

# Modelling Cognitive and Metacognitive Strategies and Their Relationships to Reading Comprehension Test Performance of Thai High School EFL Learners

Panassanan Kitichaidateanan

Faculty of Humanities and Social Sciences, Mahasarakham University, Thailand

Nithipong Yothachai

Faculty of Education and Human Development, Chaiyaphum Rajabhat University, Thailand

Apisak Sukying\*

Faculty of Humanities and Social Sciences, Mahasarakham University, Thailand

**Abstract**—Cognitive and metacognitive strategies are crucial for enabling reading comprehension and controlling language processing. This study explored the role of these strategies and their contribution to English reading comprehension test performance, as well as the extent of their relationships in reading comprehension outcomes, using Structural Equation Modelling (SEM). A total of 685 Thai high school students were assessed on a standardised reading comprehension test and a six-point Likert-scale questionnaire designed to measure strategy use. The findings indicated that cognitive and metacognitive strategies were positively related to reading test performance. Cognitive strategies, especially those of retrieval and comprehension, served as basic processes underpinning decoding, integration, and the construction of meaning from text. However, metacognitive strategies exerted significant regulatory influence, with direct effects on reading comprehension and indirect effects via cognitive strategy use. The relationship between retrieval and comprehension also emphasised their interrelated roles as components of strategic reading. Both types of strategy contributed significantly to reading comprehension, but only through language knowledge, with the learning processing model showing incremental improvement in strategy use and apparent individual differences as proficiency grew. These results point to the pedagogical importance of developing strategic awareness and self-regulated learning, as well as providing more explicit strategy instruction, and indicate that future research using longitudinal or mixed-methods designs could provide richer information about how strategies are used differently across contexts, age groups, and more advanced proficiency levels.

**Index Terms**—metacognitive strategies, cognitive strategies, reading comprehension, Thai high school students, SEM

## I. INTRODUCTION

Reading is one of the four major language skills and is central to students' comprehensive academic improvement and language learning. In addition to the reading passages, including information that is related to other subjects, it is also essential for learners in English as a Foreign Language (EFL) contexts to read general, non-academic texts in terms of learners' academic success and development of other language skills such as writing, speaking, listening, and vocabulary advancement because their exposure to authentic English input at school may be quite limited. EFL learners have difficulties understanding written material, making inferences, and generalising information from text to everyday situations. A lack of vocabulary, grammatical knowledge, and background information often compounds these difficulties.

This study investigates different reading strategies that have been shown to facilitate comprehension. Language testing research has produced a rich profile of factors affecting reading comprehension, including linguistic knowledge, processing abilities, and strategic behaviour (Grabe, 2009; Grabe & Stoller, 2020; Kitichaidateanan & Sukying, 2025; Phakiti, 2007). Of these, reading strategies learners consciously direct behaviour that they enact to facilitate the understanding of what they read have been demonstrated to be important (particularly for L2 readers of varying proficiency and learning profiles). Skilled readers are active and self-directing, modifying their reading strategies according to the difficulty of a text, the purpose of the reading (e.g., scanning content or thoroughly learning about a topic), the nature of the task requirements, and progress toward achieving comprehension.

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\* Corresponding Author. Email: [apisak.s@msu.ac.th](mailto:apisak.s@msu.ac.th)

Reading strategies are typically broken down into two main categories: cognitive and metacognitive strategies. Cognitive strategies are the mental processes used to make sense of what we read (Kitichaidateanan & Sukying, 2025; O'Malley & Chamot, 1990; Oxford, 2011; Phakiti, 2003, 2006; Sari, 2016; Zhang, 2018; Zhang & Guo, 2020). These are, for example, prediction, summarisation, inference, translation, and the integration of new information with old. Metacognitive strategies, however, are higher-order control processes that empower learners to plan, monitor, and evaluate their own cognitive strategies (Cai et al., 2022; Kitichaidateanan & Sukying, 2025; Noipa & Phusawisot, 2025; Oxford, 2017; Phakiti, 2003, 2006; Zhang, 2018; Zhang & Guo, 2020). Readers who are increasingly aware of their comprehension through metacognitive control can more effectively identify breakdowns and adapt their approach as needed. While metacognitive processing systems may initially seem to retard reading for meaning, they will ultimately lead most learners toward a more effective and independent mode of reading.

Although extensive international research has been conducted, few studies have examined the interaction between cognitive and metacognitive strategies in relation to the reading performance of Thai high school EFL learners. Although earlier studies (Kitichaidateanan & Sukying, 2025; Noipa & Phusawisot, 2025; Phakiti, 2003, 2006; Sukying, 2021) have found positive correlations between strategy use and reading comprehension, ongoing research is needed to disambiguate how these strategies might work together within Bachman and Palmer's (2010) strategic competence construct. To fill this gap, the current study seeks to model the mediating roles of cognitive and metacognitive strategies and their implications for test performance in a reading comprehension test, using Structural Equation Modelling (SEM). The following questions guide this study.

1. What are the relationships between cognitive and metacognitive strategies and reading test performance?
2. To what extent do cognitive and metacognitive strategies affect reading comprehension test performance?

## II. LITERATURE REVIEW

### A. *Communicative Language Ability*

Communicative language ability (CLA) is a multidimensional, dynamic, and context-dependent construct that pervades the successful use of a second language (L2) in real communicative situations (Bachman & Palmer, 2010; Cai & Zhao, 2022; Purpura, 1999). It is not developed or performed in a social and cultural vacuum, where its development would also be complicated (McNamara, 1996). Over the past decades, applied linguistics and language testing scholars have advanced several important models to conceptualise CLA (Chomsky, 1965) and the ways in which linguistic knowledge interfaces with contextual needs and communicative intentions.

Among the most influential and widely referenced models is the taxonomy by Bachman and Palmer (1996), which classifies CLA into two linked components: language knowledge and strategic competence. Language competence is the knowledge of language held in memory, while strategic competence is the cognitive tools that help program and organise, monitor, and evaluate what has been produced. In their 2010 revision, Bachman and Palmer developed the model further to include language processing capacities/memory functions, but also (1) cognitive methods of knowing, (2) topical learning and knowledge, as well as (3) affective schemata/traits and social attributes that affect test performance and external uses of language.

One of the critical questions in language testing is to what degree these tasks tap into learners' underlying language ability and how well scores validly represent that ability (Bachman, 2000; Purpura, 2014). Within this framework, strategic competence, as operationalised in metacognitive regulation, is central to the management of language processing. Thus, the current study uses Bachman and Palmer's (2010) model to examine the role of metacognitive knowledge in its interaction with L2 proficiency and reading test performance.

### B. *Strategy Use*

Strategic processing is a central part of strategic competence in human information processing and is closely related to metacognitive regulation. In language learning, strategic competence is typically implemented through a set of metacognitive strategies that plan, monitor, and evaluate cognitive operations. During active processing in these higher-order processes, learners monitor and control the lower-level cognitive activities of information organisation and integration, thereby increasing their ability to process complex language tasks. One crucial difference between strategic and automatic processing is awareness; whereas automatic processes occur quickly, with little attentional demand, strategic processing is conscious, goal-driven, and intentional.

The dynamic interplay between automatic and strategic processing is evident in L2 reading comprehension. Readers rely on both lower- and higher-level processes to build meaning, alternating flexibly between unconscious and conscious processing as the demands of activities change (Alderson, 2000; Phakiti, 2007; Song & Cheng, 2006). Automatic processes support rapid retrieval of word forms and grammatical structures, as well as the development of text coherence. Heterarchical processing is mandatory when learners encounter new words, complex grammar, or comprehension breakdowns. Strategic processes, for example, inferencing, problem-solving, monitoring comprehension of text, and repairing misunderstandings, are influential contributors to successful (and long-term) reading development.

Phakiti (2007) defines strategy as one of the essential components of the control processing system, governing, controlling, and regulating cognitive events in language use. Strategies in this sense are not subconscious, haphazard, or

intuitive, but rather partly conscious, intentional, and voluntary activities used to facilitate communication and learning. As a result, the strategic use of the role is highly regarded as an indicator of successful L2 performance.

Cognitive strategies are essential tools that enable learners to consciously control, manipulate, and build meaning during L2 learning (Kasimi, 2012; Song & Cheng, 2006). These strategies assist with reading comprehension, storing and recalling information—all key components of successful L2 development (Macaro, 2006; Phakiti, 2003; Song & Cheng, 2006). According to the revised language use construct proposed by Bachman and Palmer (2010), cognitive strategies are understood as concrete, observable behaviours used during the performance of a language task. Although classified as “peripheral” rather than “focal,” they are, however, essential for accounting for variance in language test scores and for linking test achievement to real-world proficiency.

The conceptual framework of cognitive strategies is cognitive learning theory, which holds that learning consists of actively managing (manipulating, organising, transforming) inputs to improve comprehension and memory. In this view, cognitive strategies are conscious mental operations that allow learners to process language information more efficiently (Anderson, 2008; Anderson & Pearson, 1984; O’Malley & Chamot, 1990; Kitichaidateanan & Sukying, 2025; Macaro, 2006). Wenden (1991) and Purpura (1999) also describe cognitive strategies as mental operations and observable behaviours that assist in processing, storing, and retrieving linguistic information. Recent empirical studies have also provided additional evidence of their importance for understanding what is read: students who actively activate relevant schema, attend to grammatical signals, make inferences from context, and monitor their comprehension often achieve better comprehension outcomes (Phakiti, 2016; Purpura, 2014; Sukying, 2021). Collectively, these theoretical and empirical findings position cognitive strategies as core processes by which learners make sense of textual information, connect new information to existing cognitive structures (i.e., mental models), and construct coherent meaning during reading.

Metacognitive strategies operate at a superordinate/executive level and concern the planning, monitoring, and management of learning operations. They are global processes that guide and regulate lower-level cognitive processes (Sheorey & Mokhtari, 2001). To this date, some controversy exists among researchers in the field regarding how specific strategies can be categorised, as predicting meaning or using textual cues, for example, is placed in either the cognitive or the metacognitive strategy category (Phakiti, 2003). Cognitive strategies mainly facilitate processing information, and metacognitive strategies are responsible for controlling and utilising this processing to comprehend (Anderson, 2009; Kitichaidateanan & Sukying, 2025; Purpura, 2014).

A second important consideration is whether strategies are trait- or state-based. Previous studies treated strategies as stable, trait-like preferences, whereas more recent research (Oxford, 2017; Phakiti, 2008; Sukying, 2021) has shown that strategy use is dynamic, situational, and task-dependent. In line with this view, the present study takes a state-based perspective by investigating learners’ actual deployment of cognitive and metacognitive strategies during reading test tasks.

By framing metacognitive strategies as dynamic, context-dependent regulatory procedures, the present study aligns with contemporary theoretical and empirical trends, emphasising the adaptive nature of strategy use and its pivotal role in L2 reading success.

### C. *EFL Reading*

Reading in a second language (L2), especially in EFL, is a complex and multifaceted cognitive activity influenced by various linguistic and non-linguistic factors. It demands decoding, as well as complete control over syntax, semantics, discourse structures, and strategic activity based on reading processes. Successful EFL reading is also contingent on the building of coherent mental representations of text, triggering the activation of both topical and background knowledge, and employing metacognitive control to oversee and regulate comprehension.

Many factors affect EFL reading ability. Factors related to the reader include the influence of the first language, English experience, L2 reading proficiency, motivation, and awareness of reading strategies. Text-based variables, such as topic familiarity, text difficulty, genre, and the addition of multimodal support (e.g., images), also interact with comprehension outcomes. Contextual factors, such as what type of text readers would usually encounter (e.g., newspaper vs. academic), could scaffold or impede comprehension depending on readers’ familiarity with it (Alderson, 2000; Phakiti, 2007). The cognitive processes involved in L1 and L2 reading are similar in many ways (Grabe & Stoller, 2020; Song & Cheng, 2006); however, due to language limitations, increased processing load, and lower automaticity, EFL reading is often slower and less fluent. Research evidence has consistently indicated that reading in EFL involves an interactive, dynamic process influenced by learners’ interlanguage state, learner differences, and the broader social context of instruction (Alderson, 2000; Kitichaidateanan & Sukying, 2025; Koda, 2005; Noipa & Phusawisot, 2025).

In light of these complexities, an examination of EFL reading processes is a crucial requirement if we are to determine what readers do when they read and how test tasks tap into this cognitive and metacognitive activity. Thus, in response to these gaps, this study, using structural equation modelling (SEM), investigates how relationships exist among cognitive and metacognitive strategy use, strategic knowledge, regulatory processes, and their performances on the English reading test for a group of high-school EFL learners in Thailand.

### III. RESEARCH METHODOLOGY

#### A. Participants and Setting

The participants in this study were 685 Grade 12 students aged 17-18 from a public high school in northeastern Thailand. The participants' English skills ranged from advanced beginners to upper-intermediate, and their families came from various socioeconomic and occupational backgrounds. All participants had completed at least 10 years of EFL courses, as required by the Office of the Basic Education Commission (Ministry of Education of Thailand, 2008). They attended four 50-minute English classes with EFL teachers and one class with native English speakers per week, with class sizes ranging from 20 to 45 students. The students were familiar with effective reading strategies and continued their English studies at a higher academic level. Convenience sampling was used to select participants for this study because it is efficient for quickly gathering basic information (Dörnyei, 2007; Sekaran & Bougie, 2016).

#### B. Research Instruments

##### (a). Reading Comprehension Test

The Reading Comprehension Test (RCT) is a standardised measure designed to assess the reading comprehension abilities of Thai secondary school learners. The test was constructed according to good language testing practices, and consultation with five expert EFL teachers ( $\geq 10$  years' experience) had taken place. The RCT is composed of 60 items on two subtests: (a) a 20-item rational cloze designed to evaluate lexico-grammatical reading ability and (b) a comprehension section assessing prominent idea recognition, supporting detail recognition, and inferencing.

A pilot study was conducted on a sample of 168 non-sample students, establishing content validity through Item-Objective Congruence (IOC). Items that did not meet the 0.60 criterion were revised or eliminated to maintain high instructional alignment. The item analysis revealed an adequate difficulty and discrimination, with all items higher than the minimum of .20 in the case of the discrimination index ( $r = .51$ ). Difficulties were calibrated to ensure equal distribution of 25% difficult, 50% moderate and 25% easy items.

To determine whether all instrument subscales showed normal distributions, mean scores and skewness values were analysed. Cronbach's alpha for the reliability of the scale was  $\alpha = .94$ , indicating excellent internal consistency. The test, constructed in gap-fill and multiple-choice formats within an hour, has been systematically developed to form a valid, reliable, and psychometrically robust measure of EFL reading comprehension for Thai high school students.

##### (b). A Cognitive and Metacognitive Strategy Use Questionnaire

The questionnaire was adapted from Phakiti's (2007) validated instrument and incorporated items from established research on language learning strategies (Sukying, 2021), reading strategies (Mokhtari & Reichard, 2002; Phakiti, 2003, 2008), and test-taking strategies (Anderson, 1991; Anderson et al., 1991; Cohen & Upton, 2006). The theoretical foundation was human information-processing theory, distinguishing between cognitive structures (sensory input, working memory, long-term memory) and functional processes (comprehension, retention, retrieval, and executive control).

To minimise linguistic load, the questionnaire was administered in Thai. Items were rated on a six-point Likert scale (0-5), consistent with Phakiti's (2007) recommendations for capturing learners' strategy use. The instrument contained 51 items across six subscales: comprehending (6), memory (8), retrieval (7), planning (10), monitoring (14), and evaluation (6). Completion time ranged from 10 to 15 minutes.

A pilot study with 168 non-sample students confirmed strong reliability. Cronbach's alpha coefficients for the subscales ranged from .81 to .97, with an overall coefficient of .99, demonstrating excellent internal consistency. These results indicate that the instrument is a psychometrically robust and well-validated measure of learners' cognitive and metacognitive strategy use.

#### C. Data Collection

The students and their parents provided written consent prior to data collection, after formal approval from the school authorities. All participants completed the RCT during the first week of class. The test lasted one hour and was conducted in a standardised testing classroom. Two experienced English teachers administered each test as proctors to guarantee standardised execution and compliance with the avoidance of using strategies.

The Cognitive and Metacognitive Strategy Use Questionnaire was administered immediately at the end of the Reading Comprehension Test to evaluate participants' strategy use throughout testing. To minimise the influence of quality on data collection, responses from participants who provided an alternative answer to 10 or more consecutive RCT items were excluded. These responses were viewed as non-serious.

#### D. Data Analysis

Participants' performance and strategy use were initially summarised using descriptive statistics (means and standard deviations), followed by inferential analysis to address the research questions. The application used two analysis targets: (1) to model and validate reading comprehension test performance with the Structural Equation Modelling (SEM) process;

and (2) to detect and treat examinees who do not fit to ensure analytical soundness. Problematic responses were omitted before SEM to reduce measurement error and improve model fit.

The dimensionality of the item groups was verified in the first stage through Confirmatory Factor Analysis (CFA), yielding composite variables with adequate measurement properties. Additionally, we conducted outlier diagnostics to identify observations that could have an undue impact on parameter estimates.

SEM adopted a single-group approach to test the measurement and structural components of the hypothesised model. This procedure comprised model specification, maximum-likelihood parameter estimation, and fit testing based on multiple criteria. These measures led to a thorough examination of the hypothesised relationships between the use of cognitive and metacognitive strategies and EFL reading performance, yielding valid and reliable inferential conclusions.

#### IV. RESULTS

##### A. Descriptive Statistics

Table 1 presents descriptive statistics on the use of cognitive and metacognitive strategies reported by Thai high school students in the reading section of a comprehension test. In sum, participants reported a moderate frequency of strategy use on average (M = 4.13, SD = 0.81). That is, reading comprehension (74.64%) was the most common strategy employed; monitoring (69.86%), memory (69.73%), and retrieval (68.63%) and planning strategies were also frequently used (67.53%). Comparison as an evaluating method was the least frequently used strategy (62.42%). These results suggest that Thai EFL learners do employ practical strategies to read in meaningful ways and to monitor their reading.

Learners reported using overall cognitive strategies (M = 4.26, 71%) more frequently than overall metacognitive strategies (M = 4.00, 66.6%) across the two main factors. This result indicates that, as a mode of learning, cognitive strategies are more frequent than higher-level control strategies of the processes involved in actual text reading. These findings also provide evidence that Thai high school learners are more balanced in their adoption of both sides, with a cognitive bias toward reading comprehension. Their low use of metacognitive strategies reflects a lack of self-regulation, and a high level of cognitive processing demonstrates the role of direct decoding.

TABLE 1  
OVERALL STRATEGY USE OF THAI HIGH SCHOOL LEARNERS

Strategy use	Mean	%	S.D.
Comprehending	4.48	74.64	0.65
Memory	4.18	69.73	0.95
Retrieval	4.12	68.63	1.04
<b>Cognition</b>	<b>4.26</b>	<b>71.00</b>	<b>0.84</b>
Planning	4.05	67.53	0.76
Monitoring	4.19	69.86	1.02
Evaluating	3.75	62.42	0.81
<b>Metacognition</b>	<b>4.00</b>	<b>66.60</b>	<b>0.81</b>
<b>Overall</b>	<b>4.13</b>	<b>68.80</b>	<b>0.81</b>

Note: N= 685

Table 2 presents the reading comprehension test (RCT) performance of Thai high school students across all components. The highest average value was also achieved for LexGrRA2 (41.90%), immediately after TxtCOMP (40.85%) and LexGrRA1 (40.67%). Note that although some fluctuations were observed between sections, all mean scores were below half of the maximum score that could be attained, which is indicative of the very challenging nature of both lexico-grammatical and text comprehension tasks for learners.

The average test score at the overall level was 40.99%, suggesting low reading comprehension among Thai high school participants. Though students showed some ability to interpret lexico-grammatical information and derive meanings from texts, they were not proficient enough to understand the readings effectively. These findings point to ongoing difficulties with both word-level processes (e.g., vocabulary and grammatical decoding) and comprehension skills (e.g., inferencing, integrating ideas, and understanding relationships between texts). Overall, the findings highlight the importance of targeted instructional intervention to develop related skills in foundational and integrative reading for these Thai high school readers.

TABLE 2  
READING COMPREHENSION TEST PERFORMANCE OF THAI HIGH SCHOOL LEARNERS

Reading comprehension test	Total	Mean	%	S.D.	Min	Max
LexGrRA1	10	4.07	40.67	2.293	0	10
LexGrRA2	10	4.19	41.90	2.483	0	9
TxtCOMP	40	16.34	40.85	6.995	5	32
<b>RCT</b>	<b>60</b>	<b>24.60</b>	<b>40.99</b>	<b>10.536</b>	<b>9</b>	<b>46</b>

Note: LexGrRA = Lexical-Grammatical reading ability, TxtCOMP = Text comprehension ability  
LexGrRA1, LexGrRA2 and TxtCOMP = Reading Comprehension Test (RCT)

##### B. Relationship Between Strategy Use and Reading Comprehension Test Performance

Before testing the proposed structural relationships, individual measurement models were checked for model fit and the possibility of misspecification within the overall latent SEM. Each model was specified and estimated for all observed variables using the maximum likelihood method, applicable to ordinal-scale data and approximately multivariate normal data. The maximum likelihood estimation reduces bias in parameter estimates by using a population-replicating variance-covariance matrix. Goodness-of-fit was tested using chi-square values, standardised residuals, and fitness indices well established in the literature and supported by both theoretical and empirical reasons.

After obtaining good measurement models, the structures were examined. The effect of metacognitive strategies on cognitive strategies was first estimated, and then the impact of cognitive strategies on reading comprehension performance was assessed. The first model (speculated) was not confirmed, and this omission left us wondering what prompted us to study further models. Conditional error correlations were added to the model, following Bentler (2006), to account for correlated measurement errors, thereby improving fit and explanatory power.

A satisfactory fit was obtained with the final SEM model (Figure 1). Although the Chi-square test was statistically significant ( $\chi^2 = 99,053.55$ ,  $p < 001$ ), and, as is common with large samples, the remaining showed a close fit:  $\chi^2/df = 2.95$ , CFI = .90, TLI = .91, RMSEA = .05 (90% CI = .046-.054), and SRMR = .049. These values met the standard acceptable-to-good fit criteria (Hair et al., 2019). All parameter estimates were significant ( $p < .05$ ), supporting the hypothesised relationships.

Table 3 summarises the standardised path coefficients and  $R^2$  for the exogenous constructs.  $R^2$  was used as an effect-size estimator, representing the proportion of variance explained in the dependent variables. For interpretive sense-making, the observed events were coded descriptively (i.e., PLA1 = plan before reading). In sum, the results offer solid empirical support for an indirect effect of metacognition on reading comprehension through its regulation of cognitive strategy use and testify to the essential role of strategic processing in Thai high school students' comprehension performance.

TABLE 3  
STANDARDISED PARAMETER ESTIMATES FOR STRATEGY USE AND READING COMPREHENSION TEST PERFORMANCE

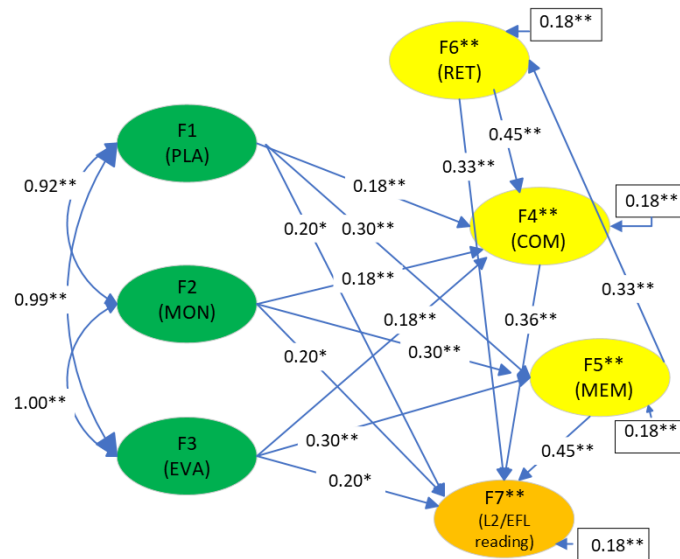
Observed variable	Label	Loading	Error	R <sup>2</sup>	
Item1	PLA1	plan before reading	0.94*F1	+0.12 E1	0.88
Item2	PLA2	understand the goal of the task	0.84*F1	+0.29 E2	0.71
Item3	PLA3	think about what to achieve	0.83*F1	+0.31 E3	0.69
Item4	PLA4	know what to do and how to do	0.80*F1	+0.35 E4	0.65
Item5	PLA5	realise whether or not plans work well	0.82*F1	+0.33 E5	0.67
Item7	PLA7	identify purposes	0.76*F1	+0.42 E7	0.58
Item9	PLA9	highlight the length and arrangement of a text	0.75*F1	+0.43 E9	0.57
Item11	COM1	look for the main idea in the first sentence	0.99*F4	+0.02 E11	0.98
Item12	COM2	figure out the link to the main ideas	0.99*F4	+0.01 E12	0.99
Item15	COM5	Predict what will happen next	0.97*F4	+0.06 E15	0.94
Item16	COM6	interpret the author's intended message	0.97*F4	+0.05 E16	0.95
Item17	MEM1	use typographic features	0.99*F5	+0.04 E17	0.96
Item18	MEM2	reread the text to understand it better	0.90*F5	+0.20 E18	0.80
Item20	MEM4	try to decipher hidden concepts	0.88*F5	+0.22 E19	0.78
Item25	RET1	use prior knowledge	0.94*F6	+0.04 E25	0.96
Item26	RET2	aware of relevant information	0.95*F6	+0.04 E26	0.96
Item27	RET3	use context clues	0.97*F6	+0.06 E27	0.94
Item28	RET4	use the grammar rules	0.97*F6	+0.07 E28	0.93
Item29	RET5	know root words	0.96*F6	+0.07 E29	0.93
Item30	RET6	infer the information	0.98*F6	+0.04 E30	0.96
Item31	RET7	comprehend from prior knowledge	0.90*F6	+0.19 E31	0.81
Item32	MON1	aware of the time limitations	1.00*F2	+0.01 E32	0.99
Item33	MON2	aware of the amount of reading and tasks	0.84*F2	+0.29 E33	0.71
Item34	MON3	aware of when and where it is confusing	0.88*F2	+0.23 E34	0.77
Item35	MON4	know when you get anxious or uninterested	0.85*F2	+0.28 E35	0.72
Item36	MON5	know when losing attention	0.78*F2	+0.38 E36	0.62
Item37	MON6	double-check, or self-reflect	0.83*F2	+0.32 E37	0.68
Item38	MON7	aware of whether or not you comprehend the text	0.86*F2	+0.25 E38	0.75
Item39	MON8	pay attention to the necessary detail	0.86*F2	+0.25 E39	0.75
Item40	MON9	adapt reading speed	0.88*F2	+0.32 E40	0.68
Item41	MON10	manage the time	0.78*F2	+0.39 E41	0.61
Item42	MON11	correct the mistake effectively	0.81*F2	+0.34 E42	0.66
Item43	MON12	adjust reading speed	0.80*F2	+0.35 E43	0.65
Item44	MON13	adapt the pace of answering	0.80*F2	+0.36 E44	0.64
Item45	MON14	use context clues	0.84*F2	+0.30 E45	0.70
Item46	EVA1	prove comprehension of the task	0.90*F3	+0.19 E46	0.81
Item48	EVA3	evaluate reading strategies	0.53*F3	+0.72 E48	0.28
V52	LexGrRA1	Lexical-Grammatical reading ability1	0.53*F7	+0.72 E52	0.87
V53	LexGrRA2	Lexical-Grammatical reading ability2	0.53*F7	+0.72 E53	0.92
V54	TxtCOMP	Text comprehension ability1	0.53*F7	+0.72 E54	0.90
F4	Com	Comprehending strategies	0.18*F1 +0.18*F2 +0.18*F3 +0.45*F6	+0.06 D1	0.94
F5	Memory	Memory strategies	0.30*F1 +0.20*F2 +0.30*F3	+0.18 D2	0.82
F6	Retrieval	Retrieval strategies	0.20*F1 +0.20*F2 +0.20*F3 +0.33*F5	+0.18 D3	0.82
F7	RCT	Reading strategies	0.36*F4 +0.22*F5 +0.33*F6	+0.22 D4	0.78

In the final SEM model (Figure 1), there were unidirectional relationships among memory, retrieval, and comprehension strategies, which did not support our initial supposition of reciprocal relationships. Memory strategies directly predicted retrieval strategies ( $\beta=.33, R^2=.11$ ). They indirectly affected comprehension strategies then the recovery ( $\beta=.15, R^2=.02$ ). The retrieval strategies had the strongest effect on comprehending strategies ( $\beta=.45, R^2=.20$ ), which positions retrieval as the single most crucial vessel connecting represented (stored) knowledge to meaning making.

The measurement model well represented cognitive strategies. Understanding strategies (e.g., understanding main ideas, connecting information, interpreting the author's purpose) and retrieval strategies (e.g., activating prior knowledge, using grammar rules, and using context clues) exhibited very strong factor loadings (.90-99), explaining 93-96% of the variance. Memory strategies (i.e., rereading, typographic cues) were also relatively strong, accounting for 85% of the variance.

Metacognitive strategies displayed greater variability. Both planning (goal setting, task organisation) and monitoring (time management, attention regulation, self-reflection) explained 71% of the variance, with evaluating strategies the weaker construct (54%). This indicates that learners are constantly planning and monitoring their reading, but do not

evaluate their own performance. These results suggest that comprehension in Thai high school learners is mediated by retrieval strategies that modulate the influence of memory on comprehension. Whereas cognitive strategies were highly reliable, metacognitive regulation, including evaluation, was inconsistently supported, suggesting a potential area for pedagogical development.



Chi-square=99053.55, df=742, p=0.000, TMSEA=0.446

Figure 1. The Hypothesised Model of the Relationships of Strategy Use and Reading Comprehension Test Performance

Note: F1 (PLA) = Planning strategies F2 (MON) = Monitoring strategies,  
F3 (EVA) = Evaluating strategies F4 (COM) = Comprehending strategies  
F5 (MEM) = Memory strategies F6 (RET) = Retrieval strategies  
F7 (L2/EFL reading) = Reading Comprehension Test

## V. DISCUSSION

The current study examines the associations among the use of cognitive and metacognitive strategies for reading comprehension among Thai high school students by investigating the predictive power of these strategies on reading comprehension and their interrelations using structural equation modelling (SEM). The results offer a holistic view of the functions of strategies in reading and how they influence learners' test performance. In sum, the findings suggest that strategy use does have some impact, albeit an indirect one, on reading comprehension.

The present study's results indicated that metacognitive and cognitive strategies were significantly positively associated with reading variables. This finding can probably be attributed to the fact that students who practised these strategies more frequently performed at higher levels of reading comprehension. Cognitive processes like inference, summarisation, retrieval, and activation of prior knowledge are dynamic mechanisms that specifically contribute to making sense of what one reads by aiding the reader in decoding information from written texts and making interpretative sense. Metacognitive strategies also mediate performance, as they allow readers to plan their reading, monitor their comprehension, and review their progress, thus controlling cognitive strategy use to maximise efficiency. The relationships between the two types of strategies found are all positive, indicating that comprehension can be explained by a general processing capacity beyond what is explicable in terms of handling linguistic analogies, particularly in terms of knowing relations. Together, these findings underscore the interactional nature of cognitive and metacognitive strategies in promoting comprehension and stress the need to focus on strategic knowledge and self-regulation skills of learners to improve overall reading ability.

The SEM analysis revealed that metacognitive strategies had direct and indirect influences on reading comprehension through cognitive strategy use. Specifically, students who planned their reading, monitored comprehension, and evaluated their progress were more likely to use specific cognitive strategies, such as inferring, to better understand the text. While the direct effects of strategic behavior ( $\beta = .58-.86$ ), although these effects were significant and in favor of their predictive capacities, they were smaller than language knowledge suggesting that strategy use enhances performance but cannot supplant the pivotal role of language mastery (Kitichaidateanan & Sukying, 2025; Lin et al., 2019; Phakiti, 2008; Purpura, 1999; Song, 2005).

The direct and indirect effects of metacognitive strategies on reading comprehension via cognitive strategy use might be explained by the fact that metamemory processes involved in actively controlling, orchestrating, monitoring, and regulating reading are critical, multifaceted categorical variables that determine learners' reading performance. This direct effect is interpreted to mean that learners who plan their reading, monitor what they have read, and evaluate the progress of their understanding are successful in comprehension, irrespective of the cognitive strategies used. Through these

regulatory behaviours, learners can more effectively establish reading goals, recognise when comprehension has broken down, and enact repairs that directly contribute to their understanding of the text.

The mediating effect indicates that metacognitive strategies support and consolidate the application of cognitive strategies. The SEM results showed that students who utilised more metacognitive regulation also tended to employ appropriate cognitive strategies, including inferring meaning, retrieving relevant knowledge, summarising main ideas, and integrating text information with their prior knowledge. Once activated, these cognitive processes provided direct access to learners' understanding. Hence, the relationship between metacognitive strategies and reading is very complex, as they contribute not only to their own regulatory role but also to the more effective utilisation of cognitive strategies.

Taken together, these routes suggest that metacognitive strategies constitute a transtheoretical control system that regulates cognitive processing in reading. Their integrated direct and indirect effects illustrate the complexity of successful comprehension and underscore why learners need explicit instructional support in regulating their strategy use. Thus, building metacognitive awareness and self-regulated learning abilities has the potential to improve reading comprehension by increasing readers' ability to monitor comprehension and to deploy cognitive strategies more effectively.

The structural relationships between cognitive strategies demonstrated a clear hierarchical pattern, in which memory processes had a significant impact on retrieval, and retrieval had an overwhelming effect on comprehension. This hierarchy implies that retrieval is the central cognitive process of reading, showing that good comprehension depends less on simple memorisation and more on the capacity to retrieve, activate, and use stored linguistic and contextual knowledge during real-time language processing. This reading is consistent with Anderson's (2009) conceptual understanding of reading as a form of information processing in which retrieval is the first and necessary process for meaningful comprehension of text. It is also in line with the notion that strategic L2 use and controlled processing are essential for handling reading tasks and enhancing comprehension performance (Kitichaidateanan & Sukying, 2025; Phakiti, 2003, 2008; Zhang et al., 2014). In sum, these findings suggest that although several cognitive strategies contribute to reading comprehension, they are not equivalent; retrieval is the primary mechanism by which memory resources are converted into a coherent understanding of the text.

Metacognitive strategies also showed a coherent internal structure, with the shared variances among planning, monitoring, and evaluation being extreme. Monitoring was also the most robust factor, in line with Oxford's (2017) S<sup>2</sup>R model, which regards monitoring as a key strategy for governing and modifying success strategies. The evaluative dimension, however, was the weakest, with reiterations of the reported difficulties in self-assessment with second language learners (Sheorey & Mokhtari, 2001). This indicates that instruction should place greater emphasis on developing students' metacognitive knowledge and self-assessment capacity.

The results have significant pedagogical implications. Since retrieval strategies are essential to language comprehension, reading instruction should focus on activities that enhance inferencing, the use of context clues, and the activation of background knowledge. The poor scores on evaluative strategies further highlight the importance of formal, explicit self-evaluation practice to make learners more aware of their progress and to enable them to modulate their strategic decisions accordingly. Moreover, the observed stability and generalizability in strategy use imply that continued efforts should be made to advance refined, integrated-strategy instruction that aims to mediate both cognitive and metacognitive components, thereby supporting learners in becoming more flexible in applying strategies across tasks and contexts.

Overall, this study extends the current research literature by establishing a comprehensive SEM model that considers the dynamic relationship between cognitive and metacognitive strategies in EFL reading performance. The findings support the facilitating, though not central, role of strategies in L2 processing, provide further evidence for language knowledge as a dominant influence on this sort of task, and demonstrate that involvement in retrieval and monitoring is essential. The results extend our understanding of the strategic processing of L2 reading and offer pedagogical implications for strategy-based instruction in EFL settings.

## VI. CONCLUSION

The present study used SEM to investigate the relationships between cognitive and metacognitive strategies and reading comprehension among Thai high school students. Results suggested that cognitive strategies were hierarchically arranged, with memory supporting retrieval, which, in turn, was the central mechanism underlying comprehension. This study indicates the importance of retrieval in constructing meaning from text. Metacognitive strategies, planning (planning in what you are going to say), monitoring (paying attention to one's speaking) and evaluation (assessing one's speaking), were also highly correlated; only the dimension of evaluation was identified as the least used by learners. Cognitive and metacognitive strategies significantly affected reading and tests through language knowledge, which mediated this effect in accordance with Bachman and Palmer's (1996) model. Taken together, these findings also underscore the importance of metacognitive regulation in the reading process and its influence on the strategic control of cognitive processes.

The results provide several practical and methodological insights. From a pedagogical point of view, they support the practice of explicit strategy-based instruction, which develops both cognitive and metacognitive processes. Instruction should focus on techniques that improve retrieval, such as activating background knowledge and inferring and using context clues. Still, learners should also be given tools to monitor their reading comprehension efforts more analytically.

The development of more conscious metacognitive awareness may also have implications for greater learner independence and greater effectiveness in dealing with texts. Methodologically, this research demonstrates the usefulness of SEM for more precisely capturing the interplay among reading variables and generates a testable model for further studies of strategic behaviour in reading.

Several limitations should be acknowledged. The sample was limited to Thai high school EFL students, so the results cannot be generalised directly to other situations, ages, or proficiency levels. Despite their accuracy, multiple-choice reading comprehension tests and Likert-scale questionnaires can fail to provide a complete analysis of reading comprehension or strategy use. Other test formats or task types may provide different insights. Additionally, the potential contribution of gender differences in strategy use and language development, widely documented across L2 research, could not be addressed with the available data, constraining a more complete description of learner variability.

A further direction for research is to investigate the impact of other assessment tasks (e.g., open-ended tasks, integrated reading and writing assessments, or think-aloud protocols) on language learners' strategy use and reading performance. Studies with a longitudinal, mixed-methods design might offer more insight into the development of these cognitive and metacognitive strategies. Future studies should examine gender and other language skills to better understand variation in strategy use across learner characteristics and proficiency domains. Lastly, intervention studies that systematically provide participants with training in evaluation and monitoring would help enhance strategic competence and promote autonomous learning in EFL settings.

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**Panassanan Kitichaidateanan** is a high school English teacher in Khon Kaen and a PhD student in the English Language Teaching Programme at Mahasarakham University, Thailand. Her academic interests include language testing, L2 reading, vocabulary acquisition, SLA, and teaching methodology, reflecting her commitment to advancing English language learning and teaching. Her email is [muikitichai@gmail.com](mailto:muikitichai@gmail.com)

**Nithipong Yothachai** works as a university lecturer in the English Education Program at the Faculty of Education and Human Development at Chaiyaphum Rajabhat University, Chaiyaphum, Thailand. His research interests include English language teaching, vocabulary acquisition, SLA, teaching methodology, academic writing, and linguistics. His email is [nithiyo@gmail.com](mailto:nithiyo@gmail.com)

**Apisak Sukying** (PhD) is an assistant professor and the Director of the PhD Program in English Language Teaching (ELT) at the Faculty of Humanities and Social Sciences, Mahasarakham University, Thailand. He earned his PhD in TESOL from the University of Sydney, Australia. His interests include L2 vocabulary acquisition and development, L2 vocabulary assessment, SLA, learner strategies, and academic writing. His email is [apisak.s@msu.ac.th](mailto:apisak.s@msu.ac.th)