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Scale Validation and Intervention Effects of Metacognitive Reading Strategies in CET-6: A Study in Chinese Second-Tier University Setting

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ABSTRACT

This study validated a metacognitive reading strategy questionnaire for CET-6 Reading (College English Test-Band 6) and investigated the effectiveness of metacognitive reading strategy instruction on CET-6 reading performance. The research was conducted at a second-tier university in China, involving 478 participants in the factor analysis phase, with 245 questionnaires used for Exploratory Factor Analysis (EFA) and 233 questionnaires used for Confirmatory Factor Analysis (CFA). In the intervention phase, there were 80 participants in total, with 40 participants in each of the experimental and control groups. The participants in the factor analysis phase and the intervention phase were independent of each other. The study employed quantitative research methods, including EFA and CFA using SPSS 26.0 and AMOS software to validate the reliability and validity of the questionnaire. Additionally, independent samples t-tests were used to compare the pre- and post-intervention test and survey scores between the experimental group (EG) and the control group (CG).The results indicated that the adapted questionnaire demonstrated good reliability and validity, confirming its suitability as a tool for measuring metacognitive strategy use in CET-6 reading. Furthermore, the intervention effectively improved students' reading performance and the use of metacognitive strategies, suggesting that incorporating metacognitive reading strategies into instruction has a positive impact on students' reading performance.This study highlights the importance of incorporating metacognitive reading strategies into pedagogical practices, providing information for improving the CET-6 pass rate accordingly.

Keywords: Metacognitive Reading Strategy; Scale Validation; CET-6 Reading Comprehension

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ARTICLE INFO

Received: 14 November 2024 | Revised: 2 December 2024 | Accepted: 6 December 2024 | Published Online: 10 January 2025
DOI: https://doi.org/10.30564/fls.v7i1.7757

CITATION

Bai, J., Sulaiman, N.A., Shukor, S.S., et al., 2025. Scale Validation and Intervention Effects of Metacognitive Reading Strategies in CET-6: A Study in Chinese Second-Tier University Setting. Forum for Linguistic Studies. 7(1): 808–820. DOI: https://doi.org/10.30564/fls.v7i1.7757

1. Introduction

In China, college English is a required course for students who are not English majors, and they must take it during their freshman and sophomore years. To support this, the Chinese Ministry of Education developed and introduced the College English Tests (CETs) in 1985. The aim of the CETs was to enforce the curriculum and improve the effectiveness of English teaching in college. Over time, the CETs has become one of the most widely administered and recognized English examinations in China [1].

The CETs consist of two levels—Band 4 (CET-4) and Band 6 (CET-6)—each comprising sections on listening, reading, translation, and writing with different weights (35%, 35%, 15% and 15%) in the overall score. Students are required to pass CET-4 (with a score of at least 425 out of 710) before becoming eligible to register for CET-6. CET-6 plays a crucial role in students' career development and academic advancement [2–4], making it one of the most recognized English proficiency certificates in China. However, passing CET-6 is challenging. Whether at prestigious universities or ordinary tertiary institutions, the pass rate for CET-6 has generally remained low [2, 5, 6], indicating that the difficulty of CET-6 is high, and the under-performance also reveals inadequacies in current college English teaching in terms of test-taking ability enhancement.

To enhance test-taking performance and improve the CET-6 pass rate, it is essential to strengthen performance across all sections. Among these, the reading section holds a particularly critical position. First, the reading section is one of the highest-weighted components in the overall score, directly impacting students' final performance. Second, the reading test not only assesses students' reading comprehension ability but also evaluates the integration of various language skills and strategies, such as vocabulary acquisition, the application of background knowledge, and the development and assessment of higher-order thinking abilities [7]. For example, skills like connecting new information with prior knowledge, self-questioning, making predictions, visualizing content, focusing on structure and signal words, skimming, and scanning are crucial for students' success in managing complex academic tasks [8]. Despite the importance of the reading strategies and skills, Chinese university students often lack effective EFL reading strategies [9]. As a result, improving students' mastery of reading strategies to enhance their performance in CET-6 reading is a critical issue that educators and researchers must address.

Among various reading strategies, metacognitive reading strategies are widely recognized as effective for enhancing reading performance [10–13]. However, research on the effectiveness of metacognitive reading strategies in CET-6 reading contexts remains limited. This study aims to address this gap by employing a quasi-experimental design with a quantitative approach that combines reading test scores and questionnaire survey results to evaluate the effectiveness of metacognitive reading strategies. Classic metacognitive strategy questionnaires were not specifically designed for test-taking context, or not all items focus on reading module [14–16], therefore, this study validates a questionnaire adapted from classic instruments to more accurately assess the use of metacognitive strategies before and after the intervention in the CET-6 testing environment. The innovation of this study lies in its first-time adaptation of a metacognitive reading strategy questionnaire specifically for China's large-scale foreign language reading exams, as well as its exploration of the effectiveness of metacognitive reading strategy instruction in the CET-6 reading section. The main objective of the study is to validate the adapted questionnaire and evaluate the effectiveness of the metacognitive reading strategies instruction in the CET-6 reading context.

2. Literature Review

2.1. Metacognition and Metacognitive Reading Strategies

Metacognition is a term in psychology that describes a higher-order thinking process, often referred to as "thinking about thinking" or "cognition about cognition" [17–19]. Flavell [18] first introduced the concept of metacognition, defining it as an individual's knowledge and cognition about their cognitive processes and products, or any knowledge related to the monitoring, regulation, and coordination of these processes. Flavell noted that metacognition comprises two components: metacognitive knowledge and metacognitive experiences, and he used the term "cognitive monitoring" to illustrate the relationship between the two.

Livingston [19] also presented a similar perspective, dividing metacognition into metacognitive knowledge and metacognitive regulation. Metacognitive knowledge in-

volves understanding one's learning processes and the nature of tasks. For example, studying in a quiet environment is more effective, or understanding a science text takes more time than a novel. Metacognitive regulation includes using metacognitive strategies including planning, monitoring, and evaluating the outcomes to control cognitive activities and ensure cognitive goals (e.g., understanding a text) are met.

The development of metacognitive theory has led to its widespread application in EFL and ESL contexts, particularly in EFL and ESL reading [17, 20, 21]. According to the explanation from Schraw and Moshman [21], metacognitive strategies in reading include planning, which involves making predictions or decisions about how to approach a task; monitoring, which involves tracking one's own comprehension and task performance; and evaluating entails reviewing and assessing the outcomes of the reading process. Metacognitive reading strategies are specific metacognitive strategies applied to the reading comprehension process, aiming to improve reading efficiency and comprehension. According to Anderson [17], metacognitive reading strategies are (a) preparing and planning for efficient reading; (b) determining the appropriate times to use specific reading strategies; (c) understanding how to monitor the implementation of these strategies; (d) learning to coordinate multiple reading strategies; and (e) evaluating the effectiveness of the strategies used. Those strategies are not in isolation, but involve the integration of all five components into a cohesive and dynamic framework of metacognition in reading. That is to say, metacognitive reading strategies are not part of a straightforward process that progresses linearly from preparation and planning to evaluation; rather, they can be employed simultaneously during a reading task. However, despite their effectiveness in guiding reading, limited research has explored how metacognitive reading strategies function in the Chinese test-taking context, leaving a gap in understanding their potential role in enhancing reading assessment performance among Chinese university students.

2.2. Metacognitive Reading Strategies in Language Assessment

Several studies have examined the effectiveness of metacognitive reading strategies and reading performance in English language assessments in non-Chinese contexts. Muhid et al. [12] conducted a quasi-experimental study on metacognitive reading strategy instruction using a reading test from the Indonesian 11th-grade high school final examination. The results revealed that the experimental group showed significant improvements in both metacognitive awareness and reading performance compared to the control group. These findings suggest that the application of metacognitive strategies enhances reading test performance within the Indonesian high school EFL context.

Apart from domestic reading assessments, the effectiveness of metacognitive reading strategies has also been empirically examined in international language assessments such as TOEFL and IELTS [22, 23]. Seedanont and Pookcharoen [22] studied the effectiveness of metacognitive reading strategies in Thai EFL classrooms on students' reading performance in the IELTS reading module. The study showed that through metacognitive strategy instruction, students significantly improved their use of metacognitive reading strategies, and their IELTS reading test scores also increased, indicating the positive impact of metacognitive strategy instruction on reading ability in IELTS test.

Azizullah Mirzaei and his colleagues [23] explored the relationship between multiple intelligences, reading strategies, and TOEFL reading scores among successful EFL readers in Iran. The research findings revealed the positive relationship between good TOEFL reading performance and good command of metacognitive reading strategies.

Although the positive effects of metacognitive reading strategies have been confirmed in language assessments both domestically and internationally, existing studies focus on language assessments other than CET-6. In other words, there is limited empirical evidence regarding the application and effectiveness of these strategies in the CET-6 context. This gap in the literature underscores the need to investigate whether promoting metacognitive strategy awareness among CET-6 candidates can lead to comparable improvements in their reading performance.

2.3. Metacognitive Reading Strategies Measurement

Given the significant role of metacognitive reading strategies in both academic reading and language assessments, it is essential to investigate how students employ these strategies in testing contexts. Accordingly, the development and validation of an appropriate and reliable measure-

ment tool are necessary. Although several well-established instruments exist—such as the Metacognitive Awareness of Reading Strategies Inventory (MARSI), developed by Mokhtari and Reichard [16] to assess students' use of metacognitive strategies when reading academic texts—certain limitations remain. MARSI categorizes strategies into three types: global strategies, problem-solving strategies, and support strategies, but some of these strategies are not well-suited to language testing environments, where students are prohibited from consulting dictionaries or reading passages aloud.

Phakiti [14] developed a widely recognized questionnaire to examine the use of cognitive and metacognitive strategies among Thai EFL learners in reading comprehension tests. The planning, monitoring, and evaluation strategies identified in his research align more closely with the demands of language testing environments. However, given the significant differences in learning environments, linguistic backgrounds, and other contextual factors between Thai and Chinese university students, it is necessary to validate and adapt these tools for the Chinese context.

Purpura [15] developed and validated an 80-item questionnaire on cognitive and metacognitive strategies, with 30 items specifically dedicated to metacognitive strategies. These items are divided into four dimensions: Assessing the Situation (before the event), Monitoring (during the event), Self-Evaluating and Self-Testing (after the event). While this questionnaire explores metacognitive strategies across multiple modules, including reading, listening, speaking, and writing, it was neither designed specifically for Chinese EFL assessments nor focused exclusively on metacognitive reading strategies. Thus, it is essential to extract relevant elements from these tools and tailor them to the specific requirements of the CET-6 reading environment.

Wu et al. [24] adapted MARSI into MARSI-CN to better suit the Chinese context, establishing it as a reliable tool for studying metacognitive reading strategies among Chinese EFL learners. However, since MARSI-CN remains structurally based on the original MARSI, it is less applicable to exam-oriented environments. Therefore, there is a need to validate and refine a new measurement tool, incorporating the strengths of classical scales while ensuring it meets the practical demands of high-stakes language testing.

Accordingly, the present study aims to address the following research questions:

RQ1: How valid is the CET-6 Metacognitive Reading Strategy Questionnaire?

RQ2: Does the intervention of metacognitive reading strategies enhance learners' metacognitive strategy use and improve their CET-6 reading scores?

3. Methodology

3.1. Research Design and Data Collection

The current study employs quantitative research methods and is divided into two phases. The first phase involves factor analysis to validate the scale, while the second phase uses a quasi-experimental design to evaluate the effectiveness of metacognitive reading strategy instruction. The data collection process for this study received official approval from the Foreign Language School of this second-tier university.

In the first phase, an extensive literature review was conducted and two classical questionnaires were selected for adaptation [14, 15]. The selection of these two questionnaires is based on their extensive adoption in metacognitive strategy research, particularly within testing contexts. In other words, the aspects of metacognitive reading strategies they assess are closely aligned with the requirements of the CET-6 exam. Items irrelevant to metacognitive strategies (i.e., cognitive strategies) or unrelated to reading tests (i.e., listening, writing) were removed. Highly repetitive items across the two questionnaires were removed to maintain conciseness. As a result, the initial scale was refined to 22 items, which were categorized based on established metacognitive strategy models [17, 19, 20]. Items 1–8 focus on planning strategies, including setting goals and organizing tasks. Items 9–14 pertain to monitoring strategies, which involve continuous monitoring of progress and comprehension. Finally, items 15–22 address evaluating strategies, which involve reflecting on reading outcomes and identifying areas for improvement.

To validate the scale, Face Validity, Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA) were conducted. The face validity of the initial scale was assessed by three experts in the field of SLA. The evaluation included: 1) determining whether each item effectively measured metacognitive reading strategies, 2) assessing the clarity and appropriateness of each item's wording, and 3)

examining the suitability of items within each factor. At this stage, no items were removed, as they were derived from established scales and had already undergone rigorous screening. However, the experts provided suggestions on specific wording within the items, which the researchers adopted. For instance, in the item "I tried to identify easy and difficult parts of the reading test," it was recommended to specify "CET-6 reading test" to highlight the context.

The revised scale, structured on a 5-point Likert scale, was administered via the Wenjuanxing platform, which generated a link shared through WeChat and QQ with students preparing for the CET-6 exam to collect data for conducting EFA and CFA. The data collection procedure was under the assistance of the first author's colleagues—college English teachers across various majors who distributed the links to their students—the participants in factor analysis stage. Students were informed that the information provided in the questionnaire would be used exclusively for research purposes, with a guarantee that their personal information would not appear in any publications, and they were also assured of their right to withdraw at any time. During data collection, participants first provided demographic information (age, major, and gender) before completing the questionnaire. To ensure data integrity and prevent contamination, participants in this validation phase were distinct from those in the intervention phase. The collected questionnaires were then randomly divided into two groups, one for EFA and the other for CFA, with an approximately equal split. Subsequently, data quality checks were conducted to exclude responses with straightlining, ensuring the reliability and robustness of the analysis. Ultimately, 245 valid questionnaires remained in the EFA group, and 233 in the CFA group.

For the sample size of factor analysis in the first phase, Thompson[25] suggests that a minimum sample size of 200 is necessary to ensure stable results. Additionally, Meyers, Gamst, and Guarino[26] recommend adjusting sample size based on the number of items, with specific guidelines as follows: 200 samples for 10 items, 250 for 25 items, 400 for 90 items, and 700 to 1000 for 500 items. The scale in this study consists of 22 items, and the sample size in each round of factor analysis exceeds 200, thus meeting these standards.

In the second phase, two existing CET-6 classes were selected purposively, since they are taught by the same instructor to control the variability in teaching methods. These two classes were assigned as the experimental group (EG) and the control group (CG), with 40 students in each, totaling 80 participants. Prior to the intervention, both groups completed demographic information forms and took a CET-6 reading pre-test and pre-survey to establish baseline performance.

During the eight-week intervention, the experimental group (EG) received CET-6 reading instruction integrated with metacognitive reading strategies, while the control group (CG) received traditional CET-6 reading instruction. The teaching process employed explicit instruction methods, including teacher modeling and think-aloud techniques. Teachers used authentic CET-6 reading materials to provide detailed explanations of linguistic features in the text and introduced appropriate metacognitive strategies based on the context, explaining when and why to use each strategy. In this way, the intervention aimed to enhance reading performance by equipping students with metacognitive strategies to support their success in the CET-6 reading test.

3.2. Participants

Participants in phase 1 include respondents from both the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) groups. The participants in the first phase were selected based on the following criteria: participants must have passed the College English Test Band 4 (CET-4) and be prepared to take the CET-6 during the year of the study. All participants were undergraduate students and voluntarily agreed to participate in the study. The EFA group comprises 245 participants. The average age of participants was 19.68 years (SD = 1.269), ranging from 18 to 23 years. Regarding gender distribution, there are 101 male participants, accounting for 41.2% of the total sample, and 144 female participants, accounting for 58.8% of the total sample. The distribution across different majors is as follows: 16 participants (6.53%) in Accounting, 18 participants (7.35%) in Agronomy, 30 participants (12.24%) in Architecture, 19 participants (7.76%) in Business Administration, 41 participants (16.73%) in Clinical Medicine, 40 participants (16.33%) in Computer Science, 29 participants (11.84%) in Electronic Engineering, 16 participants (6.53%) in Environmental Engineering, 13 participants (5.31%) in Fine Art, and 23 participants (9.39%) in Journalism.

The CFA group consists of 233 participants. The aver-

age age of participants was 19.97 years (SD = 1.276), ranging from 18 to 23 years. Regarding gender distribution, there are 97 male participants, accounting for 41.6% of the total sample, and 136 female participants, accounting for 58.4% of the total sample. The distribution across different majors is as follows: 18 participants (7.73%) in Accounting, 7 participants (3.00%) in Agronomy, 28 participants (12.02%) in Architecture, 33 participants (14.16%) in Business Administration, 44 participants (18.88%) in Clinical Medicine, 32 participants (13.73%) in Computer Science, 21 participants (9.01%) in Electronic Engineering, 14 participants (6.01%) in Environmental Engineering, 11 participants (4.72%) in Fine Art, and 25 participants (10.73%) in Journalism.

The participants in the second phase were students enrolled in the CET-6 preparatory courses offered by the university, which are specifically designed to assist students in preparing for the CET-6 exam and carry 3 academic credits. All participants had successfully passed the CET-4 exam and were scheduled to take the CET-6 exam during the academic year. They voluntarily chose to enroll in the preparatory course and provided informed consent to participate in the study. The demographic information of the control group (CG) and the experimental group (EG) in the second phase is as follows.

As shown in **Table 1**, both the experimental group (EG) and the control group (CG) consisted of 40 participants. The participants in both groups were of similar age, with the CG having an age range from 19 to 21 years (Mean = 20.08, SD = 0.694) and the EG ranging from 19 to 22 years (Mean = 20.33, SD = 0.888). Regarding gender distribution, there were 27 males (67.5%) and 13 females (32.5%) in the CG, while18 males (45%) and 22 females (55%) in the EG. As for the participants' majors, in the CG, 8 were majoring in Accounting (20%), 7 in Computer Science (17.5%), 11 in Architecture (27.5%), and 14 in Electrical Engineering (35%). In the EG, 11 were majoring in Accounting (27.5%), 10 in Computer Science (25%), 9 in Journalism (22.5%), and 10 in Early Childhood Education (25%).

Table 1. The statistic description of the CG and EG.

Categories	CG	EG
Frequency	40	40
Age	19–21 years (Mean = 20.08 SD = 0.694)	19–22 years (Mean = 20.33 SD = 0.888)
Gender	Male = 27 (67.5%)	Male = 18 (45%)
	Female = 13 (32.5%)	Female = 22 (55%)
Major	Accounting = 8 (20%)	Accounting = 11 (27.5%)
	Computer Science = 7 (17.5%)	Computer Science = 10 (25%)
	Architecture = 11 (27.5%)	Journalism = 9 (22.5%)
	Electrical Engineering = 14 (35%)	Early Childhood Education = 10 (25%)

3.3. Research Instruments

3.3.1. CET-6 Metacognitive Reading Strategy Questionnaire (CET-6 MRSQ)

The adapted questionnaire (CET-6 MRSQ) used in this study consists of 22 items, each rated on a five-point Likert scale, resulting in a total score range of 22 to 110 for each participant. The questionnaire is designed to evaluate students' use of metacognitive reading strategies within the CET-6 reading context. In the first phase of the study, the validity and reliability of the questionnaire were confirmed through EFA and CFA, and the Cronbach's alpha coefficient was calculated to ensure its good measurement properties.

3.3.2. Retired Authentic CET-6 Test Paper (Reading Part)

The study utilized two retired CET-6 reading test sets. As these are previously administered authentic test papers, their validity and reliability have been established by the original test developers. The CET-6 reading test, used as a research tool in this study, consists of three parts: cloze, paragraph matching, and multiple-choice questions. All of these sections assess reading comprehension ability. The reading section allows students to score a maximum of 248 points in total with a 40-minute time limit. The readability of CET-6 reading passages was reported in previous studies. Gu and her team[27] reported an average readability index of

45.3 for CET-6, which is comparable to the readability index of 49.50 for IELTS and 44.85 for TOEFL [28], indicating a similarity in terms of text difficulty between CET-6 reading and reading tasks in international tests.

3.4. Data Analysis

In the data analysis procedure, SPSS 26.0 and AMOS were employed for the EFA, CFA, and Cronbach's Alpha coefficient calculation in the first phase to validate the questionnaire. During the second phase, SPSS 26.0 was used to conduct independent t-tests for the pre and post-reading test and survey between the EG and CG to assess the impact of the intervention on their CET-6 reading performance and use of metacognitive reading strategies.

4. Results

4.1. Scale Validation

4.1.1. Exploratory Factor Analysis

To determine the dimensional structure of the scale, an Exploratory Factor Analysis (EFA) was first conducted. The Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were conducted to probe the feasibility of the factor analysis. The KMO value was 0.950, exceeding the threshold of 0.7, and the p-value of Bartlett's test was 0.000, revealing the suitability of the data for factor analysis [29].

Principal Component Analysis (PCA) with Varimax rotation was conducted. There were three factors with eigenvalues greater than 1 [30], and these three factors in the EFA explained 44.010%, 13.148%, and 11.036% of the variance respectively, with a cumulative variance explanation of 68.194%, indicating strong explanatory power of the scale's factor structure. The item distributions and factor loading are shown in the **Table 2** below.

According to the data presented in **Table 2**, the factor loadings of various items (i.e., x1, x2, ..., x8, y1, y2, ..., y6, and z1, z2, ..., z8) across three distinct factors (C1, C2, and C3) are shown. These factor loadings are post-rotation, which clarifies the underlying structure of the factors.

Component 2 (C2) includes items x1 to x8, with factor loadings ranging from 0.744 to 0.809. These items exhibit relatively balanced and high loadings on Factor C2, suggesting a strong relationship with this factor. Based on the items in the original scales and existing theoretical frameworks, C2 is labeled Planning. Planning comprises items x1–x8, which primarily focus on preparatory strategies before beginning a reading task, such as goal-setting, task structuring, and activating prior knowledge.

Table 2. Rotated component matrix in EFA.

Items	C1	C2	C3
x1		0.809	
x2		0.769	
x3		0.784	
x4		0.75	
x5		0.76	
x6		0.765	
x7		0.744	
x8		0.789	
y1			0.786
y2			0.795
y3			0.787
y4			0.774
y5			0.773
y6			0.773
z1	0.757		
z2	0.815		
z3	0.811		
z4	0.81		
z5	0.82		
z6	0.774		
z7	0.792		
z8	0.786		

Note: C1 = component 1, C2 = component 2, C3 = component 3.

Component 3 (C3) includes items y1 to y6, with factor loadings ranging from 0.773 to 0.795, indicating consistent and strong associations with this factor. Based on the items adapted from the original scales, along with relevant theoretical foundations, C3 is labeled Monitoring. Monitoring includes items y1–y6, which reflect ongoing metacognitive processes during reading, such as tracking progress, and adjusting strategies as needed.

Component 1 (C1) contains items z1 to z8, with loadings ranging from 0.757 to 0.82. The generally high loadings on Factor C1 suggest a strong relationship between these items and the factor. Based on the content of these original items, as well as relevant theoretical frameworks, C1 is labeled Evaluating. Evaluating includes items z1–z8, which involve post-reading reflection, such as evaluating the process of reading comprehension and identifying areas for improvement.

Based on the factor loadings and the content of the original scales, combined with metacognitive theory [17, 19, 20], the

interpretation and labeling of these components ensure theoretical consistency, aligning with the metacognitive processes outlined in prior research, which enhances the relevance of the adapted scales in assessing metacognitive reading strategies in the context of the CET-6, where these strategies play a crucial role in improving reading comprehension and test performance.

4.1.2. Confirmatory Factor Analysis

(1) Construct Validity

To further confirm the factor structure of the CET-6 MRSQ, confirmatory factor analysis (CFA) was conducted using AMOS software. Before conducting CFA, a normality test was performed on the data. The results showed that the absolute values of skewness and kurtosis for each were below 2, indicating that the data followed a normal distribution [31]. The three-factor model is shown in **Figure 1**, clearly illustrating the relationships between the latent variables (Planning, Monitoring, Evaluating) and their corresponding observed indicators (x1–x8, y1–y6, z1–z8). The figure also displays the standardized factor loadings for each observed variable, directly reflecting the contribution of the observed variables to their respective latent constructs. As indicated by the data in the figure, all factor loadings exceed 0.4, demonstrating that the observed variables have good explanatory power for their latent constructs. According to established benchmarks [32] for model fit indices, the results supported the factor structure: CMIN/DF was 1.102 (benchmark < 3 for good fit), GFI and AGFI were 0.924 and 0.906, respectively (benchmark > 0.90, indicating acceptable fit), CFI and TLI were both 0.993 (benchmark > 0.90 suggest strong model fit), and RMSEA was 0.021 (benchmark < 0.05 for excellent fit). These results confirm that the CET-6 MRSQ aligns well with the proposed factor structure derived from EFA.

(2) Convergent Validity

The convergent validity was assessed by calculating the Average Variance Extracted (AVE) and Composite Reliability (CR) for each factor, with AVE values expected to be above 0.5 and CR values above 0.7 [33]. The CR values for the three factors were 0.931 (Planning), 0.901 (Monitoring), and 0.920 (Evaluating), all exceeding 0.7, indicating high internal consistency. The AVE values for the three factors were 0.627 (Planning), 0.603 (Monitoring), and 0.591 (Evaluating) respectively, all above 0.5, further confirming good convergent validity.

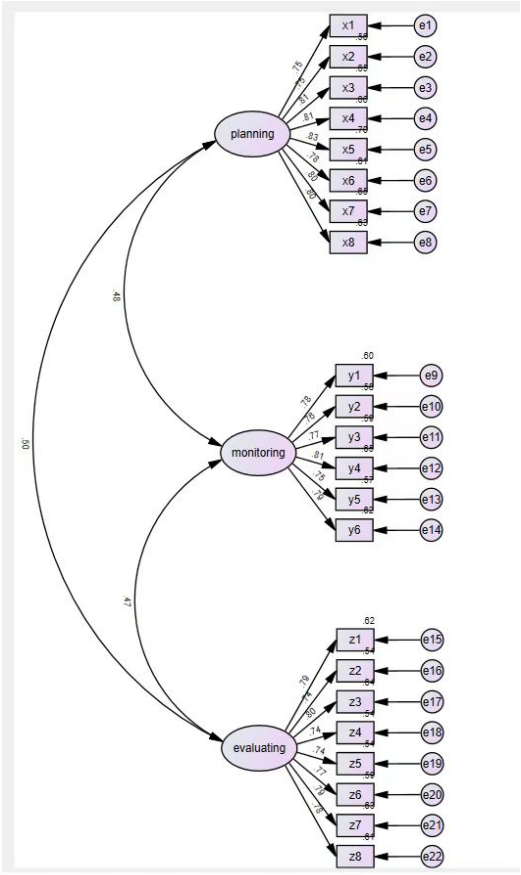

Figure 1. CFA path diagram of CET-6 MRSQ.

(3) Discriminant Validity

Discriminant validity is evaluated by comparing the square root of the AVE of each construct to its correlations with other constructs [33]. When the square root of the AVE for a construct exceeds its correlations with any other construct, this suggests strong discriminant validity. This indicates that the construct accounts for more variance in its own indicators than it shares with other constructs, demonstrating its distinctiveness.

The square roots of the Average Variance Extracted (AVE) for the three factors, along with their correlations with other constructs, are shown in **Table 3**. The AVE square roots for the three factors are 0.769 for Factor 1, 0.777 for Factor 2, and 0.792 for Factor 3. By comparing these AVE square roots with the correlations between the factors, we found that the AVE square root for each factor (the values on the diagonal) is greater than its correlation with the other factors (the values off the diagonal). Specifically, the corre-

lation between Factor 1 and Factor 2 is 0.475, which is lower than the AVE square roots of Factor 1 (0.769) and Factor 2 (0.777); the correlation between Factor 1 and Factor 3 is 0.502, which is lower than the AVE square roots of Factor 1 (0.769) and Factor 3 (0.792); the correlation between Factor 2 and Factor 3 is 0.480, which is lower than the AVE square roots of Factor 2 (0.777) and Factor 3 (0.792). These results indicate that the constructs in the model exhibit good discriminant validity, as the AVE square roots for each factor are greater than their correlations with the other factors.

Table 3. Discriminant validity matrix

Factors	1	2	3
1	0.769		
2	0.475	0.777	
3	0.502	0.48	0.792

Note: 1 = Evaluating, 2 = Monitoring, 3 = Planning; the values on the diagonal represent the square roots of the AVE for each factor.

4.1.3. Internal Consistency Reliability

To assess the internal consistency of the scale, Cronbach's alpha coefficients were calculated. The Cronbach's alpha coefficient for the overall scale was 0.934, and the Cronbach's alphas for the three factors (Planning, Monitoring, and Evaluating) were 0.931, 0.901, and 0.920 respectively. All values exceeded 0.7, indicating excellent internal consistency and further supporting the reliability of the scale. The complete set of the 22-item scale can be found in **Appendix A**.

4.2. The Intervention of MRS for CET-6 Reading

In this intervention phase, independent samples t-tests were employed to compare CET-6 reading scores and questionnaire scores between the EG and CG before and after the intervention, as shown in **Table 4**.

Prior to conducting independent samples t-tests, tests for normality and homogeneity of variance were conducted. The absolute values of skewness and kurtosis for all data were below 2, meeting the criteria for normal distribution [31]. Levene's test for homogeneity of variance for both pre- and post-tests, as well as pre- and post-questionnaires, showed p-values greater than 0.05, indicating homogeneity of variances.

In the pre-test, the mean CET-6 score for the CG was 124.08, while that of the EG was 123.27, with no statistically significant difference ($t = 0.203$, $p = 0.840$), indicating comparable reading proficiency in both groups before intervention. In contrast, the post-test results revealed a notable difference, with the CG obtaining a mean score of 130.64 and the EG achieving 147.59—a statistically significant increase ($t = -4.047$, $p < 0.001$)—showing that the intervention had a positive effect on the EG.

For questionnaire scores, the pre-survey mean value for the CG was 71.18 and 75.55 for the EG, showing no significant difference ($t = -1.598$, $p = 0.114$). In the post-survey, however, the CG had a mean value of 74.28, whereas the EG achieved a mean value of 79.10, with a statistically significant difference ($t = -2.053$, $p = 0.043$), indicating that the intervention had a positive effect on the use of metacognitive reading strategies in the CET-6 reading context.

Table 4. Independent t-test results of the EG and CG.

Categories	Group	M	SD	Sig.
Pre-test	CG	124.08	18.38	0.840
	EG	123.27	16.96	
Post-test	CG	130.64	20.07	0.000
	EG	147.59	17.3	
Pre-survey	CG	71.18	10.01	0.114
	EG	75.55	14.13	
Post-survey	CG	74.28	8.74	0.043
	EG	79.1	12.02	

Note: M = Mean, SD = Standard Deviation; the significance level (sig) is based on a two-tailed test.

In summary, the EG demonstrated significant improvement in both CET-6 reading and questionnaire scores following the intervention, while the CG showed relatively modest progress. These results suggest that the metacognitive reading strategy intervention had a positive effect on the EG, indicating that integrating metacognitive strategies into reading instruction can improve reading performance, particularly in high-stakes test contexts such as the CET-6.

5. Discussion and Conclusions

In the first phase, the study adapted classic reading strategy questionnaires as a measurement tool for examining the use of metacognitive reading strategies for test-takers in the CET-6 reading section. Although many classical reading strategy questionnaires existed for EFL and ESL learners [14, 15], Chinese CET-6 test-takers vary in terms of English proficiency, educational background, and application

of metacognitive strategies. Therefore, a scale tailored to this specific context is necessary, and validating a metacognitive reading scale suited to the CET-6 reading context is essential.

This scale comprises 22 items across three factors: planning, monitoring, and evaluating. Employing exploratory factor analysis, the study identified a three-factor structure consistent with Phakiti's model and generally aligned with Purpura's "before event–during event–after event" framework[14, 15]. Confirmatory factor analysis further demonstrated strong construct validity, convergent validity, and discriminant validity. High internal consistency reliability was also confirmed, with satisfactory values. The theoretically grounded structure of the validated questionnaire enables a detailed investigation into test-takers' use of metacognitive reading strategies in the CET-6 reading section, providing a contextually appropriate instrument for Chinese university EFL learners.

In the second phase of this study, the effectiveness of the metacognitive reading strategy intervention was assessed through pre- and post-CET-6 reading tests, as well as pre- and post-administration of a validated questionnaire. The results were analyzed using independent samples t-tests. The findings indicated that metacognitive strategy instruction improved students' performance in the CET-6 reading exam and increased the frequency with which they applied metacognitive reading strategies during the test.

Previous studies have shown that explicit instruction in reading strategies can effectively enhance students' reading comprehension[8]. The results of this study further confirm the effectiveness of metacognitive reading strategy instruction. Additionally, as noted earlier, the role of metacognitive strategies in large-scale international standardized language exams, such as TOEFL and IELTS, has been well-established[22, 23]. This study further validates the effectiveness of metacognitive reading strategies in the Chinese EFL reading test context, demonstrating that these strategies are equally effective in improving CET-6 reading performance, just as they have been proven in international English proficiency exams. Therefore, it is recommended that universities systematically incorporate metacognitive strategy training into their courses to help students master effective reading techniques and ultimately improve their exam performance.

Empirical studies on SLA education in China are steadily expanding to explore how learning strategies and emotional factors can enhance students' learning outcomes[34, 35]. In China's highly competitive, exam-oriented environment, such research holds great practical significance, offering students valuable support to perform better in various exams. Better performance, in turn, gives them the confidence to utilize strategies and foster positive emotions in foreign language learning. Therefore, in the future, strategy instruction training could be incorporated into teacher training programs to better support students' strategy use and test-taking abilities, while also enhancing teachers' professional development.

As aforementioned, the CET-6 certificate can be a prerequisite for state-owned enterprises recruitment and for graduate-school recommendation, directly influencing their further education and employment. In this post-pandemic era, the job market has become increasingly competitive, making foreign language skills and certificates even more important. Therefore, supporting students in obtaining the CET-6 certificate has become significant. Additionally, guiding students to manipulate scientifically informed strategies can alleviate their learning pressure, better preparing them to face future academic and career challenges with confidence and supporting their long-term development.

Apart from the contribution of the current study to the development of metacognitive theory by exploring the measurement of students' metacognitive reading strategies and the effects of strategy instruction in the CET-6 reading context, it still has several limitations that should be acknowledged. First, the intervention period was limited to eight weeks. This restriction was due to the academic term structure—each term lasts 16 weeks, with reading being only one of the modules—whereas students may require a more extended preparation period, sometimes even spanning a year, to pass the CET-6. Given the challenging nature of such high-stakes exams, longitudinal research would be more suitable for capturing the long-term effects of metacognitive reading strategy instruction. Future research could extend to longitudinal research to provide a more comprehensive and in-depth exploration of the impact of metacognitive reading strategies on the CET-6 exam.

Beyond CET-6 reading, future research could also explore the broader applicability of metacognitive strategies in other directions. First, future studies could examine the relationship between metacognitive strategies and emotions in

foreign language learning, using quantitative analysis to uncover the mechanisms underlying their interaction. Learning strategies and emotional factors, once viewed as by-products of SLA, have been shown to be crucial in language acquisition. Emotional factors, such as motivation, self-confidence, test anxiety, and interest in learning, often influence students' choice of strategies, especially in high-pressure exam settings. Understanding how these emotional factors facilitate metacognitive strategy use can offer valuable insights for teachers and educational practitioners.

Second, further research could assess the applicability of metacognitive reading strategies in other exams, such as the College English Test Band 4 (CET-4) and graduate school entrance examinations. These exams differ in content and objectives, posing varying demands on students' language abilities and test-taking skills. Investigating the effectiveness of metacognitive strategies in different tests would reveal how students adjust their strategies in various exams, offering a comprehensive understanding for strategy use and strategy instruction in tests. Finally, future studies could conduct stratified analyses of CET-6 test-takers to explore metacognitive strategy use among students with varying proficiency levels. Although passing the CET-4 is a prerequisite for the CET-6, students' English proficiency and learning abilities can still vary significantly. Different proficiency groups may exhibit unique patterns and needs in their strategy use. A stratified approach could help educators develop more personalized teaching methods and provide tailored support for students at different proficiency levels, thereby enhancing their preparation and performance in various language assessments.

In conclusion, future research could focus on the integration of metacognitive strategies with emotional factors, their application in diverse exam contexts, and stratified, personalized analyses of CET-6 test-takers. These directions would not only deepen understanding of metacognitive theory but also offer practical, targeted guidance for educators, maximizing students' learning potential in different testing environments and leading to better academic outcomes.

Author Contributions

All authors have made substantial, direct, and intellectual contributions to the work. Data collection was conducted by the J.B. Contributions from the N.A.S., S.S.S. and W.W. include but are not limited to, conceptualization, methodology, investigation, formal analysis, writing—original draft, and writing—review & editing.

Funding

This work received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Data will be made available on request.

Acknowledgments

We would like to express our sincere gratitude to all those who contributed to the completion of this research. Additionally, we would like to acknowledge the helpful feedback and suggestions from the reviewers, whose comments greatly improved the quality of this manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

Appendix A. CET-6 Metacognitive Reading Strategy Questionnaire

Planning Reading Strategy

1. I tried to identify easy and difficult part of the CET-6 reading test.
2. When I started to complete the CET-6 reading test, I planned how to complete it and followed the plan.
3. I determined what the test questions required me to do.
4. I made sure I understood what had to be done and how

to do it.

5. I made sure to clarify the goal and know how to complete it.
6. Before I begin CET-6 reading test, I think about how the test will be scored.
7. Before I begin CET-6 reading test, I think about which parts of the test are the most important.
8. Before I begin CET-6 reading test, I decide how important it is for me to get a good grade.

Monitoring Reading Strategy

9. I was aware of what and how I was doing in the test.
10. I was aware of which strategy to use and how and when to use it.
11. I corrected mistakes immediately when I found them.
12. I was aware of how much the test remained to be completed.
13. I was aware of my ongoing reading and test taking.
14. I kept track of my own progress to complete the question on time.

Evaluating Reading Strategy

15. I checked my own performance and progress while completing the test.
16. I thought through the meaning of the test tasks/questions before answering them.
17. I asked myself how the test questions and the given texts related to what I already knew.
18. I checked my accuracy as I progressed through the test.
19. I carefully checked the answers before submitting the test.
20. Before I hand in my English test, I check my work.
21. I try to learn from the mistakes I made in the test.
22. When I am taking this test, I try to concentrate on what I am doing.

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