Language Related Research
E-ISSN: 2383-0816
https://lrr.modares.ac.ir
https://doi.org/10.29252/LRR.12.5.16
DOR: 20.1001.1.23223081.1400.12.5.4.8

Tarbiat Modares University

Vol. 12, No. 5
pp. 433-462
November & December 2021

Received: 15 July 2020
Received in revised form: 21 August 2020
Accepted: 18 October 2020

Exploring Cognitive Activation Writing Strategies among Iranian English Language Teachers

Mahnaz Mostafaei Alaei[1], *Mohammad Hassanzadeh* [2]*, & *Masoomeh Masoudi*[3]

Abstract

In order to engage students in higher-level thinking, cognitive activation (CA) strategies have been advanced and utilized in mathematics. CA develops when learners are challenged, confronted with conflicts, asked to think and explain clearly on their learning, and realize connections between new and previous content. Extending the theme to English language teaching (ELT), this study investigated Iranian English language teachers' knowledge and practice of cognitive activation writing strategies (CAWS). In so doing, a model was proposed based on a questionnaire that was developed and validated in the present study. Through this scale, knowledge and practice of CAWS by 213 English as a foreign language (EFL) teachers were explored. During a pilot phase, the reliability of the questionnaire was calculated to be .78 for the knowledge section and .81 for the practice section. Two items in each section were removed after conducting exploratory factor analysis. Ultimately, the confirmatory factor analysis indicated that the proposed model was fit for the data. Five components were confirmed as constituents of CAWS for the knowledge section, and four components were identified for the practice section. The findings revealed that Iranian EFL teachers were already familiar with the CAWS and purportedly practiced them in their writing classes. Using the scale in the process of writing instruction can provide ELT practitioners with a helpful platform for relating to CA strategies and empowers learners to accomplish tasks such as problem-solving in their writing assignments, similar to what is practiced in mathematics.

Keywords: cognitive activation writing strategies, confirmatory factor analysis, exploratory factor analysis, strategies-based instruction, structural equation modeling

1. Associate Professor in TEFL, Allameh Tabataba'i University, Tehran, Iran;
ORCID ID: https://orcid.org/000000017110338X
2. Corresponding author: Assistant Professor, Department of English Language and Literature, Faculty of Foreign Languages, Vali-e-Asr University of Rafsanjan, Rafsanjan, Iran
& Languages & Linguistics Center, Sharif University of Technology, Tehran, Iran;
Email: mhassanzadeh@vru.ac.ir; ORCID ID: https://orcid.org/0000000315101149
3. MA in TEFL, Allameh Tabataba'i University, Tehran, Iran

1. Introduction

One of the reasons that writing strategies have been the subject of many studies over the past years is learners' persistent difficulties and their inability to use appropriate strategies to overcome the myriad obstacles they encounter while writing in a foreign language (Harris et al., 2008). In strategies-based instruction (SBI), students learn how to develop remedies for all stages of writing (Sturm & Rankin-Erickson, 2002). Research suggests that there is a positive relationship between using appropriate strategies and writing competence (Bai, 2016). SBI is aimed at converting students into independent and autonomous learners (Mayer, 2003). In this vein, cognitive strategies are behaviors, thoughts, or actions that are used by the individual in the process of learning to organize and store their knowledge and skills for future use (Weinstein & Hume, 1998). In retrospect, research has shown that cognitive models of writing help facilitate learners' writing skills (e.g., De Smedt et al., 2018; Flower & Hayes, 1977, 1981; Hayes & Berninger, 2014; Traga Philippakos et al., 2018).

Fairly similar to cognitive strategies are what scholars refer to as cognitive activation (CA) strategies which include, inter alia, summarizing, questioning, predicting, and bottom-up or top-down thinking (Burge et al., 2015). CA strategies were first utilized by a group of scholars in the OECD's 'Program for International Student Assessment' or PISA (2016) in order to enable students to solve their mathematical problems under less cognitive strain. These strategies encourage students to think more profoundly and associate or link new information to the previously acquired information. Establishing connections among mathematical facts, procedures, and notions is claimed to culminate in improved learning and a more profound understanding of the concepts in question. As noted, during CA strategies, learners are encouraged to engage in higher-level thinking such as concept formation, concept connection, visualization, idea generation, problem-solving, questioning, analytical (critical) thinking, practical thinking/application, and synthesizing/creative thinking, thereby developing an elaborated knowledge base. CA is reinforced when students are a) challenged, b) confronted with conflicts, c) asked to think and focus clearly on their learning, and d) made to realize connections between new content and what is already known (Lipowsky et al., 2009). The strategies stimulate and encourage learners to figure out creative ways of solving problems, share their thinking processes, and communicate their thoughts with classmates, peers, and teachers. In order to tackle the learners' problems in writing, teachers themselves should be familiar with various types of strategies and be able to transfer this knowledge while teaching.

Cognitive models of writing (e.g., Flower & Hayes, 1977, 1981) consider this demanding and quite challenging skill in terms of problem-solving processes, similar to what has been proclaimed in the field of mathematics. According to Beriter and Scardamalia (1987, as cited in Dean et al., 2008), skilled writers frequently "problematize" a writing task, and choose a strategy which they call "knowledge transforming" (p. 5). In contrast to novices, skilled writers choose their goals clearly, adopt the content and rhetorical objectives elaborately, and move towards the target as if they are involved in a problem-solving task. Reviewing the literature suggests commonalities between methods of language learning and mathematics particularly with regard to human brain processing (mental processes), thinking patterns (e.g., logical thinking and lateral or divergent thinking), thinking modes (such as procedure thinking, space thinking, axiomatic thinking), methods of thinking (such as abstract thinking and mapping thinking) (Li & Wang, 2013), and problem-solving (Wang & Chiew, 2010).

As mentioned, CA strategies have been used in mathematics and have yielded positive outcomes in that field (Baumert et al., 2013; Cantley et al., 2017; Donné et al., 2016). Yet, it seems to be the case that few studies have explored the role and nature of CA strategies from the perspective of instructors in other disciplines, particularly in the field of English language teaching (ELT). Although much work has been done on the use of cognitive strategies in teaching writing, little has been done with regard to CA strategies. In order to gain insights into how CA strategies inform L2 teachers' practices, this study examined Iranian EFL teachers' perceptions of SBI and their relevant empirical and theoretical practices in teaching writing. As such, we developed a scale by means of which EFL teachers' knowledge about and practice of cognitive activation writing strategies (CAWS) in the classroom could be quantified and evaluated. The results could help illuminate to what extent Iranian EFL teachers utilize CAWS in their classrooms and the type of practices they execute in order to facilitate meaningful learning. Hence, the following research questions were formulated:

1. What are the underlying factors of cognitive activation (CA) strategies in teaching writing?
2. Is the researchers' newly developed scale (i.e., the CAWS questionnaire) a

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

reliable and valid tool?

3. Are Iranian EFL teachers familiar with the CA-based approach to teaching writing in their language classes?

4. Do Iranian EFL teachers, in their own opinion, practice the CA-based approach to teaching writing in their language classes?

2. Literature Review

The aim of this section was to reconcile conceptualizations that surround learning strategies within ELT and mathematics. One of the fundamental questions confronted by many language teachers, methodologists, and course designers is whether learners should learn to use or use to learn (the language). Across disciplines, it is occasionally the case that concepts and ideas are borrowed from one discipline to another by theorists. Different disciplines borrow findings, terminology, and methodology from each other in order to explore new perspectives. For example, composition theorists and rhetoricians study the act of writing as a problem-solving process (Wang & Chiew, 2010); consequently, they use analytical techniques that are borrowed from cognitive psychology. In the current study, attempts were made to rely on the similarities that exist between learning methods in ELT and mathematics, particularly with respect to human brain processing (mental processes) within the cognitive domain. Lister et al. (2020) suggested that active learning environments and meaningful learning activities help students to reach a deeper understanding of mathematical concepts in the classroom. In cognitively active learning environments, learners engage with the lesson that they are learning in ways that could guide them through their own understanding of concepts and procedures. Meaningful learning activities lead students to think deeply about what they are doing (Prince, 2004). Lister et al. (2020) recommend strategies and instructional practices that increase active learning by attempting to choose tasks that increase reasoning and problem-solving.

2.1. The Program for International Student Assessment (PISA)

PISA was an international survey with the aim of evaluating education systems worldwide to investigate about teacher strategies and student learning outcomes (Baumert et al., 2013; Burge et al., 2015; Cantley et al., 2017). It was conducted by a group of scholars in several countries, including Ireland, Poland, Spain, the United Kingdom, Albania, Kazakhstan, Thailand, and Vietnam. Their follow-up reports underscored three underlying instructional strategies: Active learning, cognitive activation, and teacher-directed instruction. According to the results of PISA, CA strategies have a positive effect on and a strong association with students' achievement in mathematics (Förtsch et al., 2017). CA strategies were defined as practices designed to challenge and motivate students, and spark higher-order skills such as critical thinking, problem-solving and decision making (Donné et al., 2016). According to PISA, students whose teachers employ CA in teaching mathematics, show higher levels of interest, enjoyment, motivation, self-efficacy, self-concept, and lower levels of anxiety.

2.2. Writing as a Problem-Solving Process

Amongst cognitive models of writing, Flower and Hayes' model (1980a,b) considers writing in terms of problem-solving, similar to what is assumed in the field of mathematics. Skilled writing is a complex cognitive activity where the writer aspires to map the language onto his/her thoughts, feelings, and the readers' expectations (Dean et al., 2008). The complexity may entail strategic considerations such as organizing ideas or how to apply plans such as finding the right letter on the keyboard. Skilled writers are able to problematize a writing task (Bereiter & Scradamalia, 1987) and choose strategies to transform their knowledge to the reader. Moreover, they create clear ideas about the content and their rhetorical goals. Problem-solving includes the three stages of "problem recognition", "problem definition", and "problem representation" (Pretz et al., 2003, p. 3). In the problem recognition stage, the problem solvers must identify the problem. Then, they should define and represent it mentally. In the next stage, problem solvers ought to develop a solution strategy and organize their knowledge about the problem they encounter. Afterwards, they should allocate mental and physical resources to solve that problem. The next stage occurs when problem solvers have to monitor their progress toward the goal. Ultimately, they need to evaluate the solution for accuracy. However, that is not to say that all problem-solvers go through all these stages in this order. In fact, the concept constitutes a cycle where the stages are required to be repeated to a greater or lesser extent.

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

There is strong evidence from research that SBI has positive influence on students' writing competence (De Silva, 2015; Feng Teng, 2019; Hu, 2005; Ong & Zhang, 2013; Sasaki et al., 2018; Silva & Matsuda, 2002). Many researchers (e.g., Bai, 2015; Flower & Hayes, 1980a,b; Leki, 1995; O'Mally & Chamot, 1990; Sasaki, 2000; De Silva & Graham, 2015) investigated SBI from different perspectives such as learner problems in writing, and the relationship between using SBI and learner achievement in writing. For example, Mu (2005) suggested the use of rhetorical, metacognitive, cognitive, communicative, and social/affective strategies for ESL learners. Sasaki (2000) classified writing strategies under: planning, retrieving, generating ideas, verbalizing, translating, rereading, and evaluating, among others. CAWS have been defined variously by different scholars and educators in the field of science. According to Donné et al. (2016), CAWS provide students with an opportunity to think deeply, find solutions to problems through negotiating with others, and reflect on their own ways and methods of learning. Such strategies, as mentioned by Donné et al. (2016), encourage students to:

a) explain their thinking on complex problems,

b) solve problems in more than one way,

c) provide written explanations of how they solve problems,

d) work together to solve problems, connect the concepts and usage of what they learn in everyday life, and,

e) re-examine homework problems that they had not been able to solve.

2.3. Rationale

Research on cognitive writing strategies and SBI are growing in the literature (e.g., Graham, 2006; Hayes, 2012). In a similar vein, many research studies have been conducted on CA in the field of mathematics in recent years (e.g., Cantley et al., 2017; Kunter et al., 2013). However, no attempt has been made to carry out research into the concept of CA-based instruction in the form of developing a scale or a model in the field of ELT. CA is a recent topic in the field of psychology as well, and developing a credible scale can be helpful for those who intend to conduct large-scale surveys investigating educators' knowledge and practice of SBI. As already discussed, CA strategies link new information to the previous information in mind, thereby enabling students to learn more efficiently. Giving time to students to process information to find better solutions for a question, encouraging active processing strategies such as reviewing notes after the class, seeking clarification about what learners do not understand, drawing up a summary from a lecture, promoting bottom-up and top-down thinking, or enhancing collaboration are some examples of cognitively activating strategies in the teaching process. It has been claimed that activities and tasks that engage students in higher-level thinking lead them to deeper processing. Deeper processing tasks enable students to create new knowledge through integrating their previous knowledge with the new material and employ that knowledge in new contexts (Fullan & Langworthy, 2014). Nevertheless, as noted, few, if any, researchers have set out to explore the role and nature of such strategies from the perspective of instructors especially as far as the field of ELT is concerned. In so doing, the researchers developed a new scale on CAWS, the details of which follow in the sections to come.

3. Methodology

This study was conducted within multiple phases, focusing on the development of a questionnaire and its validation. In order to establish the construct validity of the scale, the questionnaire data were submitted to exploratory and confirmatory factor analysis, respectively. Exploratory factor analysis (EFA) contributed to discovering the specific underlying constructs in the questionnaire, while confirmatory factor analysis (CFA) helped us verify the fitness of the expected model. The details are elaborated below.

3.1. Participants and Sampling

During an initial piloting stage, the questionnaire was administered to 70 participants, deemed similar to the target population. The results helped us make some necessary modifications prior to the implementation of the study. The respondents’ feedback regarding the layout, length, language, clarity of the questions, and timing were taken into account to modify the items. In the next stage, the developed questionnaire was distributed among 230 Iranian ELT practitioners in various private language institutes from eleven Iranian cities via various means including e-mails, mobile apps (including *Telegram* and *WhatsApp)*, online web surveys (Google Form), and by hand. Amongst the returned questionnaires, as many as 17 were poorly completed. Therefore, 213 participants aged between 20-47 made up the final sample (see Appendix A for details of participant demographics).

3.2. Procedure

The CAWS questionnaire was chosen as an instrument for data collection in the present study. After the model was hypothesized, the questionnaire was used to test the tentative model. The following steps were taken to construct the scale and measure its reliability and validity.

3.2.1. Item accumulation and generation

In line with the aim of the study, the required information from various sources relevant to language learning, cognitive and writing strategies, and their classifications, features of learning strategies, writing process approaches, and aspects of teaching writing in L2 were examined. Certain prominent works and theories related to cognitive writing strategies were drawn on (e.g., Flower & Hayes, 1981). Reviewing the related literature, the researchers were unable to find a similar hypothesized model to serve the objectives of the present study. The CAWS questionnaire was used as a tool to collect the required data for the next phase of the study. To this end, in the first place, a number of research studies in mathematics and ELT were examined whereby a pool of 40 items was collated.

3.2.2. Expert opinion

In order to confirm the representativeness, appropriateness, and accuracy of the selected components and the generated items, a group of experts (PhD holders) in applied linguistics from two reputable Iranian universities were consulted. Consequently, some of the items were excluded to minimize bias, ambiguity, length, or redundancy. Finally, the items were reconfigured with some minor changes and placed in the questionnaire.

[DOR: 20.1001.1.23223081.1400.12.5.4.8]

[DOI: 10.52547/LRR.12.5.17]

3.2.3. The rating scale and instructions

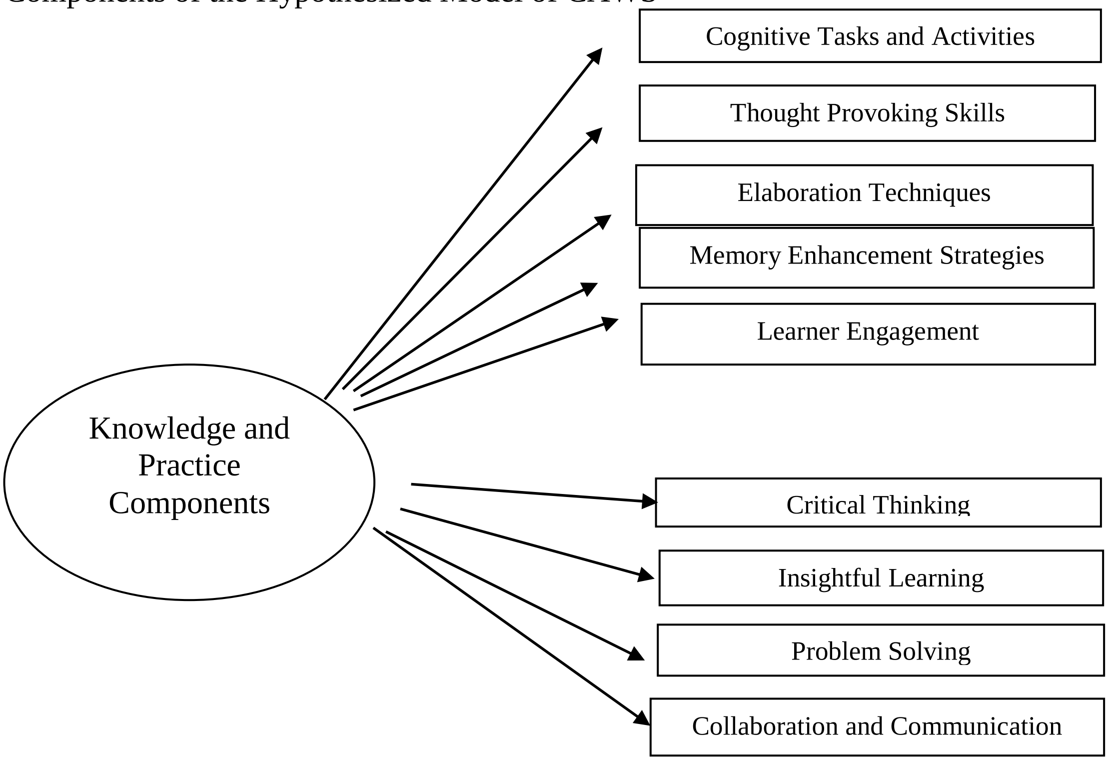
The stages of scale development were followed on the basis of Dörnyei's (2010) guidelines. The questionnaire consisted of two sections with 40 statements on a five-point Likert-scale ranging from strongly disagree (1) to strongly agree (5). The first section sought to evaluate respondents' knowledge on CAWS. The second section elicited the extent to which teachers used CA strategies in their writing classes. Respondents were notified that the information they provided would be kept anonymous so that they would feel free to speak their minds. Ultimately the model and the questionnaire were validated through exploratory and confirmatory factor analysis procedures.

3.2.4. A tentative model

In this phase, a tentative model was proposed. The main components of the CAWS that were used to generate the items are displayed in Figure 1.

Figure 1

Components of the Hypothesized Model of CAWS



3.2.5. Initial piloting

To determine any flaws within the scale, it was administered to 70 participants similar to the target population for which the questionnaire was developed. The results and the respondents' feedback regarding the scale's layout, length, language, clarity of items, and the timing were used to make the necessary modifications before finalizing the item pool.

3.2.6. Reliability index

In this phase, to ensure the consistency of the items, Cronbach's alpha coefficient was calculated. The reliability index of the questionnaire indicates whether all the items measure the same underlying construct. In order to determine how the scale items clumped together, the reliability values were calculated (see Table 1). In sum, the Cronbach's alpha coefficients were: $\alpha_{\text{Knowledge section}} = .78$; $\alpha_{\text{Practice Section}} = .81$.

Table 1

Reliability Indices of CAWS Components (Knowledge and Practice Sections)

	N of Items	Inter Item Correlations	Cronbach's Alpha
Knowledge Section			
Cognitive Tasks and Activities	3	.472	
Thought Provoking Skills	4	.195	
Elaboration Techniques	4	.222	
Memory Enhancement Strategies	4	.316	
Learner Engagement	3	.260	
All			**.776**
Practice Section			
Critical Thinking	4	.361	
Insightful Learning	5	.249	
Problem Solving	5	.276	
Collaboration and Communication	4	.289	
All			**.814**

3.2.7. Validation

The questionnaire was given to a group of experts (i.e. applied linguists) to judge its face and content validity. Their suggestions about the wording and the interpretation of the items were adopted accordingly (prior to the reliability phase). After computing the reliability, in order to establish the construct validity, factor analysis was carried out in two separate phases which will be further explained in detail under the Results section.

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

4. Results

The CAWS scale consisted of three sections including the *demographics*, teachers' *knowledge*, and teachers' *practice* sections. After developing the target items, it was distributed among Iranian EFL teachers to explore how much they were familiar with the concept of CA and to what extent they applied the related strategies in their writing classes. The details of the validation procedure are explained in the following sections.

4.1. Exploratory Factor Analysis

In order to compute the results, primarily, the correlation matrix was inspected in order to determine the adequacy of the data set for the PCA (Principal Components Analysis). For the purpose of achieving a desirable analysis, the correlation amongst the variables should be above .3 (Pallant, 2013). The results confirmed this primary condition. In the next step, the Kaiser-Meyer-Olkin (KMO) measure was checked to examine whether the correlations among variables were desirable. Based on the output, the KMO measure was above .6 for both the knowledge and practice sections of the scale ($KMO_{Knowledge}$= .73, $KMO_{Practice}$= .77 respectively), which were acceptable enough for further analysis. Then, Bartlett's test of Sphericity was checked for each section. The values were significant (P < .001), indicating the factorability of the sample.

Table 2
Kaiser's Criterion (Knowledge Section)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	**3.984**	22.133	22.133	3.984	22.133	22.133	2.497
2	**1.568**	8.714	30.847	1.568	8.714	30.847	1.961
3	**1.426**	7.920	38.767	1.426	7.920	38.767	2.046
4	**1.337**	7.429	46.196	1.337	7.429	46.196	2.391
5	**1.170**	6.498	**52.694**	1.170	6.498	52.694	2.126

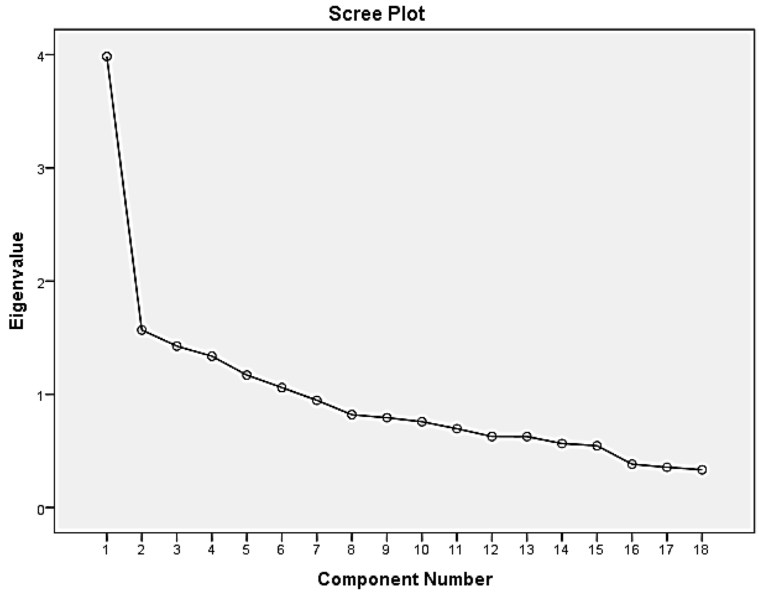
[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

Table 3
Kaiser's Criterion (Practice Section)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	**4.468**	24.820	24.820	4.468	24.820	24.820	2.979
2	**1.568**	8.710	33.530	1.568	8.710	33.530	2.592
3	**1.467**	8.148	41.678	1.467	8.148	41.678	2.847
4	**1.348**	7.486	**49.164**	1.348	7.486	49.164	2.007

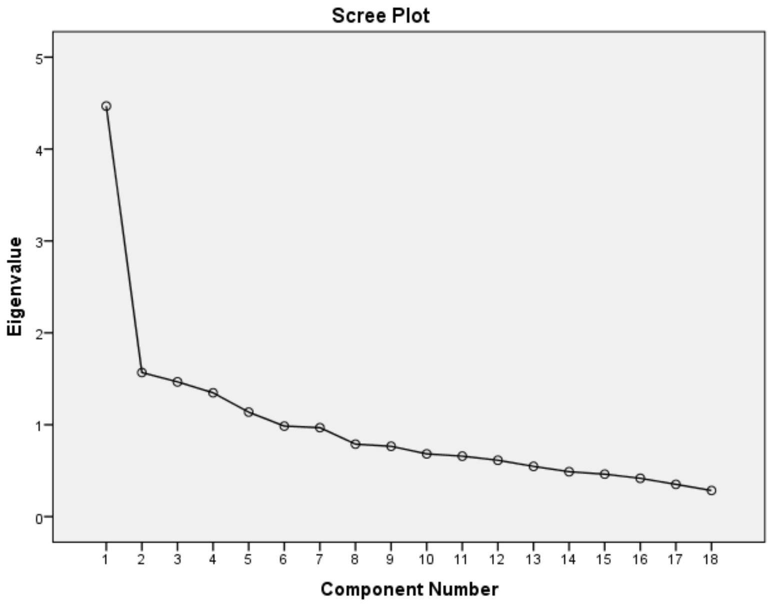
To determine the number of components (factors) in our scale, we can refer to Tables 2 and 3. Components that have an eigenvalue in excess of 1 meet the criterion. The first five components in the knowledge section explain 52.69% and the first four components of the practice section explain 49.16% of the total variance. Taken together, the PCA of all the 36 variables revealed the presence of five components for the knowledge section and four components for the practice section.

Figure 2
Knowledge section Scree plot



[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

Figure 3
Practice section Scree plot



The Scree tests imply that five components in the knowledge section and four in the practice section capture more of the variance than the remaining components (Figures 2 & 3). Items 7 and 10 from the knowledge section as well as items 6 and 15 from the practice section which had low communality (lower than .3) were removed from the analysis because they did not fit well with the other items. The highest loadings on each component of both the knowledge and practice sections are illustrated in Appendix B. Another viable option to identify the number of components during the EFA was *parallel analysis* (see Pallant, 2013). However, we decided to stick with the Kaiser's Criterion and the Scree test for factor extraction in the interest of space.

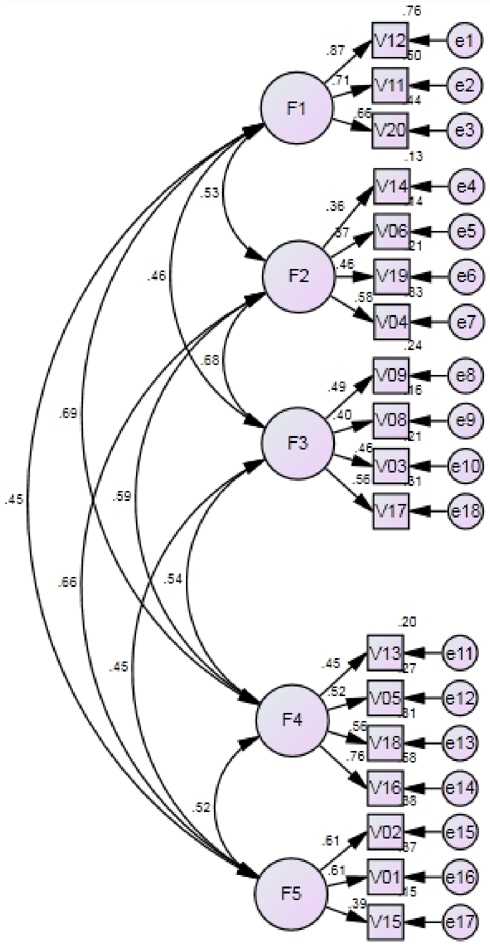
4.2 Confirmatory Factor Analysis

In the next phase of the study the CFA was run, using IBM's AMOS software (V. 25). The results helped to ascertain whether the questionnaire data and the hypothesized model would fit together. In order to test the model, Structural Equation Modelling (SEM) was conducted. The data permutation ($\varkappa^2/Df = 1.985$, RMSEA = .068, GFI = .891, AGFI = .852; knowledge section, $\varkappa^2/Df = 2.415$, RMSEA = .082, GFI = .861 , AGFI = .82; practice section) shows that the CAWS model is statistically feasible

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

and has successfully accounted for the sample data (see also Kline, 2005). All path loadings were statistically significant at the .05 level. The findings support the CAWS hypothesis, its components and subcomponents. X2/D_f value for knowledge and practice were less than 3, suggesting that the results were acceptable. Goodness-of-fit index (GIF), Root Mean Square Error of Approximation (RMSEA), and Adjusted Goodness of fit index (AGFI) were also acceptable (see the detailed output in Appendix C). Figures 4 and 5 show the schematic representation of the knowledge and practice sections of CAWS model respectively. Findings confirmed the fitness of the model. The final CAWS model, therefore, comprised five components for knowledge and four components for the practice sections.

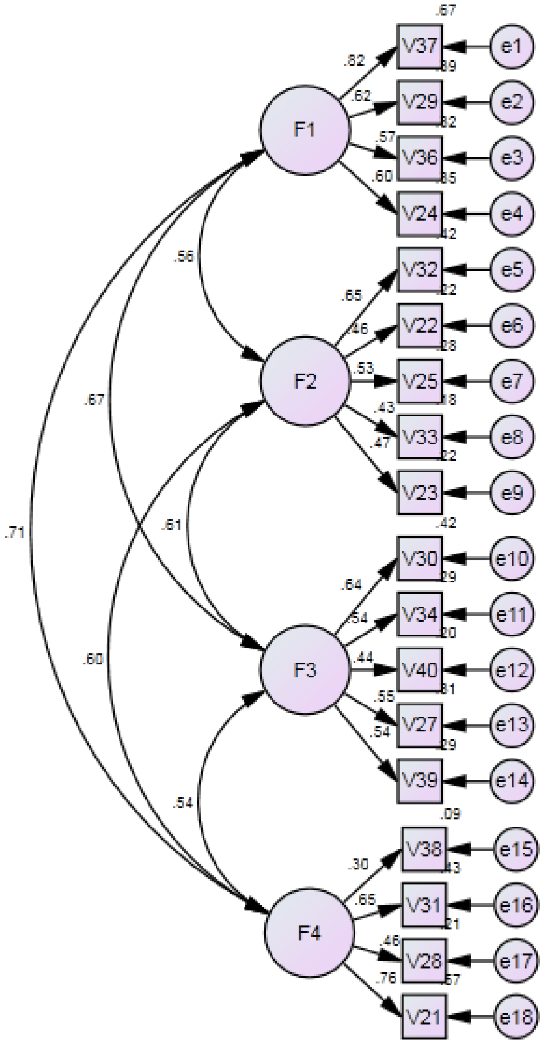
Figure 4
The final CAWS model (knowledge section)



[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

Figure 5

The final CAWS model (practice section)



5. Discussion

The first two questions enquired about the underlying factors of CA strategies in teaching writing, and their validity and reliability. The components, items, and the loadings can be found in Appendix D. The third research question intended to examine the extent to which Iranian EFL teachers were familiar with CA writing strategies. In so doing, a one sample t-test was run to determine whether the obtained mean value was statistically different from the known or hypothesized population mean (generalizable to the population mean), $M = 72.62$; $SD = 8.03$ $t = 131.9$, $df = 212$, $p < .001$. As seen, the t-test located statistical difference at .001

[DOR: 20.1001.1.23223081.1400.12.5.4.8]

[DOI: 10.52547/LRR.12.5.17]

level for the sample. Cohen's d (effect size) for the teachers' knowledge section was calculated to be 9.0, which is considerably large. In other words, Iranian EFL teachers' claims indicated that they were highly familiar with CAWS.

The purpose of the fourth research question was to investigate whether EFL teachers used CAWS in their classrooms without considering how much they knew about the strategies. Upon conducting the second one-sample t-test, statistical difference was also discerned; $M = 68.5$; $SD = 9.68$, $t = 103.3$, $df = 212$, $p < .001$. Cohen's d indicated that the magnitude of the impact was at 7.1, which is deemed as large. The results showed that Iranian EFL teachers believe that they use CAWS abundantly in their writing classes. The final model is further discussed below.

5.1. Knowledge Section

In the CAWS' final model, the knowledge part was explained by five factors (hereafter F = factor, k = knowledge, p = practice, and V = variable). First, the 'cognitive tasks' factor (F1k) which was elicited by asking participants whether they knew how to improve their students' cognitive skills in a way that leads them toward mastery of writing techniques. The second was the 'thought-provoking skills' factor (F2k), where participants were asked whether they knew how to activate student thinking to do their writing tasks. Third, the 'elaboration techniques' factor (F3k) which asked whether teachers knew how to encourage students to reflect on an existing problem. Fourth, the 'memory enhancement strategies' factor (F4k) where participants were asked whether they knew what techniques to use in order to improve their students' memory. Fifth, the 'learner engagement' factor (F5k) asking whether they knew how to involve students in discussions.

In terms of the relationships among five strategy-knowledge factors, F2k had a significant positive direct and reciprocal effect on F1k ($\beta = .53$), F3k ($\beta = .68$), F4k ($\beta = .59$), and F5k ($\beta = .66$). F1k and F4k had a significant positive direct and reciprocal effect on each other ($\beta = .69$) which was the highest among all the factors. The least positive direct and reciprocal effect among factors were between F1k and F5k, and F3k and F5k, $\beta = .45$. The item V12 (on cognitive activities) presented a significant positive loading (.87) on F1k (cognitive tasks and activities) and the item V11 (on cognitive skills) presented a significant positive loading (.71) on F1k in the knowledge section. Items V12 and V11 showed the highest significant positive loading among the other items in the knowledge section. Items V14 with a positive loading (.36) on F2k (thought-provoking skills) had the least cross-loading in the model. Finally, item V14 (in F2k) asked teachers whether they were familiar with concept maps.

5.2. Practice Section

In the CAWS' final model, use/practice was explained by four factors. First, the 'critical thinking' factor (F1p) where teachers were asked about strategies that students use to interpret, analyze, evaluate, inference, or explain while doing their tasks. Second, the 'insightful learning' factor (F2p) in which teachers were asked about strategies involving students' use of their own procedures for completing a complex activity. Third, the 'problem-solving' factor (F3p) eliciting learning strategies that stimulate cognitive functioning and processing (Depaepe & König, 2018; Lipowsky et al., 2009). And finally, the 'collaboration and communication' factor (F4p) asking about strategies that provide an environment for the students to discuss their problems.

In terms of the relationships among the strategy-use/practice factors, F1p had a positive direct and reciprocal effect on F2p ($\beta = .56$), F3p ($\beta = .67$), and F4p ($\beta = .71$). F1p and F4p had a positive direct and reciprocal effect on each other ($\beta = .71$) which is the highest direct and reciprocal effect among the factors. The least positive direct and reciprocal effect among the factors was between F3p and F4p ($\beta = .54$). Item V37 (asking about solving problems by using innovative solutions) presented a significant positive loading (.82) on F1p (critical thinking) and item V21 (asking about the environment students discuss their problems with each other and learn from their mistakes) presented a significant positive loading (.76) on F4p (collaboration and communication) in the practice section. Items V37 and V21 showed the highest significant positive loading compared to the other items in the practice section. Item V38 with a positive loading (.30) on F4p (collaboration and communication) had the least cross-loading in the model.

Components of CAWS could be compared with "contextual learning" theory (Suchman, 1987). According to this model, education transpires in life experiences and events. In this notion of teaching, students construct meaning based on their own experiences. The vast majority of contextual learning theory constituents are consistent in content with those of the CAWS components.

According to Suchman, the characteristics of this kind of learning include: a) emphasizing problem-solving, b) highlighting that learning occurs when the learners process any new information through making sense in their own frame of previous knowledge (memory, response or experience), c) recognizing that teaching and learning need to occur in multiple contexts, d) assisting students in learning how to monitor their learning and how to become self-regulated learners, e) anchoring teaching in the diverse life context of students f) encouraging students to learn collaboratively, g) discussing viewpoints, h) employing authentic assessment, i) accentuating social work and group work, and j) using self-regulation and metacognitive skills. Another strategy that was covered in our study under CA strategies was the use of concept maps. Ojima (2006) also investigated the effects of concept mapping on the development of the writing skill. His results demonstrated the use of concept mapping as an influential strategy. Another notion embedded in the CAWS were mind maps. The lines, arrows, color-coding, pictures, and symbols in mind maps can pedagogically assist teachers and learners in the writing process. Mind maps make meaningful connections between learners' prior and new knowledge. Bukhari (2016) studied on mind mapping techniques to find the most effective strategies in the EFL learners' writing quality enhancement. The study was divided into survey and experimental phases. The results indicated that cohesion and coherence, content paragraph structure and the length of writing improved significantly after the treatment. Moreover, other activities such as brainstorming relate major ideas with minor ones in the learners' background knowledge. Brainstorming helps learners to organize their thoughts and remember ideas.

6. Conclusion

This study set out to develop a scale, by means of which EFL teachers' knowledge about and practice of CA writing strategies could be investigated in the context of Iran. The results implied that Iranian EFL teachers proclaimed to know and practice CAWS in their language classes quite abundantly. The findings suggested that all factors in the CAWS model were interrelated. Each factor consisted of different strategies and each strategy was in tandem with several other strategies.

Using CAWS in the process of teaching and learning can provide a good structure for learners who use the strategies while completing their complex writing

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

assignments through a series of steps, similar to what they do when solving problems in mathematics. EFL teachers can have an important role in bridging the gap between the results of this study, learner improvement in writing and the strategies that learners use while doing their writing assignment, or the strategies they need to learn and practice. This warrants EFL teachers' preparedness, thereby highlighting the significant role assumed by teacher trainers, policy-makers and curriculum planners. Teacher learning promotes the quality of educational practices. The more familiar the teachers are with CA strategies, the better they will be able to decide which method of instruction to adopt. As acknowledged in the literature (e.g., Csizér et al., 2010; De Smedt et al., 2018), possession of teaching strategies can have far-reaching implications for the development of learners' cognitive skills and their confidence, attitudes and motivation.

As a major limitation of this study, we encountered a dearth of related empirical work on CAWS in the domain of ELT, which made it difficult to build bridges among the disciplines of language education, psychology, linguistics, and mathematics. Another issue was the complexity surrounding the concepts in the cognitive domain in education and psychology, especially when the researchers intended to choose the type of strategies. The accurate transfer of the concept of CAWS, and writing clear and comprehensible statements for the questionnaire were also excruciating procedures. In other words, what happens in the learners' minds while they are writing and the related cognitive strategies that they choose to complete the writing tasks, as well as transforming the CAWS concept to straightforward items in the questionnaire were also challenging. This might have led to some shortcomings within the data collection procedure which necessitates administering the questionnaire in various contexts for validation purposes. CAWS deserve further investigation in the field of ELT as considering all dimensions of the concept within a single questionnaire was less than feasible. As a rule, the use of SEM to validate the model and the questionnaire demands a larger sample size. As the cognizant reader can imagine, it is not always practical for the researchers to collect the required data by distributing the scale among EFL teachers in as many educational centers as ideal. To tackle this problem, on-line applications such as WhatsApp and Telegram were employed.

It is worthy of note that analyzing the relationship between teachers' application of CAWS and L2 learners' writing quality can be an interesting topic for future research, particularly if this can be realized and supplemented with the

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

aid of technology and digital applications. This study can be replicated in a different context, as SBI is affected by the context in which it is being practiced. The items in the CAWS questionnaire may not have examined this complex concept comprehensively. It will be very fortunate that further scales on CA strategies emerge in future publications. It is also suggested that future studies consider CA strategies employed by more experienced writing instructors by observing their writing classrooms to reach thicker and more profound data on CAWS. Qualitative and observational methods of data collection will further help verify teachers' claims of the extent that they practice what they preach.

References

Bai, B. (2015). The effects of strategy-based writing instruction in Singapore primary schools. *System*, *53*(6), 96–106. https://doi.org/10.1016/j.system.2015.05.009

Bai, R. (Ed.). (2016). *Writing strategies and strategy-based instruction in Singapore primary schools*. Cambridge Scholars Publishing

Baumert, J., Kunter, M., Blum, W., Klusmann, U., Krauss, S., & Neubrand, M. (2013). *Cognitive activation in the mathematics classroom and professional competence of teachers*: *A research program. Results from the COACTIV project*. Springer.

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Lawrence Erlbaum Associates.

Burge, B., Lenkeit, J., & Sizmur, J. (2015). *PISA in practice: Cognitive activation in maths.* NFER.

Bukhari, S. F. (2016). Mind mapping techniques to enhance EFL writing skill. *International Journal of Linguistics and Communication*. *4*(1), 58-77. https://doi.org/10.15640/ijlc.v4n1a7

Cantley, I., Prendergast, M., & Schlindwein, F. (2017). Collaborative cognitive-activation strategies as an emancipatory force in promoting girls' interest in and enjoyment of mathematics: A cross-national case study. *International Journal of Educational Research*, *81*, 38-51. https://doi.org/10.1016/j.ijer.2016.11.004

Csizér, K., Kormos, J., & Sarkadi, Á. (2010), The dynamics of language learning attitudes and motivation: lessons from an interview study of dyslexic language learners. *Modern Language Journal*, *94*, 470-487. https://doi.org/10.1111/j.1540-4781.2010.01054.x

Dean, P., Odendahl, N., Quinlan, T., Fowels, M., Welsh, C., & Bivens-Tatum, T. J. (2008). *Cognitive models of writing: Writing proficiency as a complex integrated skill*. Educational Testing Service.

De Silva, R., & Graham, S. (2015). The effects of strategy instruction on writing strategy use for students of different proficiency levels. *System, 53*(6), 47–59.

De Silva, R. (2015). Writing strategy instruction: Its impact on writing in a second language for academic purposes. *Language Teaching Research*, *19*(3), 301–323.

De Smedt, F., Merchie, E., Barendse, M., Rosseel, Y., De Naeghel, J., & Van Keer, H. (2018). Cognitive and motivational challenges in writing: Studying the relation with writing performance across students' gender and achievement level. *Reading Research Quarterly*, *53*(2), 249–272. https://doi.org/10.1002/rrq.193

Depaepe, F., & König, J. (2018). General pedagogical knowledge, self-efficacy and instructional practice: Disentangling their relationship in pre-service teacher education. *Teaching and Teacher Education*. *69*, 177–190. https://doi.org/10.1016/j.tate.2017.10.003

Donné, N., Fraser, P., & Bousquet, G. (2016). Teaching strategies for instructional quality: insights from the TALIS-PISA Link Data, OECD Education Working Papers, No. 148, OECD Publishing, Paris. https://doi.org/10.1787/5jln1hlsr0lr-en

Dörnyei, Z., & Taguchi, T. (2010). *Questionnaires in second language research* (2nd ed.). Routledge.

Feng Teng, M., & Huang, J. (2019), Predictive effects of writing strategies for self-regulated learning on secondary school learners' EFL writing proficiency. *TESOL Quarterly*, *53*, 232–247. https://doi.org/10.1002/tesq.462

Flower, L. S. & Hayes, J. R. (1977). Problem-solving strategies and the writing process. *College English*, *39*(4), 449–461.

Flower, L., & Hayes, J. R. (1980a). The cognition of discovery: Defining a rhetorical problem. *College Composition and Communication, 31*(1), 21–32.

Flower, L. S. & Hayes, J. R. (1980b). The dynamics of composing: Making plans and juggling constraints. In Gregg, L. & Steinberg, E. R. (Eds.), *Cognitive processes in writing* (pp. 31–50). Lawrence Erlbaum Associates.

Flower, L., & Hayes, J. R. (1981). A cognition process theory of writing. *College Composition and Communication, 32*, 365–387. https://doi.org/10.2307/356600

Förtsch, C., Werner, S., von Kotzebue, L., & Neuhaus, B. J. (2017). The role of pedagogical content knowledge and cognitive activation for students' learning. In ESERA (Hrsg.). *Conference Book*. (S. 67). Verfügbar unter: http://keynote.conferenceservices.net/resources/444/5233/pdf/ESERA2017_0107_paper.pdf

Fullan, M. & Langworthy, M. (2014). *A rich seam: How new pedagogies find deep learning*. Pearson.

Graham, S. (2006). Strategy instruction and the teaching of writing. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 187–207). Guilford.

Harris, K. R., Graham, S., Mason, L., & Friedlander, B. (2008). *Powerful writing strategies for all students*. Paul H. Brookes.

Hayes, J. R. (2012). Modeling and remodeling writing. *Written Communication*. *29*(3), 369–388. https://doi.org/10.1177/0741088312451260

Hayes, J.R., & Berninger, V. (2014). Cognitive process in writing: A Framework. In B. Arfé, J. E. Dockrell, & V.W. Berninger (Eds.), *Writing development in children with hearing loss, dyslexia or oral language problems: Implications for assessment and instruction* (pp. 3–15). Oxford University Press.

Hu, G. (2005). Using peer review with Chinese ESL student writers. *Language Teaching Research*, *9*(3), 321–342.

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. The Guilford Press.

Kunter, M., Baumert, J., Blum, W., Klusmann, U., Krauss, S., & Neubrand, M. (Eds.) (2013). *Cognitive activation in the mathematics classroom and professional competence of teachers*. Springer.

Leki, I. (1995). Coping strategies of ESL students in writing tasks across the curriculum. *TESOL Quarterly*, *29*(2), 235–260.

Li, F. & Wang, L, (2013). The study of comparison between English language and mathematical language. *Journal of Studies in Social Sciences*. *4*(2), 213–234

Lipowsky, F., Rakoczy, K., Pauli, C., Drollinger-Vetter, B., Klieme, E., & Reusser, K. (2009). Quality of geometry instruction and its short-term impact on students' understanding of the Pythagorean Theorem. *Learning and Instruction*, *19*(6), 527–537. https://doi.org/ 10.1016/j.learninstruc.2008.11.001

Lister, K., MacDonald, B., & Shumway, J. F. (2020). Experiencing active mathematics learning: Meeting the expectations for teaching and learning in mathematics classrooms. *TME*, *17*(2&3), 615–640.

Mayer, R. E. (2003). *The promise of educational psychology: Teaching for meaningful learning*. Merrill.

OECD (2016), Ten questions for mathematics teachers ... and how PISA can help answer them, PISA, OECD publishing, Paris, https://doi.org/10.1787/9789264265387-en

O'Malley, J. M., & Chamot, A. U. (1990). *Learning strategies in second language acquisition*. Cambridge University Press.

Ojima, M. (2006). Concept mapping as pre-task planning: A case study of three Japanese ESL writers. *Journal of Science Direct System*, *34*, 566–585.

Ong, J., & Zhang, L. J. (2013). Effects of the manipulation of cognitive processes on EFL writers' text quality. *TESOL Quarterly*, *47*(2), 375–398.

Pallant, J. (2013). *SPSS survival manual: a step by step guide to data analysis using IBM SPSS*. McGraw-Hill.

Pretz, J. E., Naples, A. J., & Sternberg, R. J. (2003). *Recognizing, defining, and representing problems*. In J. E. Davidson & R. J. Sternberg (Eds.), *The psychology of problem solving* (pp. 3–30). Cambridge University Press. https://doi.org/10.1017/CBO9780511615771.002

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223–231.

Sasaki, M. (2000). Toward an empirical model of EFL writing processes: An exploratory study. *Journal of Second Language Writing, 9*(3), 259–291.

Sasaki, M., Mizumoto, A., & Murakami, A. (2018). Developmental trajectories in L2 writing strategy use: A self- regulation perspective. *Modern Language Journal*, *102*, 292–309. https://doi.org/10.1111/modl.12469

Silva, T., & Matsuda, P. (2002). Writing. In N. Schmitt (Ed.), *An introduction to applied linguistics* (pp. 252–266). Arnold.

Sturm, J. M., & Rankin-Erickson, J. L. (2002). Effects of hand-drawn and computer-generated concept mapping on the expository writing of middle school students with learning disabilities. *Learning Disabilities Research & Practice*, *17*(2), 124–139. https://doi.org/10.1111/1540-5826.00039

Suchman, L. A. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge University Press.

Traga Philippakos, Z.A., MacArthur, C.A. & Munsell, S. (2018). College student writers' use and modification of planning and evaluation strategies after a semester of instruction. *Journal of Adolescent & Adult Literacy*, *62*(3), 301–310. https://doi.org/10.1002/jaal.897

Wang, Y., & Chiew, V. (2010). On the cognitive process of human problem solving. *Cognitive Systems Research. 11*(1), 81–92. https://doi.org/10.1016/j.cogsys.2008.08.003

Weinstein, C. E, & Hume, L. M. (1998). *Study strategies for lifelong learning*. American Psychology Association.

About the Authors

Mahnaz Mostafaei Alaei is presently an Associate Professor at Allameh Tabataba'i University, Tehran, Iran. She holds a PhD degree in TEFL and has been teaching various courses in applied linguistics at both MA and PhD levels. She is the director of *Issues in Language Teaching* Journal. She has published a number of articles in different academic journals and has presented several papers at national and international conferences. Her research interests focus on teaching principles and methodology, language curriculum planning, syllabus design and materials development, intercultural communication, and instructional issues in multicultural contexts.

Mohammad Hassanzadeh is an Assistant Professor of applied linguistics with the Department of English Language and Literature at Vali-e-Asr University of Rafsanjan, Iran. He earned his PhD degree from Allameh Tabataba'i University in 2015, and is currently teaching as a visiting faculty member at Sharif University of Technology's Languages and Linguistics Center. His areas of research interest lie in technology-enhanced instructed second language acquisition and experimenting with varied methods of implicit and explicit instructional categories. His key research papers have appeared in *Language Learning and Technology*, *TESOL Journal* (Wiley), *Journal of Computer Assisted Learning* (Wiley), and *ReCall* (Cambridge University Press).

Masoomeh Masoudi is an MA graduate in applied linguistics from Allameh Tabataba'i University of Tehran, Iran. She also holds a master's degree in solid state physics from Islamic Azad University, Science and Research Branch in Tehran. Alongside working as a teacher of English in the city of Tehran, she takes an interest in researching cognitive thinking strategies and the application of smart technology in teaching young learners.

Appendices

Appendix A

Summary of the Participants' Demographics

Gender	Male	50.2% (107)
	Female	49.8% (106)
University Degree	Diploma	2.8% (6)
	Bachelor	40.8%(87)
	Master	42.7%(91)
	Ph.D.	13.6%(29)
Field of Study	ELT	59.6%(127)
	English Literature	35.2%(75)
	Other	5.2%(11)
Teaching Experience	Below 3 years	36.2%(77)
	4-7years	31.5%(67)
	8-11years	13.6%(29)
	12-15years	7.5%(16)
	16-19years	4.7%(10)
	Over 20 years	6.6%(14)

Appendix B

Pattern Matrix, Questionnaire Components and their Related Items

Component	Related items in the questionnaire	
Knowledge Section Components		
1 Cognitive Tasks and Activities		
I know how to engage students in cognitive activities which enhance their critical thinking.		.763
I know how to improve my student's cognitive skills.		.764
I can engage learners in cognitively challenging activities that could result in their mastery of writing techniques, developing logical reasoning, and problem solving		.648
2 Thought Provoking Skills		
I am familiar with concept maps that allow students to illustrate similarities and differences between the features of new information and what they already know about it.		.397
Before starting to write, students should be given an opportunity during which they may brain storm to activate their mind.		.733
I know how to engage students in active processing strategies such as writing a summary, drawing illustrations, asking clarification questions		.612
I know how to activate student thinking (for example by asking provocative questions, allowing students to struggle, and encouraging them to explain their thinking		.449
3 Elaboration Techniques		
A teacher's primary instructional focus should be providing time for students to focus on new information by linking it to prior knowledge.		.509
I can encourage students to question themselves if there’s anything they don’t understand, so they can get immediate clarification.		.590
I can have students invoke self-correction techniques		.766
I can encourage students to reflect on an existing problem they prefer to write about in		.413

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

Component	Related items in the questionnaire	
their free writing activities.		
4	Memory Enhancement Strategies	
	I know what techniques to use in order to improve my students' memory	.797
	I am familiar with the strategies that can help students to communicate their thinking processes with their peers and teachers	.448
	I know how to promote student collaboration, pairing students who work well with details with the students who prefer to think about the general ideas	.577
	I know how to challenge students to find ways to actively involve other students in a closely related activity	.596
5	Leaner Engagement	
	I can involve students in a discussion about a controversial issue prior to their writing task/assignment	.478
	I know how to give students opportunities to elaborate or expand upon significant points or attributes of key ideas of a written text/passage.	.685
	I know how to use elaboration techniques (e.g. give example, making an analogy) helping students to understand complex ideas or issues in the writing process	.785
Practice Section Components		
6	Critical Thinking	
	I encourage students to solve problems they face while doing writing assignments and try different alternatives to find an innovative solution	.559
	I get students to explain their thinking to generate ideas for the writing task they have just tried to complete.	.597
	I ask students to think about the topic and then map out general and specific ideas on a diagram	.589
	I ask students to find associations between specific ideas and try to organize the related themes before they begin to write	.763
7	Insightful Learning	
	I go over the writing problems the students encounter while writing their assignments	.517
	I ask students to decide on their own procedures for completing a complex activity instead of guiding them or providing technical aid during the writing process.	.501
	I ask students to write on topics which are more challenging and need more time to get them started	.546
	I give the students writing activities that require them to think for an extended time.	.642
	I ask my students to brainstorm on both familiar and unfamiliar topics to generate creative ideas.	.677
8	Problem Solving	
	I present topics expecting students to write problem-solution essays, which help them learn how to approach a problem from several different perspectives.	.726
	I teach students various strategies requiring them to link new information to information they have already learned to see the connections between ideas	.634
	I use strategies that can activate student thinking simply by asking provocative questions, allowing students to explain their thinking on complex problems and be innovative in their work	.622
	To make sure the students have fully understood the taught concepts, I give them a passage and ask them to convert it to an outline	.559

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

Component	Related items in the questionnaire	
	I use both top-down (starting with the big picture and working down to the details) and bottom-up (starting with the details and working up to the big picture) approaches to lead the students to a deeper understanding of the concepts.	.435
9	Collaboration and Communication	
	I impose time limits to make sure that students could process information within the given time	.694
	I ask questions that make students reflect on the writing assignment/task	
	I encourage students to work together and share their ideas while working on their writing assignment/task.	.446 .664
	I provide an environment for the students to discuss their problems with each other and learn from the writing mistakes they have made.	.496

Appendix C

Fit Indices for the Final Model

Amos Indices	Recommended Level (Good)	Recommended Level (Acceptable)	Knowledge Section	Practice Section
X2/Df	0 ≤ X2/Df ≤ 2	2 ≤X2/Df ≤ 3	1.985	2.415
RMSEA	0 ≤ RMSEA≤ .05	.05 ≤ RMSEA ≤ .08	.068	.082
GFI	.95 ≤ GFI ≤ 1	.9 ≤ GFI ≤ .95	.891	.861
AGFI	.95 ≤ AGFI ≤ 1	.85 ≤ AGFI ≤ .9	.852	.82
P-value	P< .05	.05 ≤ P ≤ .1	.000	.000

Appendix D

Pattern and Structure Matrix for PCA with Oblimin Rotation of Five Factor Solution (Knowledge Section)

	Pattern Coefficients					Structure Coefficients					communalities
	Components										
	Cognitive Tasks and Activities	Thought Provoking Skills	Elaboration Techniques	Memory Enhancement Strategies	Learner Engagement	Cognitive Tasks and Activities	Thought Provoking Skills	Elaboration Techniques	Memory Enhancement Strategies	Learner Engagement	
	1	2	3	4	5	1	2	3	4	5	
V12	**.764**	-.068	.193	.090	-.017	**.798**	.061	.277	.266	-.166	.686
V11	**.763**	-.017	.040	-.020	-.207	**.794**	.105	.139	.174	-.326	.674
V20	**.648**	.262	.007	.160	.123	**.690**	.334	.125	.303	-.053	.577
V14	-.029	**.733**	.048	-.095	-.013	.039	**.728**	.149	-.002	-.121	.542

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]

V06	.368	**.612**	-.193	-.131	-.013	.390	**.608**	-.074	-.007	-.129	.532
V19	-.028	**.449**	-.020	.392	.017	.095	**.488**	.103	.435	-.120	.382
V04	.022	**.397**	.114	.233	-.211	.158	**.482**	.239	.340	-.336	.373
V09	.101	-.212	**.766**	.086	.008	.174	-.070	**.755**	.190	-.079	.627
V08	.231	.060	**.590**	-.040	.147	.268	.150	**.601**	.073	.036	.428
V03	-.303	.316	**.509**	.174	-.004	-.180	.386	**.553**	.226	-.100	.498
V17	-.060	.322	**.413**	-.072	-.353	.060	.431	**.489**	.077	-.435	.485
V13	-.098	-.035	.008	**.797**	.095	.044	.037	.096	**.758**	-.024	.597
V05	.196	-.016	.113	**.596**	.046	.319	.089	.212	**.642**	-.100	.463
V18	.086	-.042	-.149	**.577**	-.285	.227	.063	-.029	**.617**	-.374	.483
V16	.303	-.001	.194	**.448**	-.169	.441	.146	.311	**.567**	-.319	.502
V02	-.004	.117	-.066	-.075	**-.785**	.111	.229	.036	.066	**-.783**	.634
V01	.094	-.086	-.163	.210	**-.685**	.218	.040	-.054	.314	**-.702**	.573
V15	.040	-.019	.409	-.084	**-.478**	.140	.120	.455	.064	**-.515**	.430

Note: Major loadings for each item are in bold type

Pattern and Structure Matrix for PCA with Oblimin Rotation of Four Factor Solution of CAWS Items (Knowledge Section)

	Pattern Coefficients				Structure Coefficients				communalities
	Components								
	Critical Thinking	Insightful Learning	Problem Solving	Collaboration and Communication	Critical Thinking	Insightful Learning	Problem Solving	Collaboration and Communication	
	1	2	3	4	1	2	3	4	
V37	**.763**	.121	.197	.051	**.785**	-.098	.353	.161	.665
V29	**.597**	-.043	.135	.094	**.648**	-.215	.293	.189	.454
V24	**.589**	-.063	-.049	.172	**.634**	-.367	.317	.004	.408
V36	**.559**	-.216	.168	-.109	**.612**	-.204	.125	.237	.486
V32	-.143	**-.677**	.234	.171	.085	**-.705**	.363	.257	.595
V22	.014	**-.642**	.026	-.134	.152	**-.638**	.131	-.070	.424
V25	.181	**-.546**	.081	-.085	.315	**-.596**	.213	.000	.400
V23	-.043	**-.517**	-.047	.292	.459	**-.549**	.051	-.210	.358
V33	.396	**-.501**	-.085	-.286	.099	**-.525**	.094	.326	.512
V30	.008	-.107	**.726**	-.107	.183	-.240	**.731**	.030	.555
V34	.130	-.037	**.634**	-.119	.267	-.179	**.650**	.009	.452
V40	-.353	-.287	**.622**	.161	-.129	-.341	**.626**	.255	.574
V27	.255	.122	**.559**	.053	.358	-.050	**.602**	.169	.431
V39	.300	.049	**.435**	.083	.395	-.112	**.507**	.189	.349
V31	.008	.163	.035	**.694**	.358	-.301	.093	**.692**	.496
V38	.262	-.203	-.120	**.664**	.057	.091	.126	**.686**	.603
V28	.012	.032	.463	**.496**	.166	-.106	.546	**.575**	.536
V21	.390	-.320	-.068	**.446**	.500	-.438	.159	**.508**	.551

Note: Major loadings for each item are in bold type

[DOR: 20.1001.1.23223081.1400.12.5.4.8]
[DOI: 10.52547/LRR.12.5.17]