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Cognitive and Metacognitive Strategy Use in Reading: The Case of Iranian EFL Students' Test Performance

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Abstract

Individual characteristics and differences, namely strategy-use behavior have been gaining much attention among researchers due to influences that they may have on test takers' performance on reading tests. From a language testing perspective, however, further experimental studies are needed in this regard. This study investigated the relationship between test-takers' strategy-use behavior and their reading test performance. Five hundred and twenty Iranian English as a Foreign Language (EFL) learners (both male and female) participated in this study. They were assigned to high- and the low-reading ability groups based on their scores on a teacher-made reading comprehension test. They were also required to sit for a teacher-made TOEFL-based reading comprehension test and answer the adapted version of Phakiti's (2008) *Cognitive and Metacognitive Strategy Questionnaire* with 30 items immediately after the test. The reliability of both instruments was approved through Cronbach alpha and the validity was assured through content and construct evidences of validity. Confirmatory Factor Analysis (CFA) on the questionnaire indicated that three factors were identified as cognitive (comprehension, retrieval, memory) and three as metacognitive strategies (planning, monitoring, evaluation) for both ability groups. Moreover, Structural Equation Modeling (SEM) analysis showed that metacognitive strategies had a regulating function on cognitive strategies in both groups. Furthermore, the results showed that in the high ability group Comprehension (COM) and Memory (MEM) strategies and in the low-ability group, Retrieval (RET) strategies were the best predictors of reading test performance. Finally, some implications and suggestions for further research are presented.

Keywords: cognitive strategy, metacognitive strategy, reading test performance, strategy-use behavior

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1. Introduction

During the 1970s, there was a remarkable shift of attention towards the processes involved in completing any cognitive task (Purpura, 1999). Accordingly, cognitive theories have paid more attention to processing information during a cognitive task such as a reading comprehension task that requires readers to process text to make sense (Anderson, 2005). To process information during a reading task, cognitive and metacognitive strategies are required to facilitate comprehension, learning, or retention of the information. The former refers to strategies that deal with the very act of thinking and learning (e.g., comprehension, memory, retrieval) and the latter deals with thinking about thinking and learning (e.g., planning, monitoring, evaluating; Phakiti, 2008).

For the most part, reading tasks are employed for testing purposes (Phakiti, 2003, 2006, 2008; Zhang & Zhang, 2013; Zhang, 2018). Akin to all other reading tasks, the ones functioning as assessing language learners' reading competence involve cognitive and metacognitive strategy use. This strategy-use behavior within a reading test has been explored in the literature (e.g., Purpura, 1999; Phakiti, 2003, 2006, 2008; Zhang et al., 2016; Zhang, 2018; Ferrara et al., 2020; Xu et al., 2021); however, previous lines of research have mainly focused on merely identifying the type, frequency, and variety of strategies used by learners and they have failed to address the relationships between these strategies and the likely interrelationships among their components. Also missing in the literature is whether the constructed models on cognitive and metacognitive strategy use are consistent over ability levels (i.e., ability-specific models has not been discussed thoroughly previously). Additionally, previous lines of research (e.g., Macaro & Erler, 2008) mainly focused on indicating that high- and low-ability learners use strategies differently but did not clarify whether this difference led to different reading test performance. The extent that performance on a reading test relies on test-takers' cognitive and metacognitive strategy-use behavior has not been dealt with in depth previously.

So as to address these gaps, this study attempted to extend the current knowledge about test-takers' strategy-use behavior and contribute to the existing literature by scrutinizing how test-takers process information cognitively and metacognitively through using relevant strategies in a specific test-taking situation. We believed that this cannot be achieved by merely counting the strategies during the test but through constructing some structural models. These models gain importance in making test designers and language testers aware of the factorial structures of information processing in a reading test. This paper also called into question that whether the constructed models on strategy-use behavior were the same across different reading-ability levels. It aimed to construct ability-specific strategy-use models in which the relationships between cognitive and metacognitive strategies and the interrelationships among their components were illustrated for both ability levels. By comparing the constructed models for both ability levels, language testers can elaborate on the factors involved in test-takers' reading test performance and confirm the possible relationship of strategy-use behavior and their reading test performance. Accordingly, language testers and especially reading test designers will be more attentive to other unobservable and non-linguistic factors (such as the relationship between cognitive and metacognitive strategies) involved reading test-takers' performance.

Furthermore, the interrelationship between test-takers' strategy-use behavior and its causal relationship with their reading test performance can be appropriately represented by a powerful statistical measure like SEM explaining how a set of observed variables define latent variables and the relationships among these variables (Schumacker & Lomax, 2004).

1.1. Research Questions

Most of the current literature on the relationship between test-takers' strategy-use behavior and their reading test performance has overlooked developing separate models for different ability groups. By developing the separate models for each of the reading ability groups, this study learned how differently the high- and low-ability groups employed cognitive and metacognitive strategies during the test completion and to what extent the variation in the reading test scores was due to their strategy-use behavior. To extend previous findings and address gaps in current literature, the following research questions were explored:

RQ 1) How are the models of the cognitive/metacognitive strategy use constructed in the low- and high-reading ability EFL test-takers' performance?

RQ 2) What are the interrelationships among the cognitive/metacognitive strategies in the low- and high-reading ability EFL test-takers' performance?

RQ 3) What are the interrelationship between cognitive and metacognitive strategies in the low- and high-reading ability EFL test-takers' performance?

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RQ 4) To what extent do cognitive and metacognitive strategies affect the low- and high-reading ability EFL test-takers' reading test performance?

1.2. Classifications of the Strategy

Since the 1970s, due to the development of cognitive psychology, various strategy taxonomies have been brought forward. They are classified based on functions of the strategies in language learning and testing processes. The main purpose of these taxonomies is to elaborate on the role of learners' strategy-use behavior in L2 learning and test-taking situations (Oxford, 1990, 2011; Phakiti, 2007). O'Malley and Chamot's (1990) taxonomy, for instance, was established based on the concepts proposed by Brown and Palincsar's (1982) and Anderson's (1985) views on cognitive psychology. This taxonomy encompasses cognitive, metacognitive, and social-affective strategies. In the same year, Oxford (1990) presented her taxonomy with different categories (i.e., cognitive, compensation, metacognitive, memory, affective, and social), and developed the Strategy Inventory for Language Learning. More recently, Oxford (2011) devised a self-regulation language learning model composed of six strategies: cognitive, metacognitive, affective, meta-affective, sociocultural-interactive and meta-sociocultural-interactive strategies, which has received less attention.

1.3. Cognitive and Metacognitive Strategy

The *cognitive strategies* refer to "strategic options relating to specific learning tasks that involve direct manipulation of the learning" (Brown, 2007, p. 378). Cognitive strategies are defined by O'Malley and Chamot (1990) as behaviors that "involve mental manipulations or translations of materials or tasks" which improve "comprehension, acquisition, or retention" (p. 229). In the current study, these strategies were seen as conscious mental behaviors during the reading test, and test-takers utilized them to realize their mental plan during reading tests. In the literature, the metacognitive strategy is used to refer to certain regulating or executive (Phakiti, 2008) functions. Brown (2007) defined metacognitive strategies as options that "involve planning for learning, thinking about the learning process as it is taking place monitoring of one's production and comprehension, and evaluating learning after an activity is completed" (p. 378). Similarly, Purpura (1997) proposed that metacognitive strategies are "a set of conscious or unconscious mental or behavioral activities which are directly or indirectly related to some specific stage of the overall process of language acquisition, use or testing" (p. 6). In this study, the conceptualization of metacognitive strategies is congruent with Purpura's (1997) arguments about metacognitive strategy use in reading comprehension tests.

2. Literature Review

In past decades, test-takers' individual differences in strategy-use behavior and its relationship with test performance have been an important line of investigation for many researchers (Phakiti, 2016; Saito et al., 2019; Vosniadou et al., 2021). In recent years, reading tests in particular have received more attention in their work, as researchers attempted to cast more light on the nature of second language (L2) reading test performance (e.g., Phakiti, 2006, 2008; Zhang & Zhang, 2013; Zhang, 2018, Diken, 2020). For instance, Phakiti (2008) applied a longitudinal approach and examined the construct validity of Bachman and Palmer's (1996) strategic competence model over time. He utilized a series of SEM techniques to examine the relationship of test-takers' long-term strategic knowledge and current strategy use to L2 reading test performance over time. He proposed that metacognitive strategy use had a direct and significant effect on cognitive strategy use. Furthermore, he reported that cognitive strategy-use directly affected reading test performance.

Likewise, Zhang and Zhang (2013) investigated test-takers' individual differences regarding their strategy-use behavior and reading test performance through SEM techniques. They explored two factors underlying test-takers' reading test performance: lexico-grammatical and text comprehension ability, determining that monitoring strategies significantly affected lexico-grammatical, and evaluating strategies significantly affected text comprehension abilities. Furthermore, comprehending, memory, and retrieval strategies were reported to load on cognitive strategy use; and planning, monitoring, and evaluating strategies loaded on metacognitive strategy use. They further showed that metacognitive strategies had a significant and direct effect on cognitive strategies. Lin et al., (2019) also modeled the relationship between test takers' cognitive and metacognitive strategy use and their reading test performance. They collected data through a questionnaire and a high-stakes reading test, and analyzed it through

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SEM. They found that both cognitive and metacognitive strategies affected the test takers' reading test performance directly and indirectly, respectively. Moreover, they discovered that metacognitive strategies had a strong and direct effect on cognitive strategies.

In a more recent study, Lin et al., (2021) investigated the relationships between language learning strategies and comprehension in L2 Chinese reading. In their study, two types of comprehension were examined: literal and inferential. The analysis of the structural equation modeling revealed that learning strategies affected only literal and not inferential comprehension. Finally, Cai and Kunnan (2020) explored the nature of the interaction between test takers' strategy-use behavior and their reading test performance. They proposed three interaction patters and asserted that these patterns moderated the effect of strategy-use behavior on reading test performance. They reported that test takers' strategy-use behavior had a fluctuating effect on their reading test performance. In other words, depending on test takers' ability level, different patterns of the strategy-use behavior were revealed.

However, existing literature on the strategy-use behavior and its relationships with reading test performance remains inconsistent and inadequate. It has reported different types of positive and negative as well as direct and indirect relationships among these variables. Thus, there is still a need for further confirmatory experimental studies to cast more light on the nature of this strategy-use behavior and its effects on reading test performance.

3. Method

3.1. Participants

A total of 560 Iranian undergraduate EFL learners (284 females [50.71%]; 276 males [49.29%]) within the age range of 18-25 were recruited for this study. They were selected through convenience sampling from some public and private universities in Iran including Mohaghegh-Ardabili, AlZahra, and Azad Universities. The participants were from different majors including English Translation, English Language and Literature, English Language Teaching. Of the initial sample, those with scores between 15-21 were not the concern of the study and were removed from the study. All participants had taken or had already passed the Reading Comprehension 3 course at the time of data collection. This

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course is a required subject in the university within learners' four-year undergraduate program.

3.2. Instrument

In what follows, three data collection methods used in the present study are reviewed.

3.2.1. Paper- TOEFL-Based Reading Comprehension Test

One TOEFL-based reading comprehension test was exploited to assign the participants to the high- and low-reading ability groups. The test had three reading passages (each containing approximately 250 words) and 30 multiple-choice items with a 50-minute time limit. Subsequently, another researcher-made TOEFL-based reading comprehension test with five passages was used to assess the participants' reading test performance. Similar to the 3-passage test, this test tapped into some reading skills, including skimming, scanning, exploring the main idea, and making inferences. The 5-passage test with 50 items had an 80-minute time limit. Also of note is that before utilizing these reading comprehension tests in this study, they were piloted with a sample of 44 participants who were also selected from the male and female EFL learners studying at Alzahra, Mohaghegh-Ardabili, and Azad universities. The internal consistency reliability analysis yielded a Cronbach alpha coefficient of 0.90, suggesting a highly reliable scale (Cohen et al., [2011]). Moreover, both content and construct validity were assessed. The former was assured through some experts' judgments about the representativeness of the test content obtained from some university professors who have taught Reading Comprehension courses for years. The validity was assured through a *differential-groups study* (Brown, 2005) through which the researchers attempted to show that the test scores were different for two groups: one group which "had" the measured construct (i.e., reading comprehension) and another that did not have it. Comparing their performance through t-test measure showed a significant difference in the scores of the test-takers who were taught reading comprehension and those who were not, t (42) = -35.26, $p < 0.05$ (two-tailed).

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3.2.2 Phakiti's (2008) Cognitive and Metacognitive Strategy Use Questionnaire

Phakiti's (2008) *Cognitive and Metacognitive Strategy Use Questionnaire* based on the information processing model by Gagne et al. (1993) and Cushing and Purpura's (1993) Metacognitive Strategies Questionnaire was adapted in the present study. This 30-item questionnaire tapped into the strategy-use behavior of the learners during the reading test on a 6-point Likert scale: 0 (Never), 1 (Rarely), 2 (Sometimes), 3 (Often), 4 (Usually), and 5 (Always). All participants were required to answer this questionnaire immediately after completing the reading test within 20 minutes. Validity and reliability of the questionnaire were assured prior to the actual use through trials with a similar target population. Based on the results, some relatively low alpha items were removed, and subsequently, CFA was done for each measurement level. The reliability of the questionnaire calculating through Cronbach alpha measure was found to be at an acceptable level (0.89; Cohen's et al. 2011). Furthermore, the back-translation method was used through which the reliability and validity of the questionnaire were evaluated. To assure the accuracy of the translated items, one English language translator who was not previously involved in the research translated them from Persian into English and it was found that there was a match between the original and the translated questionnaire. In addition, validity was assured via expert judgments on the theoretical constructs underlying the questionnaire.

3.3. Data Collection Procedure

Initially, 560 EFL learners sat for one paper-based TOEFL-based reading test in their places to be classified into the high- and low- reading ability. The participants were classified into the high- and low-ability groups based on their scores on one paper-based TOEFL-based reading test. The scores within the range of 22 to 30 were considered as the high-reading ability (N = 260); 40 people whose scores were within the range of 15 to 21 and whom were considered as the middle-reading ability group were removed; and scores within the range of 0 to 14 were considered as the low-reading ability learners (N=260; Educational Testing Service [ETS]). One or two weeks later, the test-takers were invited to sit for another paper-based TOEFL-based reading test at their respective universities. Then, they were required to complete the *Cognitive and Metacognitive Strategy Use Questionnaire* (Phakiti, 2008) immediately after the test. The reason for requiring the immediate completion of the questionnaire was that strategy-use behavior might be accounted for by a

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specific testing situation, and if the interval between taking the test and completion of the questionnaire was long, it would be likely to lose valuable data. To ensure that all participants went through the same procedure during the test taking situation and while completing the questionnaire, all required instructions appeared on their test papers and also provided by the researchers orally.

3.4. Data Analysis

All data were analyzed through the Statistical Package of Social Science (SPSS) Version 21.0 and Analysis of a Moment Structure (AMOS) computer program Version 23.0. A series of SEM techniques were used to test the models of strategy-use behavior for both the high- and low-ability test-takers. They were also used to detect the factorial structure of the models for these groups. Moreover, SEM techniques examined the unobservable variables and the interrelationships among components of cognitive and metacognitive strategies (research questions 2-5). The separately constructed models were compared to see whether they corresponded to different reading abilities. In the case of any difference, comparing these models could indicate where (which strategy and which component) the exact difference lied and how these cognitive and metacognitive strategies were interrelated with each other in both groups. Finally, to answer the last research question, the simultaneous analyses of constructed models on the relationship between cognitive and metacognitive strategy use and the reading test were done via another SEM technique.

4. Results

In this study, we explored (a) the factorial structure of cognitive and metacognitive strategy for both the low- and high-reading ability groups; (b) the interrelationship between these strategies and their components; and (c) the relationship between test-takers' strategy-use behavior and their reading test performance. Statistical analyses on both questionnaire and reading test as well as the analysis of the constructed models for both groups are reported in the following sections.

As Table 1 details, the values of skewness and kurtosis are within the acceptable range (±1) (Bachman, 2004); furthermore, the internal consistency reliability analysis yielded Cronbach Alpha Coefficient of 0.90, suggesting highly

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reliable scales (Cohen et al., 2011).

Table 1
Descriptive Statistics and Reliability Estimates for the Reading Test (High Ability Group)

Subscale	No. of Items	*M*	*SD*	Skewness	Kurtosis	Reliability Estimates
Skimming and Scanning	24	15.77	4.76	-.186	-.608	.80
Inferencing	13	9.85	3.34	-.771	-.626	.85
Vocabulary	13	9.40	3.07	-.380	-.975	.79
Total	50					.90

Table 2 reports the skewness and kurtosis values for the questionnaire within the acceptable range supporting the normality of distribution of the questionnaire data. Furthermore, the internal consistency reliability analysis suggested a highly reliable scale (α = .89). More specifically, the reliability estimates for all components are above .70 suggesting an acceptable reliability level.

Table 2
Descriptive Statistics and Reliability Estimates for the Questionnaire (High Ability Group)

Scale	Subscale	No. of Items	*M*	*SD*	Skewness	Kurtosis	Reliability Estimates
MET	Planning	6	17.91	6.16	-.247	-.581	.75
	Monitoring	5	17.09	5.03	-.495	-.310	.79
	Evaluating	6	18.43	5.87	-.224	-.393	.81
	Subtotal	17					.86
COG	Comprehending	4	14.16	3.53	-.338	-.538	.77
	Retrieval	5	16.52	4.46	-.224	-.497	.74
	Memory	4	13.78	3.13	-.174	-.673	.78
	Subtotal	13					.77
	Total	30					.89

Note. MET = metacognitive; COG = cognitive.

4.1. CFA in the High-Reading Ability Group

CFA was conducted at the individual items and measurement models to examine if the data confirm the hypothesized model (Zhang & Zhang's [2013] model). The CFA model indicated that the Planning (PLN), Monitoring (MON), and Evaluation (EVA) strategies loaded significantly on metacognitive strategy with standardized coefficients .67, .88, and.99; and COM, RET, and MEM strategies loaded significantly on cognitive strategy with standardized coefficients .73, .93, and .79, respectively. Furthermore, the observed variables significantly (p < .05) loaded on their corresponding factor except items 1, 6, 20, and 29 from metacognitive strategies and item 12 from cognitive strategies. These items were considered for removal from the measurement model to improve further the model (Meyers et al., 2006). The CFA indicated that the metacognitive and cognitive models had a good model fit (Table 3). Two incremental fit indices Comparative Fit Index (CFI) and the Non-Normed Fit Index (NNFI) were above .90, suggesting a good and acceptable fit (ibid). The Root Mean Square Error of Approximation (RMSEA) was below .08, suggesting a good fit. Chi-square (*df*) was non-significant, indicating an acceptable match between the proposed model and the observed data (ibid).

Moreover, three underlying correlated factors in the reading test were Skimming/Scanning (SKM/SCN), Inferencing (INF), and Vocabulary (VOC). Only items 17, 30, 41, and 44 loaded significantly (p < .05) on SKM/SCN factor and were kept for further analysis, and the remaining items were excluded. By deleting these non-significant path coefficients, the CFA model for the reading test performance indicated a good model fit. These three factors significantly correlated with one another (p < .05). Having established the measurement models and conducted CFA analysis separately, it was found that the hypothesized SEM model did not fit well with the data. Therefore, some other SEM models were tested and retested to reach model re-specification (Bentler, 2006). Finally, the modified model indicated good model fit indices with NNFI = .90, CFI = .91, RMSEA = .04, and χ^2/df = 1.59 (p < .05; Table 3).

Table 3

Model Fit for the Factor Structure of the Questionnaire and Reading Test (High Ability Group)

Model	χ^2	*df*	χ^2/df	NNFI	CFI	RMSEA	RMSEA 90% CI
MET	132.56*	63	2.10	.92	.94	.06	.04 to .08
COG	68.76*	36	1.91	.91	.94	.06	.04 to .08
EFL Reading	342.47*	117	2.92	.92	.94	.08	.07 to .09
Hypothesized SEM Model	492.99*	309	1.59	.90	.91	.04	.04 to .05

Note. *p < .05; CFI = Comparative Fit Index; NNFI = Non-Normed Fit Index; RMSEA = Root Mean Square Error of Approximation; *df* = Chi-square; CI = confidence interval.

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Table 4 and 5 detail the descriptive statistics and reliability estimates for the reading test and the low-ability group questionnaire.

Table 4

Descriptive Statistics and Reliability Estimates for the Reading Test in the (Low Ability Group)

Subscale	No. of Items	*M*	*SD*	Skewness	Kurtosis	Reliability estimates
Skimming and Scanning	24	8.06	4.08	.434	-.527	.71
Inferencing	13	5.84	3.22	.317	-.595	.76
Vocabulary	13	6.17	3.45	.517	-.695	.79
Total	50					.83

The normal distribution of the data was confirmed as all skewness and kurtosis values were within the acceptable range (Bachman, 2004). The internal consistency reliability ($\alpha = .83$) suggested highly reliable scales.

Table 5

Descriptive Statistics and Reliability Estimates for the Questionnaire (Low Ability Group)

Scale	Subscale	No. of Items	*M*	*SD*	Skewness	Kurtosis	Reliability Estimates
MET	Planning	6	14.03	6.30	.036	-.724	.76
	Monitoring	5	14.17	6.44	-.230	-.872	.75
	Evaluating	6	14.19	7.02	.197	-.711	.84
	Subtotal	17					.82
COG	Comprehending	4	11.62	4.58	-.167	-.870	.74
	Retrieval	5	12.54	5.42	.077	-.698	.78
	Memory	4	9.97	4.39	.058	-.523	.73
	Subtotal	13					.86
	Total	30					.89

Note. MET = metacognitive; COG = cognitive

The normal distribution of the data for the questionnaire was also confirmed (Bachman, 2004) and the internal consistency reliability ($\alpha = .89$) revealed highly reliable scales.

4.2. CFA in the Low-Reading Ability Group

According to CFA model analysis, the PLN, MON, and EVA strategies loaded significantly on metacognitive strategy with standardized coefficients of .48, .73, and .90, respectively. Since the model fit was good, the planning strategies were retained despite their low loading (Meyers et al., 2006). Similarly, COM, RET, and MEM strategies loaded significantly on cognitive strategy with high standardized coefficients of .85, .98, and .93, respectively. Furthermore, all observed variables significantly (p < .05) loaded on their corresponding factor from both strategies. Moreover, the CFA confirmed a good model fit of the metacognitive and the cognitive model measured by NNFI, RMSEA, and χ^2/df indices (Meyers, et al., 2006; Table 6). Additionally, in the reading factor, only items 22, 28, 29, 41, and 49 loaded significantly (p < .05) on SKM/SCN factor and were kept for further analysis. The CFA model for the reading test indicated a good model fit with NNFI = .91, CFI = .93, RMSEA = .04, and χ^2/df = 1.61 (p < .05). Additionally, the three factors correlated significantly with one another (p < .05).

After testing and retesting the measurement models and conducting CFA analysis separately, it was found that the hypothesized SEM model did not have an adequate model fit. Hence, items 7, 18, and 12 from cognitive and items 5, 6, 20, 22, and 23 from metacognitive strategies were removed from further analysis because of their low loadings (Meyers et al., 2006). Additionally, some error variances were corrected so that the model was better explained (Meyers et al., 2006) and the modified model revealed good model fit indices with NNFI = .90, CFI = .91, RMSEA = .05, and χ^2/df = 1.73 (p < .05).

Table 6

Model Fit for the Factor Structure of the MET, COG, Reading, and SEM in CFA Model (Low Ability Group)

Model	χ2	*df*	χ2/*df*	NNFI	CFI	RMSEA	RMSEA 90% CI
MET	218.02*	110	1.98	.91	.92	.06	.04 to .07
COG	140.76*	58	2.42	.91	.93	.07	.05 to .08
EFL Reading	246.66*	153	1.61	.91	.93	.04	.03 to .05
Hypothesized SEM Model	448.26*	259	1.73	.90	.91	.05	.04 to .06

Note. *p < .05; CFI = Comparative Fit Index; NNFI = Non-Normed Fit Index; RMSEA = Root Mean Square Error of Approximation; *df* = Chi-square; CI = confidence interval.

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RQ 1) *How are the models of the cognitive/metacognitive strategy use constructed in the low- and high-reading ability EFL test-takers' performance?*

As presented in Figure 1, the cognitive strategies consist of COM, RET, and MEM strategies. *COM strategies* were explained by items COM7 with a loading of 0.69 (R^2 = 0.48), COM8 with a loading of 0.45 (R^2 = 0.21), COM9 with a loading of 0.43 (R^2 = 0.19), and COM10 with a loading of 0.69 (R^2 = 0.48). An R^2 (squared multiple correlation; an index for determining the amount of variance accounted for by the predictor variables) of 0.26, 0.13, and 0.02 indicate a substantial, moderate, or weak level of predictive accuracy, respectively (Cohen, 1988). As an example, the R^2 of COM7 strategy indicated that 48% of COM variance is accounted for by the item COM7 (substantial level of predictive accuracy). The remaining 52% of COM variance is accounted for by the unique factor e7. The communality or the total common factor variance is the amount or proportion of the total variance explained by two or more factors that are reported as h^2 in the calculation (Schumacker & Lomax, 2004). The h^2 of COM strategy was .34 ([.48 + .21 + .19 + .48]/4 = .34), suggesting that the four variables explained only 34% of the COM strategy variance and the remaining 66% of the factor variance was explained by the residual factor variance (D1). Moreover, *RET strategies* were explained by items RET14 with a loading of .58 (R^2 = .34), RET16 with a loading of .66 (R^2 = .43), RET18 with a loading of .55 (R^2 = .31), and RET19 with a loading of .56 (R^2 = .31). The h^2 of RET strategy was .35, suggesting that the four variables explained only 35% of the RET strategy variance. Finally, *MEM strategies* were explained by items MEM11 with a loading of .42 (R^2 = .18), MEM13 with a loading of .24 (R^2 = .06), MEM15 with a loading of .48 (R^2 = .23). The h^2 of MEM strategy was near zero, suggesting that MEM three variables could not explain factor variance.

[DOR: 20.1001.1.23223081.1401.13.3.5.2]
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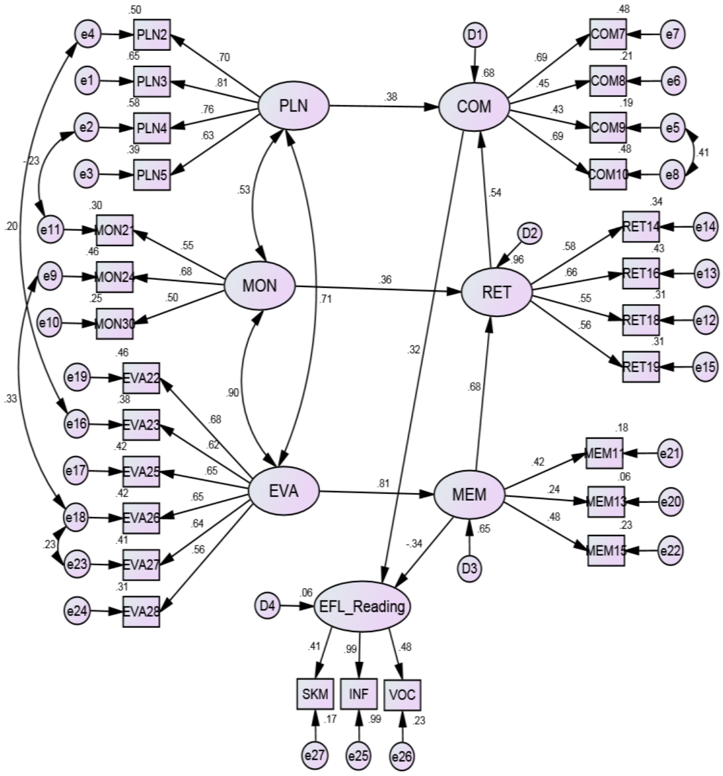
Figure 1

The Relationships among Cognitive and Metacognitive Strategies to EFL Reading Test Performance in High-reading Ability Group



Regarding the low-reading ability group (Figure 2), *COM strategies* were explained by items COM8 with a loading of .62 (R^2 = .38), COM9 with a loading of .73 (R^2 = .53), and COM10 with a loading of .76 (R^2 = .58). Moreover, the h^2 of COM strategy was .50, suggesting that the three variables explained only 50% of the COM strategy variance. Moreover, *RET strategies* were explained by items RET14 with a loading of .68 (R^2 = .47), RET16 with a loading of .62 (R^2 = .39), RET17 with a loading of .84 (R^2 = .70), and RET19 with a loading of .64 (R^2 = .41). The h^2 of RET strategy was .49. Finally, *MEM strategies* were explained by items MEM11 with a loading of .59 (R^2 = .35), MEM13 with a loading of .56 (R^2 = .31), MEM15 with a loading of .57 (R^2 = .32). The h^2 of MEM strategy was .33.

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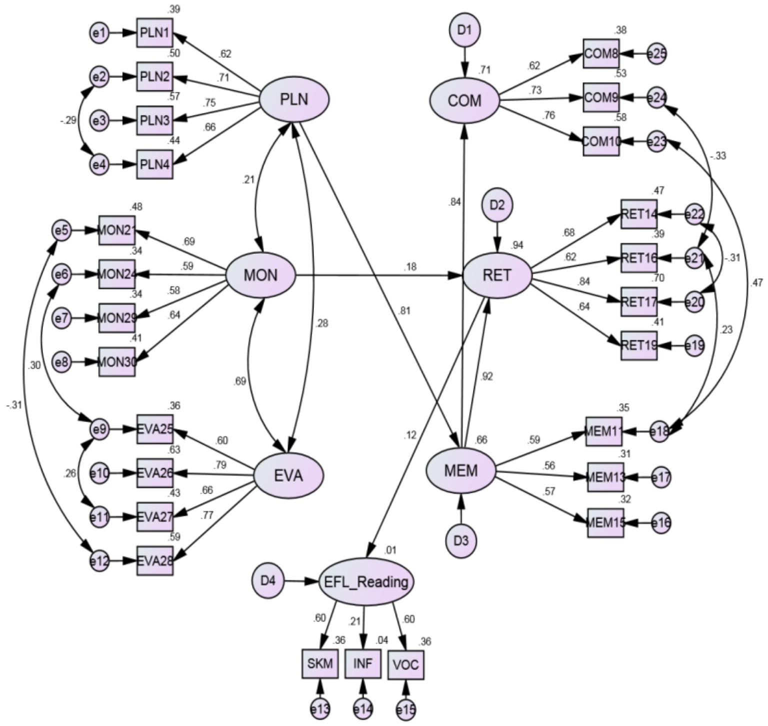
Figure 2

The Relationships among Cognitive and Metacognitive Strategies to EFL Reading Test Performance in Low-reading Ability Group



In the high-reading ability group (Figure 1), the relationship among cognitive strategies was a uni-directional correlation. MEM strategies directly affected RET strategies with regression coefficient (β) of .68, R^2 = .46. Through RET strategies, MEM strategies influenced COM strategies (β = .37 [.68 × .54], R^2 = .14). RET strategies directly affected COM strategies (β = .54, R^2 = .29). Likewise, for the low-reading ability group (Figure 2), the relationship among cognitive strategies was a uni-directional correlation. MEM strategies had a direct strong effect on RET strategies (β = .92, R^2 = .85) and had a direct strong effect on COM strategies (β = .92, R^2 = .85).

Regarding metacognitive strategies, in the high- reading ability group (Figure 1), metacognitive strategies included PLN, MON, and EVA strategies. Table 7 details the R^2, h^2, and loadings of the loaded items on each strategy.

Table 7

Loadings, R^2, h^2 in the High-reading Ability Group

Items	*Loading*	*R^2*	*h^2*
PLN2	.70	.50	
PLN3	.81	.65	
PLN4	.76	.58	
PLN5	.63	.39	
PLN Strategies			.53
MON21	.55	.30	
MON24	.68	.46	
MON30	.50	.25	
MON Strategies			.34
EVA22	.68	.46	
EVA23	.62	.28	
EVA25	.65	.42	
EVA26	.65	.42	
EVA27	.64	.41	
EVA28	.56	.31	
EVA Strategies			.38

Note. R^2 = squared multiple correlation; h^2 = proportion of the total variance explained by two or more factors.

For instance, *PLN strategies* were explained by items PLN2 with a loading of .70 (R^2 = .50), PLN3 with a loading of .81 (R^2 = .65), PLN4 with a loading of .76 (R^2 = .58), and PLN5 with a loading of .63 (R^2 = .39). The h^2 of PLN strategy was .53, showing that these four variables explained only 53% of the PLN strategy variance. In the low-reading ability group (Figure 2), *PLN strategies* were explained by items PLN1, PLN2, PLN3, and PLN4. Table 8 indicates the R^2, h^2, the loadings of the loaded items on each strategy.

Table 8

Loadings, R^2, h^2 in the Low-reading Ability Group

Items	*Loading*	R^2	*h^2*
PLN1	.62	.39	
PLN2	.71	.50	
PLN3	.75	.57	
PLN4	.66	.44	
PLN Strategies			.48
MON21	.69	.48	
MON24	.59	.34	

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Items	*Loading*	R^2	h^2
MON29	.58	.34	
MON30	.64	.41	
MON Strategies			.39
EVA25	.60	.36	
EVA26	.79	.63	
EVA27	.66	.43	
EVA28	.77	.59	
EVA Strategies			.50

Note. R^2 = squared multiple correlation; h^2 = proportion of the total variance explained by two or more factors.

MON strategies, as an example, were explained by items MON21 with a loading of .69 (R^2 = .48), MON24 with a loading of .59 (R^2 = .34), MON29 with a loading of .58 (R^2 = .34), and MON30 with a loading of .64 (R^2 = .41). The h^2 of MON strategy was .39.

RQ 2) *What are the interrelationships among the cognitive/metacognitive strategies in low- and high-reading ability EFL test-takers' performance?*

Figure 1 illustrates that the relationships among metacognitive strategies were multi-directional for the high-reading ability group. The metacognitive strategy with established covariance among its observed variables influenced cognitive strategies. The correlation coefficient between EVA and MON, MON and PLN as well as EVA and PLN were estimated to be .90 (R^2 = .81); .53 (R^2 = .28); and .71 (R^2 = .50), respectively. Similarly, for the low-reading ability group (Figure 2), the relationships among metacognitive strategies were multi-directional and the correlation coefficient between EVA and MON, MON and PLN as well as EVA and PLN were .69 (R^2 = .48); .21 (R^2 = .14); and .28 (R^2 = .08), respectively.

RQ 3) *What are the interrelationship between cognitive and metacognitive strategies in the low- and high-reading ability EFL test-takers' performance?*

More specifically, some metacognitive strategies affected different cognitive strategies to various degrees. Table 9 indicates the direction and degree of these influences. For instance, EVA→MEM (R^2 = .66) suggests that 66% of the variance of MEM was explained by EVA.

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Table 9

The Interrelationship between Cognitive and Metacognitive Strategies (High-reading Ability Group)

Effect	B	R^2
Direct	.38	.14
PLN→COM		
MON→RET	.36	.13
EVA→MEM	**.81**	**.66**
Indirect	.19	.04
PLN→MON→RET		
PLN→MON, RET→COM	.06	.004
PLN→EVA→MEM	**.58**	**.33**
PLN→EVA, MEM→RET	.39	.15
PLN→EVA, MEM, RET→COM	.21	.04
MON→RET→COM	.19	.03
MON→EVA→MEM	**.72**	**.53**
MON→EVA, MEM→RET	**.50**	**.25**
MON→EVA, MEM, RET→COM	.27	.07
EVA→MEM → RET	**.55**	**.30**
EVA→MEM, RET→COM	.30	.08

Note. R^2 = squared multiple correlation; β = regression coefficient.

Similarly, in the low-reading ability group, the metacognitive strategies affected different cognitive strategies to various degrees. Table 10 indicates the direction and degree of these influences.

Table 10

The Interrelationship between Cognitive and Metacognitive Strategies (Low-reading Ability Group)

Effect	B	R^2
Direct	**.81**	**.66**
PLN→MEM		
MON→RET	.18	.03
Indirect	**.75**	**.56**
PLN→MEM→RET		
PLN→MEM→COM	**.68**	**.46**
PLN→MON→RET	.04	.001
MON→PLN→MEM	.17	.03
MON→PLN, MEM→RET	.16	.02

Effect	B	R^2
MON→PLN, MEM→COM	.14	.02
EVA→MON→RET	**.55**	**.30**
EVA→PLN→MEM	.23	.05
EVA→PLN, MEM→RET	.23	.05
EVA→PLN, MEM→COM	.19	.04

Note. R^2 = squared multiple correlation; β = regression coefficient.

RQ 4) *To what extent do cognitive and metacognitive strategies affect the low- and high-reading ability EFL test-takers' reading test performance?*

Like the previous research question, the interrelationships between cognitive and metacognitive strategies and reading comprehension had different directions and different degrees of strength. Tables 11 and 12 illustrates these interrelationships and their direction and strength in the high- and low-ability groups, respectively.

Table 11

The Interrelationship between Strategies and Reading Comprehension (High-reading Ability Group)

Effect	B	R^2
Direct	-.34	.12
MEM→RC		
COM→RC	.32	.10
Indirect	.17	.03
RET→COM→RC		
PLN→COM→RC	.12	.01
PLN→MON, RET, COM→RC	.03	.001
PLN→EVA, MEM, RET, COM→RC	.07	.004
MON→PLN, COM→RC	.06	.003
MON→EVA, MEM, RET, COM→RC	.08	.006
EVA→MEM, RET, COM→RC	.09	.008
EVA→PLN, COM→RC	.08	.006

Note. R^2 = squared multiple correlation; β = regression coefficient.

The values of R^2 indicate the percentage of the variance of the dependent variable (reading comprehension) explained by the independent variables (cognitive and metacognitive strategies) of the model. For instance, MEM→RC (R^2 = .12) suggests that MEM explained 12% of the RC variance in the high group (Table 11).

Table 12

The Interrelationship between Strategies and Reading Comprehension (Low-reading Ability Group)

Effect	B	R^2
Direct RET→RC	0.12	0.01
Indirect MEM→RET→RC	0.11	0.01
PLN→MEM, RET→RC	0.09	0.008
PLN→MON, RET→RC	0.004	0.00002
MON→RET→RC	0.02	0.0004
EVA→MON, RET→RC	0.01	0.0001

Note. R^2 = squared multiple correlation; β = regression coefficient.

5. Discussion and Conclusion

The main motivation for this study was the premise that the variability in test performance can be accredited to test-takers' strategy-use behavior (Bachman & Palmer, 1996, 2010). Accordingly, this study focused on the test-takers cognitive and metacognitive strategies during the reading test. The results revealed that for both ability levels, cognitive strategies were manifested differently from metacognitive strategies. These findings, indeed, supported the idea that language processes of understanding, learning, or utilizing (the focus of cognitive strategies) are different from the regulation of these processes (the focus of metacognitive strategies; Phakiti, 2008). Moreover, the results showed that all items assessing cognitive and metacognitive strategies loaded significantly on the corresponding factor for both ability groups. Furthermore, similar to the studies by Purpura (1999), Phakiti (2003, 2006, 2008), Zhang (2018), Zhang and Zhang (2013), and Song and Cheng (2006), it was reported that in both groups cognitive and metacognitive strategies were correlated with each other. However, this correlation was higher in the high ability group. This finding supports Purpura’s (1999) statement that integrating the cognitive and metacognitive strategies plays

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an important role in successful language test performance.

Consistent with Phakiti (2008), Zhang and Zhang (2013), and Lien et al., (2019), it was found that metacognitive strategies affected cognitive strategies directly. For instance, in the high group, PLN, MON, and EVA strategies (metacognitive strategies) were reported to have a direct effect on COM, RET, and MEM (cognitive strategies), respectively; and in the low group, PLN and MON strategies had direct effects on MEM and RET, respectively. These findings converge with previous research (e.g., Purpura, 1999; Phakiti, 2008) validating Bachman and Palmer's (1996, 2010) model of strategic competence in terms of a metacognitive function of human cognition. It can be implied that metacognitive strategies had some regulating function on cognitive strategies in both groups, especially the high one (Purpura, 1999; Phakiti, 2008; Zhang & Zhang, 2013; Zhang, 2018; Lien et al., 2019). Therefore, the results support the Bachman and Palmer's (1996, 2010) theory of strategic competence with *strategic knowledge* and *strategic regulation*. The results have further supported this model in that metacognitive strategies are the core of strategic competence by providing empirical evidence for Bachman and Palmer's (2010) revised language-use model in which cognitive strategies are considered test-takers' peripheral and metacognitive strategies as their focal attributes.

In addition to exploring the relationship between cognitive and metacognitive strategies, this study investigated the test-takers' strategy-use behavior and its effect on their reading test performance. Accordingly, two groups of the test-takers with high- and low-reading abilities were required to sit for a reading test and complete a strategy use questionnaire. The results revealed that both groups used cognitive and metacognitive strategies to optimize their performance on the reading test. Furthermore, analyzing the data through SEM techniques showed that strategy-use behavior in both groups could account for some variance in their reading test performance; however, this behavior was more dominant in the high-ability test-takers and they benefitted more from the use of the strategies during the test.

More indicatively, the results showed that in the high ability group MEM (R^2 = -.12) and COM strategies (R^2 = .1) accounted for reading test performance directly, with the former affecting reading test performance negatively. Moreover, in line with Purpura's (1999) and Lien, et al.'s (2019) study, MEM and COM strategies mainly elucidated the reading test performance and decreased the correlation among other cognitive and metacognitive strategies. Consistent with Song and Cheng's (2006) study, it was revealed that Inference ability was the strongest predictor of reading test performance (ß = .99), and Skimming/Scanning ability was the weakest one. However, this finding diverged from Zhang and Zhang's (2013) study in which test-takers' reading test performance was strongly relied on low-level abilities like lexical and grammatical abilities rather than higher-level ones including inference-making and integration.

Regarding the low-ability group, only RET strategies impacted the reading test performance directly (R^2 = .01); others affected it indirectly. These results imply that the reading test performance does not require more strategy use (Phakiti, 2008) for the low-ability group. Instead, other factors such as language ability and test demands may be necessary for explaining their performance. Moreover, VOC and SKM/SCN ability (ß = .60) strongly predicted reading test performance. This result was in line with Phakiti's (2008) in that the Lexico-Grammatical ability was the strongest predictor of the reading comprehension ability and Zhang and Zhang's (2013) in that test-takers' performance on reading comprehension was predicted by their lexical and grammatical abilities. The reason may be that inference ability is somehow underdeveloped in the low-reading ability test-takers. They mainly relied on their vocabulary knowledge and skimming abilities to understand the passage and "depended more heavily on their ability to decode text at the lexical and syntactic levels, rather than at inferential levels" (Phakiti, 2008, p.259).

Moreover, among the strategies utilized by the high-ability group, MEM strategies were the dominating contributors to the variance of reading test scores. In the low-ability group, it was RET strategies that played such a role. Furthermore, the relationship between strategy-use behavior and the reading test performance for both ability groups supports the interactionist perspective, which considers language test performance as a product of the interaction among different factors including traits, contextual factors, and strategic competence. In line with Phakiti (2008) and Lien et al., (2020), the results showed that reading test variance was explained by test-takers' strategy-use behavior to some extent (up to 12%). There are some reasons for these findings, namely, as Bachman and Palmer (1996, 2010) clarified, factors including communicative language ability, the characteristics of test-takers, and other random factors simultaneously play roles in explaining test-takers' performance. Similarly, as Anderson (2005)

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mentioned, being successful in using strategies depends on whether (1) there is a good match between the strategy and the task; (2) the strategy is well-connected to other strategies or processes in the task; and (3) there is a match between test-takers' learning styles and the strategy.

Other researchers also linked test-takers' good performance to language ability (Bachman & Palmer, 2010), their working memory capacity (Robinson, 2001), levels of language processing automaticity (Segalowitz, 2003), and even the complexity level of the task (Skehan, 1998). Additionally, Rumelhart's (2004) information processing model asserts that readers utilized various tools including their prior knowledge and experience and some strategies to figure out the meaning. As the test-takers in this study were EFL learners with limited vocabulary knowledge, they tried to compensate it by using some strategies. Moreover, as Zhang (2018) mentioned, in a test-taking situation with various information sources and task demands within a specific time limit, test-takers' strategy-use behavior is vaguely distinguished and it leads to their self-report of multiple strategies simultaneously. In brief, splitting cognitive and metacognitive strategies cannot be clearly done since the line between them is fuzzy during test completion (Zhang, 2018). Therefore, since test-takers were not fully aware of the self-assessment and elf-evaluation (Phakiti, 2008), they did not report their actual strategy use. Another reason for the inconsiderable reading test performance variance explained by the strategies is that there may be some methodological and analytical limitations in measuring the strategy-use behavior of the test-takers. Since strategic competence cannot be observed and measured directly, researchers rely mainly on the test-takers' self-reports on their strategy-use behavior. Moreover, since the strategy-use behavior is dynamic in nature and relies heavily on situational factors, its constructed models should be considered with caution (Phakiti, 2008). Similarly, measurement error may also be a reason for the weak effect of strategy use on test performance (Phakiti, 2003). Lastly, in both ability groups, especially in the high group, what affected the reading test both directly and indirectly to a large extent was cognitive strategies. This finding diverged from that of Zhang's (2018), which found that the metacognitive strategies had the main effect. Likewise, compared with the low-ability group, the high-ability one utilized more metacognitive strategies with more substantial reading test performance effects.

This study has several practical, pedagogical, and theoretical implications.

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Firstly, the findings of this study suggest some courses of action for English teachers and university instructors. For instance, it found that both ability groups, particularly the high ability group, employed cognitive and metacognitive strategies to improve their reading test performance. More specifically, inferencing was the strongest predictor of the reading comprehension in the high ability group. This suggests that instruction on this and other influential strategies may help test takers optimize their reading scores and influence their performance on the test positively. On the other hand, however, in the low ability group, it was vocabulary knowledge that predicted reading comprehension strongly. Thus, based on the learners' ability levels, English teachers might decide to design and implement different reading activities or syllabi accordingly. Additionally, this study conducted separated SEM models for different reading-ability groups to investigate the relationships between strategy use and reading test performance. One promising application of this is examining strategy-use behavior across different groups during an actual test-taking process, which has been a point of contention for language testing researchers.

This study also has some theoretical implications. For example, it provided supportive evidence for Bachman and Palmer's (1996, 2010) language ability model. According to this model, language ability encompasses language knowledge and strategic competence. The latter is considered as metacognitive strategies with management function. In their revised model, however, Bachman and Palmer (2010) insert a set of cognitive strategies too. This study reported that both metacognitive and cognitive strategies play a role in enhancing test takers' reading test performance and indicated that both strategies function in conjunction with each other during the actual test-taking situation. This, as a result, yields some empirical evidence for the validation of Bachman and Palmer's (2010) model. An additional theoretical implication of this study deals with defining the construct of L2 reading ability. This study extended the current knowledge on the factorial structure of reading ability and provided empirical evidence in this regard. It found that for the high ability group, inferencing and for the low ability group, scanning and vocabulary knowledge were the underlying factors of the reading ability.

Although this study attempted to examine group-specific strategy-use behavior, the groups were classified only in terms of their reading abilities. Future research is suggested to investigate whether strategy-use behavior is consistent over

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different groups (e.g., male and female) or over time. Similarly, it is strongly recommended for future research to focus on the strategy-use behavior in both test-taking and non-test-taking situations to detect the possible similarities and differences. The complex and unobservable nature of strategy-use behavior needs more explanations and elaborations since it was found that each strategy type may not contribute to improving reading test performance. Similarly, it was reported that less variance of reading test performance was accounted by strategy-use behavior, especially in the low-ability group, so other factors and their contribution merit further examination. Another suggestion is that more items on measuring cognitive and metacognitive strategies in the questionnaire are needed to identify the underlying factors of strategy-use behavior more distinctly. In a nutshell, exploration of strategy-use behavior and distinct classification require joint work with other experts in other fields of study such as language learning, testing, psychology, or even neuro-psychology and linguistics. In conclusion, it is hoped that this study has illuminated L2 learners' strategy-use behavior during actual test-taking situations, both empirically and theoretically.

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