ISSN 1799-2591
Theory and Practice in Language Studies, Vol. 14, No. 5, pp. 1525-1536, May 2024
DOI: https://doi.org/10.17507/tpls.1405.26

EFL Students Develop Cognitive and Metacognitive Self-Regulated Writing Strategies Using Automated Feedback: A Case Study

Amal Abdul-Aziz Mohammed Al-Othman
Department of English Language and Literature, College of Languages and Translation, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia

***Abstract*—This study investigated the impacts of automated feedback on EFL students' development of cognitive and metacognitive self-regulated writing strategies, using *ProWritingAid* online tool. Data were collected from EFL students enrolled in level one writing course at a public university, in Riyadh, Saudi Arabia. They are Saudi female undergraduate students who study English Language. The results indicated significant impacts of automated feedback on students' self-regulated writing strategies, reflected in an overall mean score of (3.75 ± 0.69).Findings after using automated feedback showed participants' development of cognitive strategies, including language usage (e.g., grammar, spelling, punctuation), which reached 73%. The cognitive strategies of writing revision, encompassing revise cohesiveness and connection among sentences, reached 70%. Participants' development of metacognitive strategies, including idea planning and goal-oriented monitoring and evaluation, reached 75% and 77%, respectively. The results also indicated significant impacts of automated feedback on motivational and social strategies, with scores of 87% and 80%, respectively. Comparing participants' written assignment scores before and after using automated feedback, the results showed a 62% improvement in performance among low-proficient students. One implication of the study is that, with the aid of automated feedback, EFL students have the abilities to autonomously improve their writing skills. The adoption of a self-regulated approach, within the utilization of automated feedback, significantly influences students' performance. These findings suggest that integrating automated feedback into the EFL curriculum and instruction can foster students' self-reliance and proficiency in writing.**

***Index Terms*—automated feedback, cognitive strategies, metacognitive strategies, self-regulated approach**

I. Introduction

Students who study English as a Foreign Language (EFL) perceive writing as a challenging skill due to its complexity, which requires performing multiple tasks. Students need not only strong linguistic capabilities to compose correct texts that observe language lexical, syntactic, and semantic aspects, but they also need planning, monitoring, and revising strategies to write effectively. In this respect, considerable research (Chen et al., 2022; Sun et al., 2022; Sun & Wang, 2020; Teng & Zhan, 2023; Zimmerman, 2002, 2013; Wijaya, 2021) indicated that students need to develop cognitive and metacognitive self-regulated strategies to improve writing performance. Mastering self-regulated strategies is crucial for becoming EFL proficient writers (Wijaya, 2021). These studies found that writing performance is influenced by cognitive strategies, including language usage and writing revision, along with metacognitive strategies that encompass idea planning, goal-oriented monitoring and evaluation, as well as motivational and social tactics. Self-regulated strategies are part of self-regulated learning, which involves students monitoring, and controlling cognitive and metacognitive abilities while planning and using suitable strategies for completing writing tasks. The interaction between cognition and motivation provides deeper understanding of the aspects that affect students' self-regulated learning (Fin, 2021). This means that students' abilities to self-motivation, self-monitor, self-assess, and self-regulate the writing process are essential. In other words, students need to use self-regulated strategies to write and revise their assignments independently. With the advancement of technology, many students often turn to automated feedback for enhancing writing skills. Automated feedback refers to computer-generated feedback provided by programs for automated evaluation on the written work (Shermis & Burstein, p. xiii; cited in Cotos, 2023). Technology offers automated feedback web-based tools to assist students to identify grammar, structural, and organizational errors, and provides suggestions to help them develop writing proficiency. Furthermore, the growing interest in the recent advancements of artificial intelligence (AI) programed Automated Writing Evaluation (AWE) has been investigated, indicating that students' interaction with AWE feedback is important for reducing cognitive barriers that students face, assisting them to improve engagement in the writing process, and consequently their writing performance (Gayed et al., 2022; Godwin-Jones, 2022; Nazari et al., 2021; Yang et al., 2023). Automated feedback provides immediate understanding of grammatical correctness, syntactical structures, and vocabulary usage, addressing the writing challenges that EFL students encounter, and helping them improve writing accuracy, and quality (Barrot, 2023; Dizon & Gayed, 2021; Fan & Ma, 2022; Waer, 2021). Additionally, Lee (2020), Geng and Razal (2022), and Wei et al. (2023)

indicated that automated feedback impacts students' writing performance, especially the writing of low proficient students, as the constant use of AWE feedback results in long-term writing improvement. These studies highlight the benefits of using AWE outside the classroom for daily writing practices. Furthermore, previous research (Bellhäuser et al., 2023; Ling et al., 2021; Mayordomo et al., 2022; Rusdin et al., 2023) highlights the benefits of automated feedback beyond the aspect of correction, enforcing students' critical thinking by explaining the rationales for the suggested modifications. Applying this method of feedback, using the corrections suggested by the automated tool, enhances students' metacognitive abilities, by increasing their engagement, self-assessment, and intrinsic motivation. In other words, students who use automated feedback, are encouraged to reflect on their writing, acquiring deeper understanding of the writing process itself. Thus, these earlier studies demonstrate that the utilization of automated feedback proves to be an effective method for dealing with students' writing problems, as the automated tools, initially created for essay assessment, have been developed exceeding traditional spelling and grammar corrections. The personalized nature of automated feedback offers suggestions to students addressing their individualized needs, and fostering their cognitive and metacognitive skills. Students can reflect on their writing assignments, applying the appropriate strategies learned from automated feedback to improve the quality of their writing. This process strengthens student self-confidence and self-reliance. Hence, automated feedback serves as a valuable tool in fostering self-regulated writing strategies among EFL students. However, despite considerable research on the use of automated feedback in EFL writing classrooms, there is still a gap in the literature concerning specifically the effects of automated feedback on the development of cognitive and metacognitive self-regulated writing strategies. Empirical research on the specific writing assistance that automated feedback offers and how students utilize it, is lacking (Shi & Aryadoust, 2022). This gap is particularly noticeable among low proficient students who are using automated feedback for the first time. In addition, within the utilization of automated feedback, the influence of motivational concepts, including self-regulation and self-efficacy, on students' writing performance needs further investigation(Camacho et al., 2021; De Smedt et al., 2023).The current study is an attempt to bridge this gap by exploring how low-proficient EFL students use automated feedback, and its impacts on the development of their cognitive and metacognitive self-regulated writing strategies, which, in turn, affects their motivation and, consequently, their writing performance.

II. Literature Review

A. Models and Theories of Writing

Theories and models of writing present different perspectives on both the writing process and writing production, addressing various aspects, including cognition, metacognition, information processing, problem-solving, and social influences. In a recent study, De Smedt et al. (2023) examined various theories, including self-theory, which, explains learners' beliefs towards learning development as being innate or acquired (Dweck, 1999), achievement goal theory (Elliot & Harackiewicz, 1996; Elliot & Church, 1997), self-efficacy theory (Bandura, 1986, 1997), and self-determination theory (Ryan & Deci, 2000; as cited in De Smedt et al., 2023, pp. 1-11). The study by De Smedt et al. aimed at exploring the relationship between writing and cognitive and metacognitive domains, emphasizing a broad range of interconnected concepts, including writing and motivation, self-efficacy for writing, and writing performance. The results showed that students who achieved higher levels of writing mastery goals were more driven by autonomous writing motives. On the other hand, students who achieved higher levels of performance were more driven by either external or internal motives to write. These motives include factors such as language level, writing practices, and motivation. In this respect, Brenner (2022) examined motivation in relation to self-determination theory and self-regulated learning, indicating that developing self-regulated learning practices requires engagement and motivational supports. The study found that the learning environments that are characterized by autonomy support foster an atmosphere where students can enhance personal beliefs regarding task value, and competence. These elements collectively contribute to advanced levels of engagement and the development of autonomous motivation for writing. On the other hand, Kormos (2023) examined models of writing that handle motivation in relation to cognitive factors, including language proficiency, the working memory, and individual differences, suggesting using a task environment mediated cognitive model of L2 writing that describes for the students the role of cognitive factors in the writing processes. The task environment, as described by Hayes (1996, 2012; cited in Kormos, 2023), which includes the cognitive, linguistic, and genre-based demands of the task, the time allocated for writing, and the choice of transcribing technology (handwritten vs. typed), can influence the working memory capacity of L2 writing processes and outcomes. Hayes' (2022) model is based on an understanding of how individual differences, such as reading comprehension and working memory, influence cognition and writing ability. In a different study, Golparvar and Khafi (2023) employed structural equation modeling, revealing a model of three components that depend on development of motivation and self-efficacy, which, in turn, impact writing performance. These components include linguistic self-efficacy, self-regulatory processes, and performance self-efficacy. Similarly, some studies (Camacho et al., 2021; Chen et al., 2022; Guo & Bai, 2022; Sun et al., 2022; Tian et al., 2022) revealed that the implementation of self-regulated learning strategies has positive impacts on writing performance, fostering greater autonomy and metacognitive awareness among learners.

Some models of writing, including Zimmerman's (2002, 2008, 2013) highlight three processes of writing: cognition and metacognition, motivation, and strategic action. The model consists of four phases: forethought, emphasizing goal-

setting and planning; performance, involving drafting and revising; self-reflection, assessing writing against goals; and self-regulation, encompassing adjusting goals, monitoring progress, and utilizing strategies for ongoing improvement in motivation and self-efficacy. Zimmerman's model combines views from theories of self-efficacy and self-determination to emphasize the relationship between the writing process, motivation, autonomy, and performance. Thus, the connection between self-regulation and self-efficacy stems from having a strong sense of self-efficacy that can contribute to effective self-regulation. When students believe in their ability to perform a task (self-efficacy), they are more likely to engage in self-regulatory processes to achieve their goals. In this respect, Mitchell et al. (2023) found a positive association between the mastery of writing goals and self-efficacy, indicating that higher self-efficacy encourages students to generate ideas, adhere to grammatical rules, and implement self-regulating strategies while performing various writing tasks. In a different study, Bellhäuser et al. (2023) applied a writing model that depends on automated feedback as an interventional training program to examine the effects of automated feedback on daily self-regulated learning. Students in the experimental group, exposed to confirmative feedback (affirming effective writing approaches), informative feedback (covering learning outcomes), and transformative feedback (involving guiding writing process improvements), experienced enhanced self-efficacy, as revealed by the results. In a similar study, Karagul and Seker (2021) employed a screencast tool to investigate the influence of automated feedback on self-regulated writing strategies, revealing significant improvements in the use of goal setting and reflection strategies among participants after the intervention period.

B. Cognitive and Metacognitive Self-Regulated Writing Strategies

Self-regulation is a set of self-directed processes and self-beliefs that empower learners to translate their cognitive abilities, such as verbal aptitude, into specific writing skills (Zimmerman, 2002). It involves individuals monitoring, controlling, and regulating their thoughts, and motivations to achieve their academic goals (Zimmerman, 2008). According to Zimmerman, cognitive strategies which include language usage, and writing revision, and metacognitive strategies, which encompass idea planning, and goal-oriented monitoring can be enhanced through self-regulation learning. Zimmerman also asserted that social strategies, including discussion, participation, collaboration to share feedback, and motivational strategies, involving students in self-assessment, affect significantly writing performance. Thus, cognitive, social, motivational, and behavioral processes should be emphasized when assessing the relationship between students' self-regulation development, and writing performance. In this regard, Teng (2020) examined the role of metacognitive knowledge and regulation in mediating writing performance, revealing aspects of metacognition, including planning, monitoring, and evaluating, and found a positive correlation with EFL writing performance. The findings emphasized the significance of improving metacognitive regulatory skills for the writing performance of university EFL learners. Considerable research (Chen et al., 2022; Karagul & Seker, 2021; Sun et al., 2022; Teng & Zhan, 2023; Wijaya, 2021) investigated cognitive and metacognitive self-regulated learning in second language (L2) writing, highlighting its correlations with strategic interventions. The studies found that the most successful self-regulators are characterized by elevated cognitive, metacognitive, and motivational components of self-regulated learning. Learners with the lowest levels on self-regulated components recorded the lowest scores in writing self-efficacy. The findings showed that students who use self-regulated strategies are more self-motivated in developing autonomous learning. Tian et al. (2022) found that cognitive strategies were more prominent when revising based on automated feedback, while motivational strategies were more prevalent with teacher feedback. In their study, both quantitative and qualitative data supported the association between feedback type, quantity, and the effective use of self-regulated writing strategies for completing the assignments. In the same line, Bellhäuser et al. (2023), and Theobald and Bellhäuser (2022) emphasized the correlation between automated feedback, revising strategies, and overall writing performance. These studies affirmed that different categories of self-regulated strategies, including cognitive, metacognitive, social behavior, and motivational strategies, are developed based on learners' response to feedback. In the same line, Teng and Zhang (2016) developed a questionnaire, validating four categories of writing strategies within self-regulated learning. These categories include cognitive strategies (e.g., text processing and writing course memory strategies), metacognitive strategies (e.g., idea planning and goal-oriented monitoring and evaluation), social behavior strategies (e.g., feedback handling and peer learning), and motivational strategies (e.g., motivational self-talk, interest enhancement, and emotional control), each contributing to students' engagement in writing tasks. Sun and Wang (2020) investigated self-regulated writing strategies across the entire writing process, encompassing planning, organizing, monitoring, and revising. In their study, revising strategies were specifically classified as cognitive approaches to revision, focusing on tasks such as revising mechanics, making lexical, morphological, and syntactic changes, and revising ideas at the clause/sentence level. The study suggests that writing strategies should focus on the process of revising as well as the meta-strategies that are involved in making revision decisions based on feedback from external sources.

C. *Benefits and Potential Limitations of Automated Feedback*

Numerous studies (Barrot, 2023; Bellhäuser et al., 2023; Fan & Ma, 2022; Fu et al., 2022; Uwe & Klotz, 2022) explored the benefits of using automated feedback in the writing classroom, affirming that automated feedback enhances self-regulated writing strategies, and consequently, assists students in improving their writing performance. In this respect, Han and Sari (2022) investigated the impact of automated feedback on writing scores and accuracy, and

concluded that it helps in identifying and correcting errors found in students' approaches towards essay writing, resulting in improving their overall writing skills. Mayordomo et al. (2022) found that online feedback has positive effects on cognitive and emotional engagement with feedback, guiding students to improve their writing drafts. Lee (2020) explored the effects of artificial intelligence-based automated feedback on students' writing skills, and found that automated feedback produced significant improvements in language coherence and cohesion. Fan and Ma (2022) found that automated feedback has positive impacts on writing quality, guiding students to improve structures and styles in argumentative writing. Moreover, Bellhäuser et al. (2023), Karagul and Seker (2021), Tian et al. (2022), and Theobald and Bellhäuser (2022) emphasized how automated feedback contributes to the improvement of self-regulated learning, influencing social and behavioral processes, fostering the development of cognitive and metacognitive abilities that, in turn, affects the overall students' performance. Wei et al. (2023) assessed automated feedback, utilizing the Grammarly platform, revealing that the experimental group consistently exhibited superior performance across all aspects of writing skills compared to the control group. However, while automated feedback holds promises for improving writing performance, the literature shows some potential limitations associated with this approach. For example, Link et al. (2022) explored automated feedback alongside teacher feedback in the context of higher-level (HL content and organization) and lower-level (grammar) writing skills. The findings indicated that students who utilized automated feedback improved their writing accuracy in the long term, while those without access to automated feedback showed lower retention. In a different study, Woodworh and Barkaoui (2020) found some criticisms revolve around two issues, including automated feedback's constrained capacity to deliver individualized guidance that addresses student needs, and the risk of diminishing teacher's role. The study suggested that automated feedback should be used alongside, rather than in place of, teacher-written feedback. In the same light, Wambsganss et al. (2022) suggested that the integration of automated feedback for argumentative writing should be complemented with instruction on social cues to empower students in enhancing argumentative writing skills by evoking personalized aspects, including behavior and attitude. Burstein et al. (2020) raised a concern about the need to improve construct-relevance in automated essay scoring. They argue that research should aim to incorporate personalized learning analytics because it is important to align automated systems with the specific content and skills being assessed. Conversely, Uwe and Klotz (2022) found patterns in automated systems, highlighting the use of learners' knowledge level and behavior to tailor feedback to their academic needs. The authors also noted that future research directions are promising in terms of incorporating learner's data into feedback assignment rules.

III. Methodology

The current study employed a quantitative design to investigate the impacts of using automated feedback on EFL students' development of cognitive and metacognitive self-regulated writing strategies. The quantitative design helped in examining the frequencies of using the strategies with the assistance of automated feedback. Quantitative data also revealed statistical evidence of the effects of self-regulated strategies on writing performance.

A. Research Questions

1. What are the most frequent cognitive self-regulated writing strategies that EFL students develop upon utilizing automated feedback?
2. What are the most frequent metacognitive self-regulated writing strategies that EFL students develop upon utilizing automated feedback?
3. What are the impacts of cognitive and metacognitive self-regulated writing strategies, developed from automated feedback, on the writing performance of EFL students?

B. Participants

This study used a focused group of 41 EFL students participated in the study, selected from Saudi female undergraduate students who study in the English Department at a public university, in Riyadh, Saudi Arabia. The participants' age ranges between 18-20 years old. Their mother tongue is Arabic, and they have studied English for 6 years at school before they joined the university. They are enrolled in the writing course of EFL program, Level I. This course focuses on descriptive and narrative writing. The participants did not use automated feedback prior to this study.

C. Instruments

A 5-point Likert questionnaire was used to collect the data. The questionnaire items deal with cognitive and metacognitive strategies. The cognitive strategies include language usage, including grammar, spelling, and punctuation, and writing revision, i.e. revise cohesiveness and connection among the sentences. The metacognitive strategies encompass idea planning, goal-oriented monitoring and evaluation, and motivational and social strategies. The questionnaire was adapted from Tian et al. (2022), and the modified version was validated by a pilot study. Additionally, 20 writing assignments, representing the lowest-performing group out of the total 41 participants in the study, were used to examine the impact of automated feedback on their writing performance by comparing their scores before and after using automated feedback. This process helped in examining detailed aspects of each participant's writing development. Further, the present study employed the automated tool *ProWritingAid*, developed by Orpheus (2023). *ProWritingAid*

was selected because it serves as a learning tool. It gives feedback based on genre and purpose, encouraging students to employ cognitive and metacognitive strategies, promoting critical thinking and reflection while correcting the writing mistakes. It also offers a wide range of language lessons for distinguishing between formal and informal writing, including resources for understanding citations and preventing plagiarism.

D. Procedures

First, the participants were involved in orientation sessions for two weeks to ensure that they understand the purpose of automated feedback, and how it is used. The second procedure involved the participants to write a descriptive essay of three-paragraphs on *Traveling*, to describe a place they visited and their experiences in that place. This task is in alignment with course description, aiming at helping them to write descriptive, narrative, and opinion essays, enhancing their awareness of planning strategies, and the principles of clarity and coherence in essay writing. The participants did not previously write on this topic. A validated rubric was used to grade this assignment. The third procedure required from each participant to submit the essay twice: once before utilizing *ProWritingAid* automated feedback, and a second time after using it. The participants' writing performance was evaluated based on their scores in the essays both before and after utilizing automated feedback. The final procedure involved 41 participants to respond to the questionnaire, to quantify the extent to which automated feedback assisted them in developing cognitive and metacognitive self-regulated strategies. Further, the study adopts Zimmerman's (2008, 2013) model to guide students in developing self-regulated writing strategies with the help of automated feedback. Zimmerman's model comprises four phases for completing the writing assignment: forethought, performance, self-reflection, and self-regulation. These phases encourage goal-setting, planning, drafting, revising, and self-assessment based on feedback.

E. Research Limitations

This case study was limited to a small group of 41 female EFL undergraduate students, who study the writing course level I, at the English Department, in public university, in Riyadh, Saudi Arabia. The results do not include students who study in different levels, or different courses of EFL. The time span covered by the study was only one semester of the academic year 2023.

IV. Results

A. Validity and Reliability of Study

Data were analyzed using IBM-SPSS® (version 25.0) for statistical analysis which aided in calculating frequencies and percentages to detect participants' responses to research questions. Mean and standard deviation were employed to identify the frequencies and percentages of responses to the questionnaire items. The Pearson correlation coefficient was utilized to reveal the internal consistency and validity of the study tool. The results showed a Pearson correlation coefficient estimated between (.534 – .878), indicating high internal consistency and high validity indicators that are reliable when applied in the study. The results of the Alpha Cronbach's stability coefficient revealed the stability of the tool, indicating a statistically acceptable reliability of (0.960), which represents a high degree of stability.

B. Answering Study Questions

1. To determine the most the most *frequent cognitive self-regulated writing strategies that EFL students developed upon utilizing automated feedback*, percentage, mean and standard deviation, of the individuals' responses were calculated. Table1 shows the results.

TABLE 1
PARTICIPANTS' RESULTS OF IMPROVING COGNITIVE STRATEGY OF LANGUAGE USE (*n*=41)

N	Items	Approval degree										Mean	SD	Ranking
		Always		Often		Sometimes		Rarely		Never				
		F	%	F	%	F	%	F	%	F	%			
6	Use correct form of words.	18	45.0	15	37.5	4	10.0	1	2.5	2	5.0	4.15	0.85	1
10	Use correct citations to avoid plagiarism.	19	47.5	9	22.5	10	25.0	0	0.0	2	5.0	4.08	0.86	2
8	Use new English words that I learn from the feedback.	16	40.0	11	27.5	9	22.5	3	7.5	1	2.5	3.95	0.88	3
7	Use the English words that I know in different ways.	15	37.5	11	27.5	11	27.5	1	2.5	2	5.0	3.90	0.80	4
3	Check the structure of my sentence logical coherence	15	37.5	13	32.5	5	12.5	6	15.0	1	2.5	3.88	0.86	5
5	Check whether my topic and content have been clearly expressed.	17	42.5	11	27.5	5	12.5	1	2.5	6	15.0	3.80	0.92	6
9	Use different sentence patterns in English that I learn from the feedback.	13	32.5	14	35.0	7	17.5	3	7.5	3	7.5	3.78	0.81	7
1	Check my grammar mistakes.	14	35.0	13	32.5	6	15.0	2	5.0	5	12.5	3.73	0.94	8
2	Check my spelling, punctuation, and capitalization mistakes.	15	37.5	10	25.0	6	15.0	7	17.5	2	5.0	3.73	0.92	9
4	Check the cohesiveness or connection among my sentences.	12	30.0	10	25.0	11	27.5	5	12.5	2	5.0	3.63	0.89	10
Overall mean												**3.86**	**0.78**	-

Table 1 shows that participants often used automated feedback to improve the cognitive self-regulated writing strategies of language use, encompassing grammar, spelling, and punctuation, with an overall mean score and standard deviation (*SD*) of (3.86 ± 0.78). In this context, the statement 'using the correct form of words' was highly perceived

and ranked first, with a mean score and standard deviation (*SD*) of (4.15 ± 0.85), while the statements about 'using spelling, punctuation, and capitalization correctly' and 'observing sentence cohesiveness' pointed to mean scores and standard deviations (*SD*) of (3.73 ± 0.92) and (3.63 ± 0.89), respectively. These results suggest that the participants benefited from automated feedback to develop grammar usage, spelling, punctuation, and capitalization, improving the readability of their writing. These results revealed that they were able to correct their writing according to automated feedback report. Regarding the cognitive strategies of writing revision, Table 2 shows the results.

TABLE 2
PARTICIPANTS' RESULTS OF IMPROVING COGNITIVE STRATEGY OF WRITING REVISION (*n*=41)

N	Items	Approval degree										Mean	SD	Ranking
		Always		Often		Sometimes		Rarely		Never				
		F	%	F	%	F	%	F	%	F	%			
8	Revise my use of correct citations to avoid plagiarism according to what is taught in my writing course.	13	32.5	14	35.0	10	25.0	2	5.0	1	2.5	3.90	0.80	1
6	Revise my use of correct form of words according to what is taught in my English course.	18	45.0	6	15.0	12	30.0	2	5.0	2	5.0	3.90	0.89	2
5	Revise my use of words and expressions according to what is taught in my English course.	14	35.0	12	30.0	10	25.0	2	5.0	2	5.0	3.85	0.92	3
2	Revise my spelling, punctuation, and capitalization according to what is taught in my writing course.	15	37.5	11	27.5	9	22.5	2	5.0	3	7.5	3.83	0.92	4
3	Revise my sentence structures logical coherence according to what is taught in my English course.	12	30.0	13	32.5	11	27.5	2	5.0	2	5.0	3.78	0.90	5
7	Revise my use of different sentence patterns in English according to what is taught in my English course.	13	32.5	11	27.5	11	27.5	3	7.5	2	5.0	3.75	0.81	6
10	Revise my writing according to logical thinking taught in my writing course.	11	27.5	12	30.0	11	27.5	4	10.0	2	5.0	3.65	0.91	7
4	Revise cohesiveness and connection among my sentences according to what is taught in my English course.	9	22.5	17	42.5	6	15.0	6	15.0	2	5.0	3.63	0.85	8
9	Revise my topic and content according to what is taught in my writing course.	12	30.0	10	25.0	10	25.0	6	15.0	2	5.0	3.60	0.94	9
1	Revise my writing according to what is taught in my grammar course.	10	25.0	8	20.0	14	35.0	3	7.5	5	12.5	3.38	0.99	10
Overall mean												**3.73**	**0.88**	-

As displayed in Table 2, the cognitive strategies of writing revision, which include revising cohesiveness and connection among sentences, point to an overall mean score and standard deviation (*SD*) of (3.73 ± 0.88). In this context, the statement about 'revise the use of correct citations to avoid plagiarism according to the writing rules that studied in the writing course' was highly perceived, and ranked first with a mean score and standard deviation (*SD*) of (3.90± 0.80), followed by the statement about 'revise use of correct form of words according to what is taught in the English course', with a mean score and standard deviation (*SD*) of (3.90± 0.89). The strategy of revising use of words and expressions according to writing rules pointed to a mean score and standard deviation (SD) of (3.85± 0.92) while the strategy or revising topic and content according to what is taught in the writing course referred to mean score and standard deviation (*SD*) of (3.60± 0.94), and (3.38 ± 0.99) respectively. Revising sentence structures and logical coherence pointed to a mean score and standard deviation (*SD*) of (3.78±0.90), while revising the use of different sentence patterns in English showed a mean score and standard deviation (*SD*) of (3.75± 0.81) These results suggest that the participants benefited from automated feedback during the second phase of developing self-regulated strategies for revising the first draft of the essay.

2. To determine the most frequent metacognitive self-regulated writing strategies that EFL students developed upon Utilizing automated feedback, frequencies, percentage, mean and standard deviation, of the individuals' responses were calculated. Table 3 shows the results.

TABLE 3
PARTICIPANTS' RESULTS OF IMPROVING METACOGNITIVE STRATEGY OF IDEA PLANNING (*n*=41)

N	Items	Approval degree										Mean	SD	Ranking
		Always		Often		Sometimes		Rarely		Never				
		F	%	F	%	F	%	F	%	F	%			
3	Read related articles to help me revise my writing.	16	40.0	16	40.0	6	15.0	1	2.5	1	2.5	4.13	0.94	1
9	Read about my topic before I write.	20	50.0	6	15.0	11	27.5	2	5.0	1	2.5	4.05	0.81	2
8	Use the internet to search for related information to help me revise my writing.	16	40.0	14	35.0	6	15.0	3	7.5	1	2.5	4.03	0.84	3
7	Use online dictionaries to search for related information to help me revise my writing.	16	40.0	11	27.5	9	22.5	3	7.5	1	2.5	3.95	0.88	4
4	Organize the content of my writing to be revised.	17	42.5	8	20.0	10	25.0	4	10.0	1	2.5	3.90	0.85	5
1	Think carefully about the content of the automated feedback to improve planning my ideas.	16	40.0	10	25.0	9	22.5	2	5.0	3	7.5	3.85	0.93	6
2	Evaluate the content of my writing to make correct revising decisions.	12	30.0	18	45.0	4	10.0	3	7.5	3	7.5	3.83	0.97	7
6	Write an outline to help organize my ideas.	15	37.5	10	25.0	11	27.5	1	2.5	3	7.5	3.83	0.80	8
5	Categories the content of my writing to be revised.	15	37.5	10	25.0	7	17.5	7	17.5	1	2.5	3.78	0.82	9
10	Discuss my topic before I write	11	27.5	7	17.5	13	32.5	3	7.5	6	15.0	3.35	0.97	10
Overall mean												**3.87**	**0.79**	-

Table 3 shows that the participants often used automated feedback to improve their metacognitive strategy of idea planning, with an overall mean score and standard deviation (*SD*) of (3.87 ± 0.79). In this context, the third item, which states 'read related articles to help me revise my writing,' was highly perceived and ranked first, with a mean score and standard deviation (*SD*) of (4.13 ± 0.94), followed by the ninth item with a mean score and standard deviation (*SD*) of (4.05 ± 0.81). Items 5 and 10 about revising the content, and discus the topic before writing, ranked last, with mean

scores and standard deviations (*SD*) of (3.78 ± 0.82) and (3.35 ± 0.97), respectively. Table 4 displays the results of the participants' frequency of usage of the metacognitive strategy of goal-oriented monitoring and evaluation.

TABLE 4
PARTICIPANTS' RESULTS OF IMPROVING METACOGNITIVE STRATEGY OF GOAL-ORIENTED MONITORING AND EVALUATION (*n*=41)

N	Items	Approval degree										Mean	SD	Ranking
		Always		Often		Sometimes		Rarely		Never				
		F	%	F	%	F	%	F	%	F	%			
7	Improve my critical thinking to develop my wiring content.	17	42.5	9	22.5	10	25.0	1	2.5	3	7.5	3.90	0.92	1
8	Improve my analytical thinking to develop my wiring content.	14	35.0	12	30.0	10	25.0	1	2.5	3	7.5	3.83	0.97	2
9	Improve my creative thinking to develop my wiring content.	13	32.5	11	27.5	11	27.5	2	5.0	3	7.5	3.73	0.80	3
1	Define my goals in order to direct my feedback revision.	10	25.0	13	32.5	12	30.0	3	7.5	2	5.0	3.65	0.90	4
2	Focus on my writing revising plan to improve it.	9	22.5	13	32.5	13	32.5	4	10.0	1	2.5	3.63	0.83	5
10	Establish new learning goals to improve my revising process.	12	30.0	10	25.0	10	25.0	6	15.0	2	5.0	3.60	0.92	6
3	Check my revising progress to achieve my goal.	9	22.5	12	30.0	13	32.5	3	7.5	3	7.5	3.53	0.83	7
6	Reflect on my revision progress.	9	22.5	12	30.0	10	25.0	4	10.0	5	12.5	3.40	1.03	8
4	Monitor my writing revising process regularly.	9	22.5	13	32.5	8	20.0	3	7.5	7	17.5	3.35	0.99	9
5	Evaluate my writing revising process regularly.	9	22.5	8	20.0	13	32.5	4	10.0	6	15.0	3.25	1.00	10
Overall mean												**3.59**	**0.87**	-

Table 4 shows an overall mean score and standard deviation (*SD*) of (3.59 ± 0.87) for improving the metacognitive strategies. In this context, item 7, involving 'improving critical thinking to develop writing content,' was highly perceived and ranked first with a mean score and standard deviation (*SD*) of (3.90 ± 0.92), followed by item 8 about improving analytical thinking, with a mean score and standard deviation (*SD*) of (3.83 ± 0.97). Items 4 and 5 ranked last with mean scores and standard deviations (*SD*) of (3.35 ± 0.99) and (3.25 ± 1.0), respectively. The results in Table 4 and Table 5 reveal that the participants developed self-reflection, which is an important component of self-regulating learning. They were aware that developing goal-oriented monitoring and evaluation strategies improve clarity and maintain consistency in the presentation of information.

TABLE 5
PARTICIPANTS' RESULTS OF IMPROVING METACOGNITIVE MOTIVATIONAL STRATEGIES (*n*=41)

N	Items	Approval degree										Mean	SD	Ranking
		Always		Often		Sometimes		Rarely		Never				
		F	%	F	%	F	%	F	%	F	%			
5	Enhance my passion for using feedback to become a better writer.	18	45.0	11	27.5	10	25.0	0	0.0	1	2.5	4.13	0.97	1
3	Concentrate on every comment in the feedback to improve my writing.	18	45.0	13	32.5	6	15.0	1	2.5	2	5.0	4.10	0.98	2
4	Adopt a positive attitude to push myself even further when I begin to lose interest for revising my writing.	18	45.0	9	22.5	10	25.0	1	2.5	2	5.0	4.00	0.93	3
2	Pay attention to use the feedback to improve my writing.	14	35.0	15	37.5	7	17.5	2	5.0	2	5.0	3.93	0.90	4
1	Become interested in improving my English writing based on the feedback I receive.	14	35.0	10	25.0	9	22.5	4	10.0	3	7.5	3.70	0.86	5
Overall mean												**3.97**	**0.89**	-

Table 5 shows that automated feedback for improving motivational strategies was used, with an overall mean score and standard deviation (*SD*) of (3.97 ± 0.89). Item 5, focusing on 'enhancing passion for using feedback to become a better writer,' was highly perceived, with a mean score and standard deviation (*SD*) of (4.13 ± 0.97), while item 3, regarding 'concentrating on every comment in the feedback,' ranked second, with a mean score and standard deviation (*SD*) of (4.10 ± 0.98). Items 2 and 1 ranked last, with mean scores and standard deviations (*SD*) of (3.93 ± 0.90) and (3.70 ± 0.86), respectively. These results suggest the development of motivation upon utilizing the automated feedback tool. Table 6 shows participants' frequency of usage of social strategies.

TABLE 6
PARTICIPANTS' RESULTS OF IMPROVING SOCIAL STRATEGIES (*n*=41)

N	Items	Approval degree										Mean	SD	Ranking
		Always		Often		Sometimes		Rarely		Never				
		F	%	F	%	F	%	F	%	F	%			
4	Discuss with my peers when I am hesitant about some points to revise.	13	32.5	12	30.0	8	20.0	5	12.5	2	5.0	3.73	0.80	1
3	Ask my peers for ides when I do not fully understand some feedback.	12	30.0	10	25.0	11	27.5	4	10.0	3	7.5	3.60	0.91	2
5	Share my writing problems with my pears to understand the problems and how to solve them.	12	30.0	9	22.5	10	25.0	5	12.5	4	10.0	3.50	1.03	3
1	Discuss my topic with my peers to have more ideas to revise.	10	25.0	13	32.5	8	20.0	3	7.5	6	15.0	3.45	0.96	4
2	Collaborate with my peers to revise together.	10	25.0	7	17.5	14	35.0	3	7.5	6	15.0	3.30	1.04	5
Overall mean												**3.52**	**0.96**	-

Table 6 reveals that automated feedback for improving social strategies was used, with an overall mean score and standard deviation (*SD*) of (3.52 ± 0.96). Item 4, regarding 'discussing with peers some points when hesitant,' and item 3, about 'asking peers for ideas when not fully understanding some feedback,' were highly perceived, with mean scores and standard deviations (*SD*) of (3.73 ± 0.80) and (3.60 ± 0.91), respectively. Items 1 and 2 ranked last, with mean scores and standard deviations (*SD*) of (3.45 ± 0.96) and (3.30 ± 1.04), respectively. Additionally, the results revealed six categories of cognitive and metacognitive self-regulated strategies, pointing to the highest frequencies used by the participants. Table 7 displays the results.

TABLE 7
PARTICIPANTS' RESULTS OF IMPACTS OF AUTOMATED WRITING FEEDBACK ON SELF-REGULATED WRITING STRATEGIES (*n*=41)

N	*Sections*	*Mean*	*SD*	*Ranking*
6	Motivational Strategies	3.97	0.89	1
3	idea planning	3.87	0.79	2
1	language usage	3.86	0.78	3
2	writing revision	3.73	0.88	4
4	goal-oriented monitoring and evaluation	3.59	0.87	5
5	Social Strategies	3.52	0.96	6
Overall mean		**3.75**	**0.69**	-

Table 7 reveals that there are high impacts of automated feedback on self-regulated strategies, with an overall mean score and standard deviation (*SD*) of (3.75 ± 0.69). In this context, motivational strategies were highly ranked first, with a mean score and standard deviation (SD) of (3.97 ± 0.89), followed by the idea planning strategy with a mean score and standard deviation (*SD*) of (3.87 ± 0.79). The language usage strategy came in third place with a mean score and standard deviation (*SD*) of (3.86 ± 0.78). In the fourth rank is the writing revision strategy, with a mean score and standard deviation (*SD*) of (3.73 ± 0.88), followed by the goal-oriented monitoring and evaluation strategy with a mean score and standard deviation (*SD*) of (3.59 ± 0.87). However, social strategies ranked last with a mean score and standard deviation (*SD*) of (3.52 ± 0.96). These results suggest that automated feedback helped the participants develop six cognitive and metacognitive strategies within the spectrum of self-regulation.

3. To determine the impacts of cognitive and metacognitive self-regulated writing strategies, developed from automated feedback, on the writing performance of EFL students, the participants' assignments were corrected using the validated rubric, and the grades were compared, revealing the percentages of improvement. The comparison of scores showed writing improvement, as displayed in Figure 1. The results provide insights into the participants' writing content, demonstrating how a thorough examination of each assignment unveiled the nature of the feedback provided to each participant and the role that automated feedback played in the development of these strategies, impacting their performance. Figure 1 shows the results.

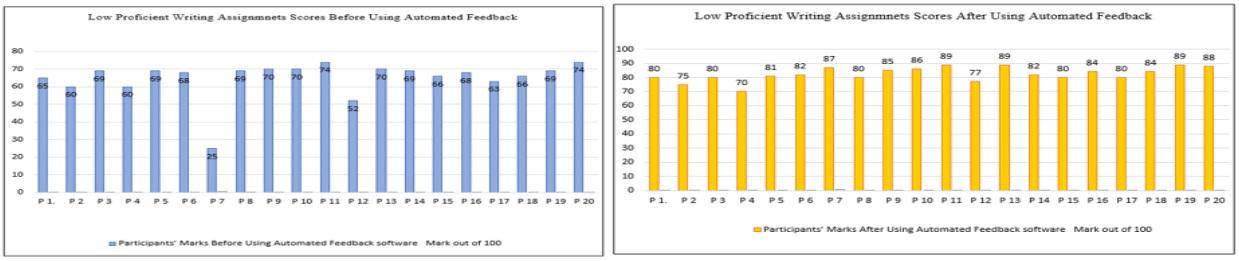

Figure 1. Participants' Writing Assignments Results Before and After Using Automated Feedback Based on Assignments Grades

Figure 1 shows the participants' writing scores before and after using automated feedback. The lowest score is demonstrated by (*P*# 7), pointing to (62%), whose assignment scored (25%) before using automated feedback, and which improved to (87%) after using the automated tool. Another low score before using the automated tool is associated with (*P* #12), with a percentage of (60%), which improved to (77%) after using the automated tool. The highest score is attributed to (*P*# 9) with a percentage of (70%) before using the automated tool, and which improved to (85%) after using it. These results reveal that the participants benefited from reading their automated feedback to improve writing performance. Figure 2 compares the writing assignments' scores before and after using automated feedback, indicating that the highest scores after using automated feedback were (89%), (87%), (86%), and (85%), respectively, while the lowest scores were (65%), (63%), and (60%), respectively. Figure 3 demonstrates the participants' self-regulated 6 categories of cognitive and metacognitive strategies before and after using automated feedback.

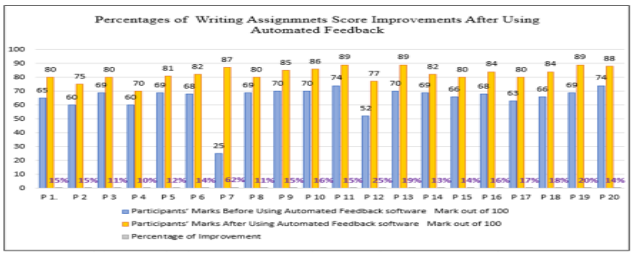

Figure 2. Participants' Writing Improvements Comparing Scores After Using Automated Feedback

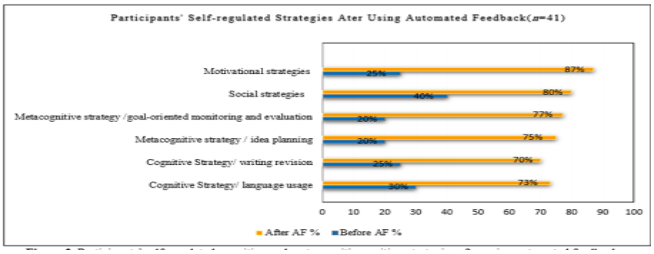

Figure 3. Participants' Self-Regulated Cognitive and Metacognitive Writing Strategies After Using Automated Feedback

As displayed in Figure 3, cognitive strategies of language usage and writing revision reached (73%) and (70%) each after using the feedback, compared to (30%) and (25%) each before using it. This suggests that students implemented the corrections suggested by the automated tool. The metacognitive strategies of goal-oriented monitoring and evaluation pointed to (77%) and idea planning to (75%), in contrast to (20%) for each before using the tool. The motivational strategies and social strategies (interacting and engagement with feedback) referred to (87%) and (80%) respectively after using automated feedback, compared to (25%) and (40%) before using the tool. These results reveal the positive impacts of automated feedback on the six categories of writing strategies, as reflected in the percentages of improvement that ranged between the highest rate of (62%) and the lowest rate of (43%). Figure 4 shows specific language development.

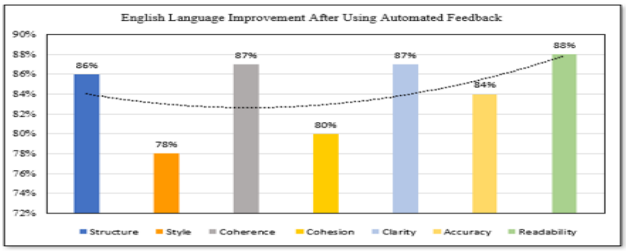

Figure 4. Results of Participants' Language Improvement After Using Automated Feedback

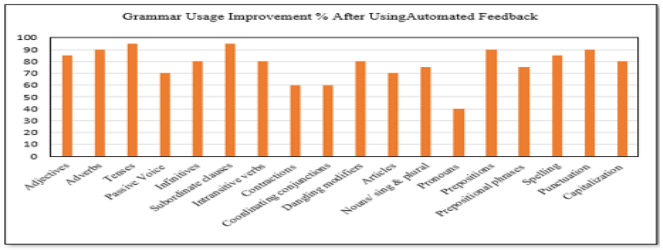

Figure 5. Participants' Improvements of Grammar Rules After Using Automated Feedback

As displayed in Figure 4, the participants benefited from the automated feedback to improve various areas, including: (a) writing structures, with 90%; (b) style, with 78%; (c) coherence, with 87%; and (d) cohesion, with 80%; (e) clarity, with 87%; (f) accuracy, with 80%; and (g) readability, with 95%. Results revealed that automated feedback assisted the participants in correcting morphological, lexical, syntactic, and semantic errors with the rates of 85%, 80%, 90%, and 91%, respectively. Furthermore, Figure 5 shows specific grammar aspects that the participants improved, including enhancements in using adjectives, with a percentage of 85%, adverbs with 90%, tenses with 95%, passive voice with 70%, and infinitives with 80%. Other specific grammar aspects improvements include using subordinate clauses with a percentage of 95%, intransitive verbs with 80%, prepositional phrases with 75%, contractions, and coordinating conjunctions with 60%, respectively. Additionally, spelling improvement reached a percentage of 85%, punctuation with 90%, and capitalization with a percentage of 80%. These results reveal development of the participants' mechanics of the language, which reflected development of writing accuracy and quality.

V. Discussion and Findings

The findings revealed significant impacts of automated feedback on EFL students' self-regulated cognitive and metacognitive writing strategies, reflected in an overall mean score and *SD* of 3.75 ± 0.69 (see Table 7), confirming the beneficial effects of automated feedback on improving writing performance. These findings align with prior research (Bellhäuser et al., 2023; Karagul & Seker, 2021; Theobald & Bellhäuser, 2022; Tian et al., 2022), demonstrating consistency in the observed findings. The current study findings pointed to a (73%) development of cognitive strategies of language use, including grammar, spelling, punctuation, as reflected in the writing assignments grades (see Figure 3), with an overall mean score and *SD* of 3.86 ± 0.78 (see Table 1). Concerning the cognitive strategy of writing revision, the findings indicated an overall mean score of (3.73 ± 0.88), which encompasses the aspects of revising cohesiveness and establishing connection among sentences (see Table 2), reflected by (70%) in the writing assignments (see Figure 3). These findings reflect improvements in language mechanics, influencing writing accuracy and quality. Meanwhile, development of metacognitive strategies, including idea planning and goal-oriented monitoring and evaluation, reached (75%) and (77%), respectively (see Figure 3), with an overall mean score and *SD* of (3.87 ± 0.79) and (3.59 ± 0.87), respectively (see Tables 3 & 4). These findings indicate that handling feedback goes beyond general revision activities; it involves employing context-specific strategies that students utilize in response to feedback. These findings reveal that the strategies of planning the ideas, language usage, revision, and monitoring the assignment goals are intertwined, and that the self-regulated approach, enhanced in automated feedback, enables students to improve their writing

independently. In alignment with these results, Teng and Zhan (2023) examined the variables that affect writing, including task complexity, proficiency, and self-regulated writing strategies, asserting that self-regulated strategies can help student develop the necessary skills to become independent writers. Fitria (2021) found that automated feedback assisted students to develop cognitive abilities to understand the mechanics of writing, completing their writing tasks free of grammatical errors. Similar findings by Barrot (2023), and Koltovskaia (2020) indicated that automated feedback provides students with immediate report on grammatical corrections, syntactical structures, and vocabulary usage, addressing language problems, helping them improve writing accuracy. Fan and Ma (2022) found empirical evidence that automated feedback has positive effects on writing quality, as the automated editing process directs students to improve writing structures and styles. Similarly, Zhang (2020) asserted that students who interact with automated feedback, particularly in the revision process, improve the writing process, emphasizing that student engagement with the feedback is a crucial factor in their writing development.

The current study also found a significant impact of automated feedback on motivational and social strategies, revealed with an overall mean score of 3.97 ± 0.89 (see Table 5 & Table 6), reflected by the rates of 87% and 80%, respectively in their writing assignments (see Figure 3). These findings affirm positive influence of automated feedback on writing development. The present study's findings align with previous research in emphasizing the importance of developing motivational strategies for increasing students' awareness of intrinsic motivation when they use automated feedback. In the same line, Finn (2021) found that the interplay between motivation and cognition provides additional insights into students' self-regulatory learning behaviors, indicating that motivation is rooted in students' achievement experiences, subsequently influencing their effort and learning strategies. Golparvar and Khafi (2023), and Sun et al. (2023) found that automated feedback fosters critical thinking skills, which, in turn, enhances motivation, as students are encouraged to reflect on their writing for a better understanding of the writing process. Guo and Bai (2022) found positive effects of self-regulated learning strategies on motivation in EFL writing, affirming the vital role that self-regulated strategies play in the development of self-efficacy. In this respect, Geng and Razali (2022), and Karagul and Seker (2021) revealed automated feedback significantly enhanced students' self-regulated learning while developing cognitive, metacognitive, motivational, and social strategies through daily practices. Wijaya (2021) found that self-regulated strategies help EFL students become metacognitively and motivationally independent, competent, and strategic academic writers. Additionally, the current study findings pointed to the effect of automated feedback on writing performance. Comparing participants' written assignment scores before and after using automated feedback, the results showed a (62%) improvement in performance among low-proficient students (see Figure 2). There were improvements in writing structures, reaching (90%) for style, (78%) for coherence, and (87%) for cohesion (see Figure 4). The findings revealed specific grammar aspects that the participants improved, including using adjectives, adverbs, passive voice, infinitives, subordinate clauses, intransitive verbs, coordinating conjunctions, and prepositional phrases (see Figure 5). In alignment with these findings, Sun et al. (2023) affirmed the relationship between EFL developing cognitive and metacognitive abilities and writing performance. Teng and Zhan (2024) concluded that the integration of automated feedback among lower-proficiency EFL learners is effective for improving their writing style and overall language abilities. Similarly, Mayordomo et al. (2022) and Yang et al. (2023) identified positive impacts of automated feedback on the acquisition of self-regulated writing strategies. This was achieved through the development of engagement and motivational interactions with automated feedback, leading to an improvement in writing quality, particularly among low-proficient students. Similar findings were revealed by Karagul and Seker's (2021) study, showing a significant increase in the use of self-regulated writing strategies in the experimental group when automated feedback was used as an intervention to enhance their low performance, affirming a correlation between cognitive and metacognitive strategies and L2 writing performance.

VI. Recommendations and Conclusion

The present study points to a number of implications. First, automated feedback can provide instant reports to help students identify and correct errors in real-time, reinforcing their awareness of the importance of revision as an integral component of the writing process. Secondly, automated feedback assists students to develop cognitive and metacognitive strategies, enhancing critical and reflective thinking, while understanding the cycle of continuous writing and editing. Students become aware that the writing process involves planning, monitoring, evaluation, revision, and rephrasing. Thirdly, automated feedback plays an important role in motivating students through increased engagement and persistence in self-regulated learning, especially in writing ability, which many learners find daunting. Thus, the study recommends using automated feedback in EFL writing classes as it offers numerous advantages for enhancing students' writing skills. It provides students with immediate, personalized feedback for improving the quality of their writing. By receiving consistent feedback, students are encouraged to take a more active role in their writing process. They learn to set goals, monitor their progress, and make revisions independently, fostering a sense of autonomy and self-efficacy, enhancing self-regulated strategies for better performance in writing. In conclusion, this study explored the challenges that EFL Saudi students encounter in writing, aiming at examining the impacts of automated feedback on developing cognitive and metacognitive self-regulated writing strategies. The study found that the integration of automated feedback into the EFL instruction stands as a powerful solution to deal with the difficulties students face in writing, enabling them to improve performance. The advantages of incorporating automated feedback into EFL writing

classes extend beyond mere correction as it involves the cultivation of autonomy and self-reliance. Through immediate and personalized feedback, students are encouraged to take ownership of their writing process. This shift towards self-regulation not only enhances their writing skills, but also fosters a sense of self-efficacy that can be applied across various academic endeavors. Therefore, this study suggests the incorporation of automated feedback into EFL curriculum and instruction to foster students' self-reliance and proficiency in writing.

FUNDING

This work was supported and funded by the Deanship of Scientific Research at Imam Mohammad Ibn Saud Islamic University (IMSIU) (grant number IMSIU-RG23015).

REFERENCES

[1] Barrot, J. S. (2023). Using automated written corrective feedback in the writing classrooms: effects on L2 writing accuracy. *Computer Assisted Language Learning*, *36*(4), 584-607.
[2] Bellhäuser, H., Dignath, C., & Theobald, M. (2023). Daily automated feedback enhances self-regulated learning: a longitudinal randomized field experiment. *Frontiers in Psychology*, *18*(14), 1125873.
[3] Brenner, C. A. (2022). Self-regulated learning, self-determination theory and teacher candidates' development of competency-based teaching practices. *Smart Learning Environments*, *9*, 3-10.
[4] Burstein J, Riordan B, & McCaffrey D. (2020). *Expanding automated writing evaluation: Handbook of automated scoring,* (pp. 329–346). eBook. https://doi.org/10.1201/9781351264808
[5] Camacho, A., Alves, R. A., De Smedt, F. et al. (2021). Relations among motivation, behavior, and performance in writing: a multiple-group structural equation modeling study. *British Journal of Education Psychology*, *91*, 1456–1480.
[6] Chen, J., Zhang, J., & Chen, X. (2022). L2 learners' self-regulated learning strategies and self-efficacy for writing achievement: A latent profile analysis. *Language Teaching Research*, *9*, 3-62.
[7] Cotos, E. (2023). Automated feedback on writing. In Kruse, O., *et al*. *Digital Writing Technologies in Higher Education.* Springer, 347-254.
[8] DeSmedt, F., Landrieu, Y., DeWever, B. & VanKeer, H. (2023). The role of writing motives in the interplay between implicit theories, achievement goals, self-efficacy, and writing performance. *Frontiers in Psychology*, *14*, 1149923.
[9] Dizon, G., & Gayed, M. (2021). Examining the impact of Grammarly on the quality of mobile L2 writing. *JALT CALL Journal*, *17*(2), 74-92.
[10] Fan, N., & Ma, Y. (2022). The effects of automated writing evaluation (AWE) feedback on students' English writing quality: systematic literature review. *Language Teaching Research Quarterly*, *28*, 53–73.
[11] Finn, B. (2021). Exploring interactions between motivation and cognition to better shape self-regulated learning. *Journal of Applied Research in Memory and Cognition*, *9*(4), 461–467.
[12] Fu, Q., Zou, D., Xie, H., & Cheng, G. (2022). A review of AWE feedback: Types, learning outcomes, and implications. *Computer Assisted Language Learning*, 1–43.
[13] Gayed, J., Carlon, M., Oriola, A. et al. (2022). Exploring an AI-based writing assistant's impact on English language learners. *Computers and Education: Artificial Intelligence*, *3*, 1-7.
[14] Geng, J. & Razali, A. (2022).Effectiveness of the automated writing evaluation program on improving undergraduates' writing performance. *English Language Teaching*, *15*(7), 49-60.
[15] Godwin-Jones, R. (2022). Partnering with AI: intelligent writing assistance and instructed language learning. *Language. Learning & Technology*, *26*(2), 5–24.
[16] Golparvar, S., & Khafi, A. (2023). The role of L2 writing self-efficacy in integrated writing strategy use and performance. *Assessing Writing*, *47*(1), 100504.
[17] Guo W., & Bai, B. (2022). Effects of self-regulated learning strategy use on motivation in EFL writing: a comparison between high and low achievers in Hong Kong primary schools. *Applied Linguistics Review*, *13*, 117–139.
[18] Han, T., & Sari, E. (2022). An investigation on the use of automated feedback in Turkish EFL students' writing classes. *Computer Assisted Language Learning*, 1–24.
[19] Hayes J., & Hayes A. (ed.). (2022). *Introduction to mediation, moderation, and conditional process analysis: a regression-based approach* (3rd ed.). Guilford.
[20] Karagul, B., & Seker, M. (2021). Improving language learners' use of self-regulated writing strategies through screencast feedback. *SAGE Open*, *11*(4), 1-14.
[21] Koltovskaia, S. (2020). Student engagement with automated written corrective feedback (AWCF) provided by Grammarly: s multiple case study. *Assessing Writing*, *44*, 100450.
[22] Kormos, J. (2023). The role of cognitive factors in second language writing and writing to learn a second language. *Studies in Second Language Acquisition*, *45*(3), 622-646.
[23] Lee, Y. (2020). The long-term effect of automated writing evaluation feedback on writing development. *English Teaching*, *75*(1), 67-92.
[24] Li, R. (2021). Modeling continuance intention to use automated writing among Chinese EFL learners. *SAGE Open*, 1-10.
[25] Ling, Guangming, Elliot, N., Burstein, J. C., McCaffrey et al. (2021). Writing motivation: a validation study of self-judgement and performance. *Assessing Writing*, *48*, *1-15*.
[26] Link, S., Mehrzad, M., & Rahimi, M. (2022). Impact of automated writing evaluation on teacher feedback, student revision, and writing improvement. *Computer Assisted Language Learning*, *35*(4), 605–634.
[27] Mayordomo, R. Espasa, A., Guasch, T., & Martínez-Melo, M. (2022). Perception of online feedback and its impact on cognitive and emotional engagement with feedback. *Education and Information Technologies*, *27*(6), 7947–7971.

[28] Mitchell, K., Zumbrunn, S., Berry, D. et al. (2023). Writing self-efficacy in postsecondary students: a scoping review. *Education Psychology Review*, *35(*82), 45-80.
[29] Nazari, N., Shabbir, M., & Setiawan, R. (2021). Application of artificial intelligence powered digital writing assistant in higher education: randomized controlled trial. *Heliyon*, *7*(5), e07014.
[30] Orpheus Tech. (2023). *Pro-writing aid automate feedback*. Retrieved March, 2023, https://powritingaid.com/
[31] Rusdin, D., Mukminatien, N., Suryati, N. et al. (2023). Critical thinking in the AI era: An exploration of EFL students' perceptions, benefits, and limitations. *Cogent Education*, *11*, 2290342, 1-18.
[32] Shi, H. & Aryadoust, V. (2022). A systematic review of automated writing evaluation systems. *Education and Information Technologies*, 1–25.
[33] Sun, T., & Wang, C. (2020). College learners' writing self-efficacy and writing self-regulated learning strategies in learning English as a foreign language. *System*, *90*, 102221.
[34] Sun, T., Wang, C., & Wang, Y. (2022). The effectiveness of self-regulated strategy development on improving English writing: Evidence from the last decade. *Reading &Writing*, *35*(10), 2497-2522.
[35] Sun, Q., Pan, H., & Zhan, J. (2023). Untangling the relationship between English as a foreign language learners' metacognitive experience and writing proficiency: A mixed-methods approach, *System*, *117*, 103100.
[36] Teng, F. (2020). The role of metacognitive knowledge and regulation in mediating university EFL learners' writing performance. *Innovation in Language Learning and Teaching*, *14*(5), 436–450.
[37] Teng, L., & Zhang, L. (2016). A questionnaire-based validation of multidimensional models of self-regulated learning strategies. *Modern Language Journal*, *100*, 674–701.
[38] Teng, M., & Zhan, Y. (2023). Assessing self-regulated writing strategies, self-efficacy, task complexity, and performance in English academic writing. *Assessing Writing*, *57*,100728.
[39] Teng, M., & Zhan, Y. (2024). Assessing self-regulated writing strategies, working memory, L2 proficiency level, and multimedia writing performance. *Language Awareness*, 1-28.
[40] Theobald, M., & Bellhäuser, H. (2022). How am I going and where to next? Elaborated online feedback improves university students' self-regulated learning and performance. *Internet &Higher Education*, *55*, 1-49.
[41] Tian, L., Liu, Q., & Zhang, X. (2022). Self- students' revision regulated writing strategy use when revising upon automated, peer, and teacher feedback in an online English as a foreign language writing course. *Frontiers in Psychology*, *13*, 1–12.
[42] Uwe, M. & Klotz, C. (2022). Personalized feedback in digital learning environments: Classification framework and literature review. *Computers and Education: Artificial Intelligence*, *3*, 100080.
[43] Waer, H. (2021). The effect of integrating automated writing evaluation on EFL writing apprehension and grammatical knowledge. *Innovation in Language Learning and Teaching*, 1–25.
[44] Wambsganss, T., Janson, A., & Leimeister, J. (2022). Enhancing argumentative writing with automated feedback and social comparison nudging. *Computers & Education*, *191*,104644.
[45] Wei, P., Wang, X. & Dong, H. (2023). The impact of automated writing evaluation on second language writing skills of Chinese EFL learners: a randomized controlled trial. *Frontiers in Psychology*, *14*, 124999.
[46] Wijaya, K.F. (2021). English education master students' self-regulated learning strategies in academic writing. *Journal of English teaching*, *7*(1), 15-29.
[47] Woodworth, J., & Barkaoui, K. (2020). Perspectives on using automated writing evaluation systems to provide written corrective feedback in ESL classroom. *TESL Canada Journal*, *37*(2), 234–247.
[48] Yang, H., Gao, C. & Shen, H. (2023). Learner interaction with, and response to, AI-programmed automated writing evaluation feedback in EFL writing: exploratory study. *Education &Information Technologies*, 1-22.
[49] Zhang, Z. (2020). Engaging with automated writing evaluation (AWE) feedback on L2 writing: Student perceptions and revisions. *Assessing Writing*, *43*, 100439–100414.
[50] Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, *41*(2), 64–70.
[51] Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, *45*, 166–183.
[52] Zimmerman, B. J. (2013). *Self-regulated learning and academic achievement: Theoretical perspectives*. Routledge.

Amal Abdul-Aziz Mohammed Al-Othman received her PhD in Applied Linguistics from IMSIU, College of Languages and Translation, English department with the first honor degree. She has been teaching English since 2004. Her research interests include EFL writing and Language acquisition, computational linguistics, phonology, sociolinguistics grammatical theory, historical linguistics, and psycholinguistics. Email: aalothman@imamu.edu.sa