table 5 reveals that there were no significant cross-level interaction effects between group and students' baseline CRM, $t (334) = - 1.90$, $p > 0.05$. It implied that there were no significant effects of baseline CRM at the class level on the relationship between students' baseline CRM and treatment conditions.

Table 6 Model estimates in the multilevel analysis of metacognitive awareness of reading strategies with student- and class-level variables

Parameter	Model 0	Model 1	Model 2
Fixed effects			
Intercept	43.30*** (1.45)	45.53*** (1.80)	45.41*** (1.90)
Level 1			
Gender (female)[a]		1.47 (0.78)	1.47 (0.78)
Household income (high)[b]		0.12 (0.80)	0.12 (0.80)
School[c]		− 4.77* (1.95)	− 4.58* (2.19)
Grade[d]		− 5.96** (1.83)	− 5.84** (1.92)
Baseline MARS		0.42*** (0.07)	0.43*** (0.07)
Group[e]		6.13** (1.87)	6.12** (1.87)
Level 2			
Baseline MARS × Group[e]			0.03 (0.17)
Random parameters			
Level 2			
Intercept (σ^2_{u0})	37.92*** (13.32)	13.77*** (5.48)	13.77*** (5.48)
Level 1			
Intercept (σ^2_{e0})	52.54*** (4.14)	47.21*** (3.72)	47.20*** (3.72)
Model fit			
Deviance	2374.17	2322.17	2322.14
χ^2	278.20	124.31	123.19
df	19	19	19
p	< .001	< .001	< .001
Reference		Model 0	Model 1

Standard errors are in parentheses

$N = 342$

MARS metacognitive awareness of reading strategies

*p < .05; **p < .01; ***p < .001

[a]Male is the reference category

[b]Low household income serves as the reference category

[c]School in town acts as the reference category

[d]Grade 7 is the reference category

[e]Control group is the reference category

Effects on students' MARS

Table 6 shows the results of the multilevel analysis with students' MARS as a dependent variable. In Model 0, the intercept-only model, the estimated intercept 43.30 was the average MARS across all individual students and classes. The ICC at the class level was 0.42, which indicates 42% of the variance of the MARS measures was the variance between classes, and 58% was the variance within classes between students. Thus, a multilevel analysis was appropriate for this hierarchical data.

Model 1 indicates that, when the effects of student gender, household income, school type, student grade, and students' baseline MARS were controlled for, a significant positive effect of reading strategy instruction on students' MARS was found, $t (335)=3.28$, $p<0.05$. The effect size of the intervention on students' MARS was medium, Cohen's $d=0.36$. There were significant effects on students' MARS of school, $t (335)=- 2.44$, $p<0.05$, grade, $t (335)=- 3.25$, $p<0.05$, and baseline MARS, $t (335)=6.28$, $p<0.05$, but no significant gender effects, $t (335)=1.87$, $p>0.05$, and no significant household income effects, $t (335)=0.15$, $p>0.05$. The total explained variance was 49%. When the student level variables were added, as compared with Model 0, the model fit improved, deviance$=2322.17$, $\chi^2=124.31$, $df=19$, $p<0.001$.

As Model 2 shows, there was no significant cross-level interaction between treatment and students' baseline MARS at the class level on the relationship between group and students' MARS, $t (334)=0.19$, $p>0.05$. It implied that there were no significant effects of students' baseline MARS at the class level on the relationship between students' MARS and treatment conditions.

Results of mediating effects of ARM, CRM, and MARS

Figure 2 displays the mediating effects of reading motivation (ARM and CRM) and MARS on the relationship between reading strategy instruction and reading comprehension. The results indicated that there were significant direct effects of reading strategy instruction on reading comprehension, $\beta=0.46$, $p=0.000$. Bootstrapping procedures, in which unstandardized indirect effects were computed for each of
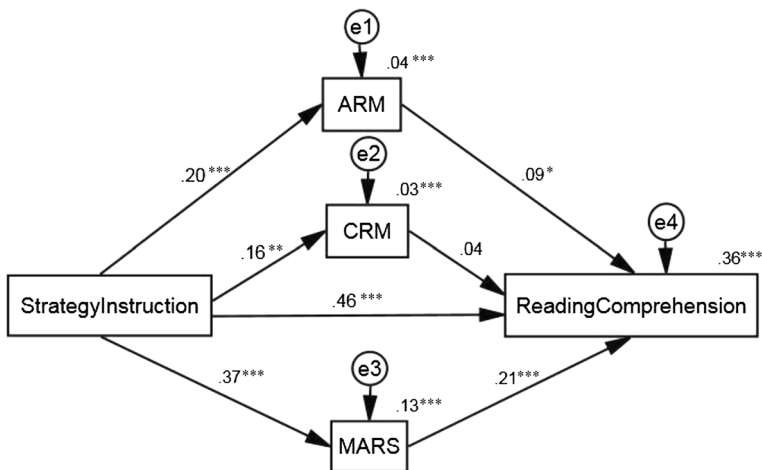
Fig. 2 Standardized coefficients in structural equation modeling for the relationships between reading strategy instruction, reading comprehension, autonomous reading motivation (ARM), controlled reading motivation (CRM), and metacognitive awareness of reading strategies (MARS). Strategy instruction here refers to reading strategy instruction in the experimental condition, compared with conventional reading teaching in the control condition.*$p<.05$; **$p<.01$; ***$p<.001$

5000 bootstrapped samples, were used to test the significance of indirect effects. The bootstrapped unstandardized indirect effect of the path through ARM was 0.36, and the 95% confidence interval (CI) ranged from 0.03 to 0.92, $p = 0.028$. Similarly, that effect of the path through MARS was 1.54, 95% CI 0. 78 to 2.61, $p = 0.000$. Thus, these indirect effects were statistically significant, which indicated that ARM and MARS partially mediated the effects of reading strategy instruction on reading comprehension. However, no significant mediating effects of CRM were found, unstandardized indirect effect $= 0.124$, 95% CI – 0.20 to 0.56, $p = 0.391$. These results supported Hypotheses 4a and 4c, but not Hypothesis 4b.

Discussion

The results of the present study showed that reading strategy instruction could improve struggling readers' reading comprehension, ARM, and MARS in Chinese secondary schools. Consequently, Hypotheses 1, 2, and 3 on the effects of the intervention were confirmed. In particular, reading strategy instruction had large effect size on students' reading comprehension, medium effect size on MARS, and small effect size on ARM in the experiment. Moreover, MARS and ARM were mediators of the relation between reading strategy instruction and reading comprehension, while CRM was not a mediator of the relation.

Reading strategy instruction and reading comprehension

Prior studies have noted the importance of reading strategy instruction in developing students' reading comprehension (e.g., Alfassi, 2004; Brevik, 2019; Jitendra & Gajria, 2011; Lau, 2006). Researchers have found that student's reading strategies was a strong predictor of student's reading achievement (e.g., Meng et al., 2016; Wu et al., 2019). The present study tried to conduct the research of Chinese reading strategy instruction with a focus on struggling readers in Chinese secondary school, using an integration of seven reading strategies. Its findings suggest that there is a significant positive impact of this instruction on struggling readers' text comprehension when the influence of the covariates is eliminated. Further, reading comprehension receives the strongest direct effect from the instruction among the dependent variables. Thus, the findings support the existing literature on the positive role of reading strategy instruction. More importantly, they indicate that struggling readers at Chinese secondary school can catch up with successful readers by learning reading strategies. This teaching approach brings hope of the improvement of Chinese reading to weak schools in rural areas of mainland China.

   This intervention effect could be attributed to the optimization of struggling students' learning process under the teacher's intensive guidance in reading strategies: (a) When these students acquire declarative, procedural, and conditional strategy knowledge on reading strategies, which, in turn, would improve their cognitive process of reading comprehension, they would accomplish their reading tasks more effectively (Spörer & Brunstein, 2009; Stahl, 2008). (b) They would become more

actively engaged in the reading process when taught to use strategies (Wilkinson & Son, 2011). Therefore, after adjusting for the covariates' effects mentioned earlier, the intervention effect on reading comprehension is statistically significant.

The present research tries to consider issues of language and culture when implementing the instruction. For instance, vocabulary recognition plays a fundamental role in students' reading comprehension, but struggling readers only have a very limited number of Chinese vocabulary (Li, 2018). In the intervention, when they came across an unfamiliar word, idiom, or proverb, teachers would teach them to use techniques to understand it, such as guessing its meaning with clues and consulting a dictionary for its meaning. This was a shift from the passive way of Chinese vocabulary learning (e.g., reciting and memorizing) to an active way. In addition, considering the cultural hindrance of traditional teacher-dominated classroom in mainland China (Xiao, 2010), the present research focuses on teachers' formation of student-centered teaching concept in teacher training and the strengthening of students' ability to use strategies independently in practice.

Reading strategy instruction and reading motivation

Previous research has found that reading strategy instruction may correlate with reading motivation (Lau & Chan, 2003; Wigfield et al., 2012), which can promote reading comprehension (Song et al., 2000; Zentall & Lee, 2012). It could exert a positive influence on reading motivation (Orkin et al., 2018). Available evidence indicates that this instruction could enhance Hong Kong Chinese students' reading motivation besides their reading comprehension (Lau, 2017). The current study further demonstrates that it could improve struggling students' reading motivation in mainland China. Provided that struggling students' reading strategy use is based on their self-regulation, it could invoke their reading motivation and engagement (Paris & Paris, 2001). More particularly, the present findings indicate that reading strategy instruction has a significant positive effect on ARM, which is consistent with previous recommendations that reading strategy instruction could support primary school students' ARM (De Naeghel et al., 2012) and that it could enhance intrinsic reading motivation of struggling readers in secondary school (Guthrie & Davis, 2003). However, it does not have a significant effect on students' CRM. It may help to promote self-determination and automation of reading comprehension in the Chinese struggling readers because they may feel more supported and encouraged by their teachers and peers (i.e., a sense of relatedness), more effective in reading texts (i.e., a sense of competence), and more free in setting their reading goals (i.e., a sense of autonomy) (Deci & Moller, 2005). Additionally, according to the theory of self-determination, ARM could improve reading performance through active engagement in the classroom (Ryan & Deci, 2009, 2017).

Reading strategy instruction and MARS

Previous research has suggested that MARS could influence reading comprehension. Israel (2007) argued that MARS played an important part in effective reading comprehension. Similarly, other researchers found that MARS could be a significant predictor of reading comprehension in secondary school students (Fitrisia et al., 2015; Wu et al., 2019) and in college students (Sheikh et al., 2019). The present experiment offers further evidence that reading strategy instruction could facilitate the improvement of MARS. The results show that this instruction has a medium effect size on MARS, which supports previous research indicating that reading strategy instruction could promote reading metacognition in struggling readers (Cantrell et al., 2010). It is possible that this instruction make up struggling students' knowledge of reading strategies, positively affecting their reading comprehension (Alexander, 2005; Graesser, 2007; Pearson & Cervetti, 2017). In the instruction, struggling readers could learn to control and monitor their reading process effectively and could become aware how different reading strategies should be used in different situations as skilled ones do.

Mediation of reading motivation and MARS

Previous studies have demonstrated that there are mediating effects of motivation on the relation between learning behavior and outcome (Davis & Wiedenbeck, 2001; Núñez & León, 2016; Vansteenkiste et al., 2004). Furthermore, there are mediating effects of reading behavior on the relation between reading motivation and reading comprehension (McElvany et al., 2008; Schiefele et al., 2012). Similarly, the current study shows that there is a mediating effect of ARM on the relation between reading strategy instruction and reading comprehension although the effect size is small. However, no mediating effects of CRM can be found in the study. The findings suggest that ARM could exert an indirect positive influence on reading comprehension in reading strategy instruction.

In a recent study conducted by Miyamoto, Pfost and Artelt (2019), evidence suggests that metacognitive knowledge of reading strategy use mediate the relation between intrinsic motivation and reading comprehension. The present study further presents that there is a mediating effect of MARS on the relation between reading strategy instruction and reading comprehension in struggling readers. Although MARS has been accepted as an important factor in reading comprehension (Alexander, 2005; Graesser, 2007; Zhang, 2018), mediation of MARS on the relation between the instruction and reading comprehension has not been fully explored. The mediating effect can be attributed to students' effective use of reading strategies, which may reinforce students' metacognition, motivation, and engagement in reading process.

In the present research, the mediating effect analysis not only helps to reveal the complex indirect relationship among the four teaching phenomena of reading strategy instruction, reading motivation, MARS, and reading comprehension, but also

helps to indirectly reveal the positive significant relationship between reading strategy instruction and reading comprehension. The mediating effect of reading motivation and MARS shows the intensity of their partial indirect effects in this relationship. To sum up, a comprehensive understanding of the direct and intermediary relationships of these variables is of positive significance for the reconceptualization of reading teaching.

Implications for educational practices for reading literacy

The findings suggest that the integration of reading strategies could work well in the intervention for struggling readers at secondary school. Because most Chinese school administrators and Chinese language teachers are not familiar with reading strategy instruction, it would be necessary for them to consider the implementation of this instruction. For school administrators, they could make policies to train teacher' teaching skills on reading strategy instruction and to fund intervention programmes to make up for struggling readers' lack of knowledge and skills about reading strategy use. For teachers, they could attend training classes on reading strategy instruction and could implement this instruction in their classes. In particular, they could adapt textbooks, supplement the knowledge and tasks of reading strategies in the textbooks, and further guide struggling readers to use reading strategies correctly in and out of class. They could explicitly teach the concept, usage, application purpose and context, type of questions answered, advantages and disadvantages of each reading strategy, following the teaching model of gradual release of responsibility (McEwan, 2004, 2007; Pearson & Gallagher, 1983; Webb et al., 2019). Additionally, they could enhance struggling readers' ARM and MARS to improve those students' reading comprehension.

Limitations and implications for future research

Several limitations exist in the present study. First, the participating students were 7th and 8th graders from five secondary schools in south China. In this case, the current findings cannot be generalized to students in other grades. However, on the premise of adequate evidence, future reading intervention studies in other graders will likely be approved by school administrators, teachers, and students in China and other countries. Second, although we adjusted for the effects of student gender, household income, school type, student grade, student's pretest comprehension, baseline ARM, baseline CRM, and baseline MARS in the multilevel analysis, there were still other variables which might need to control for in future research, such as student's intelligence quotient, learning style, and engagement in reading. Third, we did not assess the lasting effect of reading strategy instruction, which prevented us from further exploring whether there were long-term effects after the intervention. It may be advisable for future research to include a prolonged period after the intervention and evaluate the retention effect. Fourth, this study lasted for a relatively short period of time. The intervention was completed within ten weeks, 80 min per

week. Hence, the results should be interpreted with caution. Finally, further research could explore the differential effects of this instruction on struggling, intermediate, and good readers, which would contribute to the effective instruction of different reading levels of students.

Conclusion

This study suggested that reading strategy intervention could promote struggling readers' reading comprehension, ARM, and MARS, and that ARM and MARS could partially mediate the relation between reading strategy instruction and reading comprehension. In the context of global emphasis on linguistic competence and reading literacy, struggling readers should be able to get more effective reading teaching and guidance from their teachers so as to keep up with other students. In this sense, reading strategy instruction can be an effective way to help struggling readers to overcome reading difficulties and to become skilled readers at secondary school.

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