Impact of flipped classroom on EFL learners' self- regulated learning and higher-order thinking skills during the Covid19 pandemic

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Abstract

The advent of innovative online tools has ushered in new possibilities for enhancing the quality of language learning. This study delved into the influence of the flipped classroom approach on augmenting the cognitive and meta-cognitive competence of EFL learners. Two distinct participant groups were enlisted for the study's sequential phases, necessitating varying sample sizes to compare the effects of the flipped classroom against traditional instructional modes on the improvement of EFL learners' self-regulated learning strategies and higher-order thinking. Homogeneous groups of language learners were essential for addressing the research inquiries, and participants were selected from two private language institutes in Arak, Iran. Multiple data sources, including a language proficiency test, the Self-Regulation Questionnaire, a flipped classroom attitude questionnaire, and the Higher-Order Thinking Skills Test, were employed to gather the necessary data. The results demonstrated a significant impact of flipped classrooms on learners' utilization of cognitive self-regulated learning strategies, indicating that the flipped classroom approach fosters students' development as self-directed learners. Concerning the influence of the flipped classroom on enhancing EFL learners' higher-order thinking skills, it was deduced that the flipped classroom significantly affected the learners' engagement in evaluating, analyzing, and creating. The implications of these findings underscore the potential of the flipped classroom approach to positively shape EFL learners' self-regulated learning and higher-order thinking skills, advocating for its incorporation into language education practices.

Keywords: Flipped classroom, Learners, Self- regulated learning, Higher-order thinking skills, Cognitive and metacognitive strategies

Introduction

The global COVID-19 pandemic has compelled educational institutions worldwide to embrace online learning measures to mitigate the virus's spread. UNESCO reports that the pandemic has disrupted the learning of over 290.5 million students due to

widespread school closures (Yulistiana, 2020). In response to these challenges, the flipped classroom (FC) emerges as an instructional technique, falling under blended learning, aiming to transform the conventional classroom model. This approach emphasizes optimizing class time effectively by leveraging technology to invert the traditional roles of classroom and home-based activities (Warden, 2016). Teachers, recognizing the potential of the FC model, have increasingly incorporated it into their instructional practices (Fraga & Harmon, 2015). In this model, activities traditionally conducted in the classroom, such as lectures, take place outside class, allowing in-class time for interactive learning experiences (Fraga et al., 2015).

Despite the reported positive impacts of FC on learners' achievement, satisfaction, and participation, empirical evidence regarding its effectiveness in enhancing language learning remains scarce (Kim, 2014; Mehring, 2016). While FC benefits, such as increased higher-order thinking skills, have been discussed, there is a notable lack of empirical studies, particularly within the realms of self-regulated learning and higher-order thinking. As electronic learning gives way to traditional approaches, the continuity of the teaching and learning process is imperative (Holmes et al., 2020). Given the limited exploration of FC in the context of self-regulated learning and higher-order thinking, there is a need for further research to comprehensively assess its impact on these variables.

The existing literature predominantly addresses general aspects of the flipped classroom, leaving a noticeable void in the exploration of its effects on specific variables, such as EFL learners' self-regulated learning and higher-order thinking. While previous studies have focused on related issues, there remains a distinct research gap in understanding the impact of FC on these critical dimensions. Consequently, this research aims to address this gap by investigating how FC, particularly implemented via Google Meet, influences students' self-regulated learning and perceptions, particularly in the post-COVID-19 pandemic context, as compared to traditional classroom settings. This study seeks to contribute valuable insights into the effectiveness of FC in enhancing cognitive and meta-cognitive competencies, filling an existing research gap and offering practical implications for EFL education in Iranian tertiary settings.

Literature review

Numerous researchers have highlighted the efficacy of the flipped classroom in facilitating students' academic achievement (Bergmann & Sams, 2012; Hung, 2015; Lockwood & Folse, 2014). The integration of pre-class and in-class activities empowers students to take greater responsibility for their learning, fostering more interactive and communicative participation in class activities (Namik et al., 2014). The educational landscape has shifted from a teacher-centered approach to one centered around student learning (Lai & Hwang, (Lai et al. 2016)). The flipped learning model represents a pedagogical approach emphasizing active learner participation in collaborative activities, with the teacher adopting a facilitator role rather than that of a traditional instructor (Green, 2015; Sankey & Hunt, 2014). Also known as the inverted classroom model, it redefines the traditional teaching paradigm (Bergmann & Sams, 2012).

Flipped classroom model and self-regulated learning

The year 2020 witnessed substantial changes in people's lives and educational practices due to the global COVID-19 pandemic, prompting universities worldwide to transition to online teaching (Vilkova & Shcheglova, 2021). Consequently, distance education gained popularity, necessitating students to assume responsibility for their learning, marking a shift toward self-regulated learning (SRL) (Jansen et al., 2017).

Self-regulated learning has gained prominence in second language acquisition, with Zimmerman pioneering the exploration of its sub-processes (1986, 1989, 2000, 2009). Notably, students employ diverse strategies to regulate their learning, with variations in both the strategies chosen and their frequency of use (Barnard-Brak et al., 2010; Dörrenbächer & Perels, 2016). Importantly, self-regulation is context-specific, requiring separate examination in online foreign language education due to differences from traditional in-class learning environments (Wang & Zhan, 2020).

A review of the literature classifies SRL strategies into three categories: cognitive, metacognitive, and resource management (Pintrich et al., 1991). Meta-analyses by Richardson et al. (2012) reveal that SRL strategies, including effort regulation, time management, metacognition, elaboration, critical thinking, help-seeking, and concentration, significantly predict students' grades. Notably, effort regulation, time management, elaboration, and metacognition consistently exhibit the highest correlation with GPA across studies.

Puzziferro (2008) discovered, among 815 online liberal arts students, that someone who scored higher on the subscales of effort regulation and time management can gain higher final grades although none of the other SRL strategies (rehearsal, elaboration, organization, critical thinking, metacognition, peer learning, or help seeking) were found to be meaningfully related to grade. Similar to aforementioned study, Carson's (2011) huge study of 4909 first year online students also indicated that effort regulation and time management and metacognition had a small positive correlation with grade. Their weighted mean correlations (ranged from 0.05 to 0.14), were lower than those found by Richardson et al. (2012).

The flipped classroom model and higher- order thinking

The term "flipped classroom" is often associated with e-learning due to its heavy reliance on technology, wherein students engage in independent computer-based learning outside the classroom and collaborate with peers in small groups during class time (Bishop & Verleger, 2013). Despite criticisms of the buzzword nature of "flipped classroom," proponents argue that it enhances flexibility in learning, fosters student achievement, and enables creative teaching (Couch, 2014; Herreid & Schiller, 2013). Chua and Lateef (2014) further note the widespread acceptance of the model among university students in Asia.

Higher-order thinking involves critical and creative thinking to solve complex problems, a central goal in modern curriculum reform (Leung, 2013; Yeung, 2012). Smith (2007) emphasizes the use of open-ended questions to stimulate comparisons, justifications, and searches based on prior knowledge, contributing to the development of higher-order thinking skills. Leung (2013) advocates for active learning strategies to enhance higher-order thinking, and research suggests that the flipped classroom

supports this by allowing students to pause videos for content comprehension (Hamdan et al., 2013; Herreid & Schiller, 2013).

Lankford (2013) underscores that the flipped classroom model empowers facilitators to allocate classroom time to the top layers of Bloom's taxonomy, focusing on application, synthesis, evaluation, and analysis. Nederveld and Berge (2015) argue that flipped learning enables instructors to dedicate classroom time to application and higher-level learning rather than traditional lecturing and lower-level thinking tasks. Zainuddin and Halili (2016) highlight the use of classroom tools in flipped learning, such as group discussions, which afford students more time for higher-level learning. This study aims to address the following research questions:

1- Is there a significant difference between FCIM and conventional modes of instruction in enhancing EFL learners' self-regulated learning strategies?
2- Is there a significant difference between FCIM and conventional modes of instruction in enhancing EFL learners' higher-order thinking using the flipped classroom approach?
3- Are there any significant relationships between students' higher-order thinking skills and self-regulated learning in the flipped classroom?

Methodology

Design and participants

In the two distinct phases of the study, two cohorts of participants were carefully chosen. The quantitative phase, which sought to compare the impact of Flipped Classroom Instructional Mode (FCIM) and conventional instructional modes on enhancing EFL learners' self-regulated learning strategies, necessitated two disparate sample sizes. Specifically addressing research questions 1 and 2, two groups of homogeneous language learners were required. To meet the minimum requirement for ensuring normal distribution of the data, each group required 30 participants. Consequently, the researcher identified and selected four intact classes, each comprising 15 language learners. Two of these intact classes, totaling 40 language learners, were designated for FCIM, while the remaining two intact classes, also comprising 40 language learners, were allocated to the conventional instruction mode. For the third research question, which aimed to explore the relationships between students' higher-order thinking skills and self-regulated learning in a flipped classroom, a total of 40 freshman English students, including 18 females and 22 males, were selected. The participants were drawn from two private language institutes, specifically Is Iran and Milan, located in Arak.

Diverse research methodologies were deployed to address the research questions. For research questions 1 and 2, a quasi-experimental research method was employed, whereby intact groups were assigned to two distinct treatment conditions: Flipped instruction and conventional teaching. The research design utilized pretest/posttest control and experimental groups. In addressing the third research question, a correlational research design, a subtype of ex-post facto research designs, was adopted. The study variables, measured on an interval scale, encompassed the sub-components of Self-Regulated Learning Strategies (SRLS) and the sub-components of Higher-Order Thinking Skills (HOTS).

Instruments

In this study, three distinct instruments were utilized for comprehensive data collection, each meticulously outlined below.

Language Proficiency Test To ensure the homogeneity of language learners, a language proficiency test was administered. The test encompassed multiple sections:

- Reading: Comprising three parts with various question formats, including multiple-choice items, matching exercises, and a cloze test.
- Writing: Involving the reading of a short story and responding to related questions.
- Listening: Consisting of participants listening to a recorded text and answering associated questions.
- Speaking: Comprising two parts, with each participant undergoing this section concurrently with another candidate.

> The reliability of the test was estimated using KR-21, and the reliability was found to exceed 0.82 for all modules, which seemed to be acceptable.

Higher-Order Thinking Skills (HOTS) Test Developed by Alsowat ([2016](#)), this questionnaire aimed to evaluate students' thinking skills, specifically analyzing, evaluating, and creating. The content covered in both experimental and control groups spanned units 1–10 over a 13-week period (26 h). Aligned with the revised Bloom's taxonomy, only higher-order thinking skills were incorporated into the test. A meticulous content analysis, employing a table of specifications, ensured comprehensive coverage of all lessons and higher-order thinking skills. The reliability of the test was affirmed through administration to a pilot group (30 students), yielding an acceptable internal consistency score of 0.73 as assessed by the KR-21 formula.

The Self-Regulation Questionnaire (SRQ) Originating from the work of Pintrich and De Groot (1990) and subsequently translated and validated by Mousavinejad ([1998](#)), the SRQ consisted of 47 statements categorized into two principal components: motivational beliefs and self-regulation learning strategies, encompassing cognitive and metacognitive strategies. The self-regulated learning strategies subscale included 22 items, measuring three facets of academic self-regulation: cognitive strategies, metacognitive strategies, and resource management.

Procedure

The study was conducted through a systematic procedure involving multiple stages. Initially, four intact groups were designated to distinct treatment conditions. Both control and experimental classes underwent placement tests, Higher-Order Thinking Skills (HOTS) assessments, and evaluations of self-regulated learning strategies at the commencement of the study. Two intact groups received flipped classroom instruction, while the remaining two received conventional instruction. Following the completion of the prescribed treatment, HOTS and self-regulated learning strategy (SRLS) scales were administered to both control and experimental groups. Subsequently, their scores, along with their respective components, were subjected to comparative analysis using appropriate data analysis techniques.

To assess the impact of the Flipped Classroom Instructional Model (FCIM) on students' higher-order thinking skills (HOTS), self-regulated learning, and attitude, specific units from the general English Language course were selected. The control group adhered to traditional teaching methods, while the experimental group experienced FCIM. Both groups were instructed by the researcher, and the treatment spanned ten weeks, with two lectures (100 min each) per week. Before each session, the treatment group received instructional content via the Google Meet platform four days in advance. Students were required to review the content, respond to provided questions related to evaluation, comprehension, and analysis, and submit their answers two days before the class for assessment. The class sessions were organized into three segments:

1 The first part (20 min) focused on reviewing students' answers and providing corrective feedback.
2 The second part (60 min) constituted the core of the class, with planned activities targeting higher-order thinking skills and self-regulated learning strategies. Students collaborated in pairs or groups to discuss assigned ideas or problems, and feedback was provided after each activity.
3 The third part (20 min) was dedicated to revisiting the entire learning outcome, summarizing key points, and allowing students to raise questions and write a brief lesson summary.

Data analysis

Data collected from this study underwent a rigorous analysis process to derive meaningful insights and draw valid conclusions. The analysis encompassed several key steps, including descriptive statistics, inferential statistics, and thematic analysis. Descriptive statistics were employed to provide a comprehensive summary of the main features of the dataset. This involved calculating measures such as mean, median, standard deviation, and range for each variable under investigation. Various statistical tests, including t-tests were conducted to examine the significance of differences between groups. Additionally, correlation analyses were performed to explore relationships between different variables.

Results

The quantitative data underwent various analytical procedures. Initially, independent sample t-tests were employed to compare the scores of the control and experimental groups across all constructs measured by the two scales for research questions 1 and 2. Additionally, the researcher computed the mean, standard deviation, and variances of the group scores. Regarding research question two, a Pearson Correlation Coefficient was computed to explore the correlation between the groups' scores on Higher-Order Thinking Skills (HOTS) and Self-Regulated Learning Strategies (SRLS).

The research question sought to examine whether the Flipped Classroom Instructional Model (FCIM) and conventional modes of instruction exhibited significant

Table 1 T-test for comparing the groups' use of self-regulated learning strategies before the treatment

		Levene's test for equality of variances		t-test		
				t	df	p
Cognitive	Summarizing	1.6	0.251	− 1.530	78	0.131
	Rehearsal	1.7	0.23	− 1.905	78	0.061
	organization	1.3	0.24	− 2.175	78	0.033
	Comprehension	0.381	0.56	− 0.737	78	0.463
Meta-cognitive	Planning	0.323	0.501	− 0.314	78	0.754
	Ordering	0.099	0.77	− 2.088	78	0.765
	Monitoring	0.381	0.621	0.280	78	0.780
Motivational	Self-efficacy	1.81	0.25	− 0.896	78	0.373
	Orientation	0.521	0.411	− 0.558	78	0.579
	Intrinsic values	1.62	0.33	1.055	78	0.295
	Test anxiety	0.61	0.73	− 0.375	78	0.709
Total		1.6	0.321	− 2.046	78	0.06

Table 2 T-test for comparing the groups' use of self-regulated learning strategies after the treatment

		Levene's test for wquality of variances		t-test		
				t	df	p
Cognitive	Summarizing	1.354	0.249	7.3	78	0.000
	Rehearsal	1.407	0.240	4.42	78	0.000
	organization	0.044	0.834	5.2	78	0.000
	Comprehension	1.2	0.31	7.5	78	0.001
Meta-cognitive	Planning	1.8	0.27	5.13	78	0.001
	Supervision and control	0.09	0.91	6.1	78	0.001
	effort regulation	0.93	0.11	6.8	78	0.000
Motivational	Self-efficacy	1.63	0.23	4.3	78	0.001
	goal orientation	0.53	0.47	10.11	78	0.001
	Intrinsic values	1.4	0.24	2.1	78	0.09
	Test anxiety	0.09	0.72	0.66	78	0.11
Total		1.6	0.25	3.12	78	0.001

differences in enhancing EFL learners' self-regulated learning strategies. Independent sample t-tests were conducted on the group scores from the pre-test and post-test, and the outcomes are detailed in the subsequent sections.

Question 1: comparing the groups' self-regulated learning skills before the treatment

The mean scores of the FCIM and conventional groups on the SRLS and its components were submitted to independent samples-t-tests. Results are shown in.

As is seen in Table 1, there was no statistically significant difference between the two groups mean scores on the self-regulated learning skills at the onset of the treatment ($p > 0.05$), suggesting that both groups used the self-regulated learning strategies equally.

As is seen in Table 2, the treatment significantly affected the sub-categories of cognitive self-regulated learning strategies (summarizing, rehearsal, organization, and

Table 3 T-test for comparing the groups' scores on HOTS

HOTS	Levene's test for equality of variances		t-test		
	F	Sig	t	df	p
Analyzing	0.003	0.954	0.381	78	0.704
Evaluating	1.659	0.202	− 0.763	78	0.448
Creating	0.076	0.784	− 1.119	78	0.267
Total	0.339	0.562	− 0.733	78	0.466

Table 4 T-test for comparing the groups' scores on HOTS after the treatment

HOTS	Levene's test for equality of variances		t-test		
	F	Sig	T	Df	p
Analyzing	1.9	0.09	6.762	78	0.001
Evaluating	1.826	0.181	3.712	78	0.001
Creating	3.027	0.086	4.301	78	0.001
Total	2.581	0.0.13	7.161	78	0.001

comprehension). Detailed analysis shows that the differences between the groups' means on summarizing (t=7.3, df=78, p=0.001), rehearsal (t=4.42, df=78, p=0.001), organization (t=5.2, df=78, p=0.001), and comprehension (t=6.1, df=78, p=0.001) were statistically significantly, favoring the group exposed to flipped learning condition.

Concerning the second category, meta-cognitive strategies (planning, ordering, and monitoring), results show that the two groups' mean scores were statistically significant ($p > 0.05$). Further detailed analysis shows that the control group's mean scores on planning, ordering, and monitoring were 3.1, 3.2, and 3.3, respectively. However, the experimental group obtained mean scores of 3.8, 3.9, and 4.1, respectively, suggesting that the experimental group outperformed the control group.

However, it can be seen that the flipped learning approach affected two sub-categories of motivational self-regulated learning strategies but did not affect the other two sub-categories. Further analysis indicates that the difference between the two groups' scores on self-efficacy (t=4.3, df=78, p=0.001) and orientation (t=10.11, df=78, p=0.001) was statistically significant. In contrast, the two groups mean scores on the test anxiety and intrinsic values were not statistically different ($p > 0.05$).

Research question 2

The second research question aimed at investigating whether FCIM and conventional modes of instruction are significantly different in enhancing EFL learners' higher-order thinking using the flipped classroom approach or not. The group's mean scores on pre-test and post-test were submitted to independent samples-t-tests. The two groups' mean scores on HOTS were submitted to three independent samples-t-tests. Results are presented in Table 3

As is seen in Table 3, the two groups' scores on HOTS ($p = 0.46$), analyzing ($p = 0.70$), evaluating ($p = 0.44$), and creating ($p = 0.26$) were not statistically significant, suggesting that the two groups were homogenous in using higher order thinking strategies at the onset of the study. The t-tests for comparing the groups' use of HOTS after the treatment was over are presented in Table 4.

As seen in Table 4, the difference between the conventional group's mean score (M = 3.59, SD = 1.06) and experimental group (M = 4.92, SD = 0.66) on analyzing was statistically significant (t = 6.76, df = 78, $p = 0.001$). It can also be seen that while the conventional group obtained the mean score of 3.86 on evaluating (SD = 0.97), the experimental group obtained the mean score of 4.75 (SD = 0.72), and the mean difference between the two groups was statistically significant (t = 3.72, $p = 0.001$). It can also be seen that the difference between the conventional group's mean (M = 3.87, SD = 0.97) and that of the experimental group (M = 4.64, SD = 0.75) in the creating was statistically significant (t = 4.31, $p = 0.001$). Finally, the groups' means on HOTS were statistically significant (t = 7.16, $p = 0.001$), suggesting that flipped learning conditions significantly contributed to the language learners' higher-order thinking skills. The mean and SD of the groups' scores on the HOTS administered after the treatment are presented in Table 5.

Research question 3

The third research question aimed at exploring the relationship between the participants' scores on HOTS and self-regulated learning strategies. The participant's scores on self-regulated learning strategies and higher order thinking skills were submitted to Pearson Product correlation. Results are presented in Table 6.

As seen in Table 6, there is a significant correlation between cognitive SRLS and Evaluating (r = 0.65, $p = 0.001$), creating (r = 0.42, $p = 0.05$), analyzing (r = 048, $p = 0.05$), and HOTS (r = 0.46, $p = 0.5$). It is also seen that the correlation between summarizing strategy and HOTS and its components is statistically significant ($p = 0.001$), suggesting the higher scores on summarizing strategy, the higher use of HOTS. Findings also reveal that the relationship between rehearsal and analyzing is statistically significant (r = 0.46, $p = 0.05$), but the other sub-categories of HOTS are not correlated with rehearsal. However, the correlation between the other two sub-categories of cognitive skills (organization & comprehension) and all sub-categories of HOTS is statistically significant.

Table 5 Mean and SD of the groups' scores on HOTS administered after the treatment

	Groups	N	Mean	SD
Analyzing	Flipped	40	4.92	0.66
	Conventional	40	3.59	1.04
Creating	Flipped	40	4.64	0.75
	Conventional	40	3.87	0.97
Evaluating	flipped	40	4.75	0.72
	conventional	40	3.86	0.97
HOTS2	flipped	40	14.40	1.46
	conventional	40	11.34	2.07

Table 6 Correlation between the participants' scores on HOTS and self-regulated learning strategies

	Evaluating	Creating	Analyzing	HOTS
Summarizing	0.65**	0.63**	0.68**	0.59**
Rehearsal	0.12	0.13	0.48*	0.16
organization	0.54**	0.71	0.56**	060**
Comprehension	0.63**	0.47**	0.68**	0.61**
Planning	0.46**	0.51**	0.49**	0.48**
Ordering	0.21	0.11	0.12	0.14
Monitoring	0.15	0.14	0.19	0.17
Self-efficacy	0.63**	0.51**	0.56**	0.57**
Orientation	0.56**	0.49**	0.53**	0.56**
Intrinsic values	0.14	0.16	0.10	0.12
Test anxiety	− 0.16	− 0.11	− 0.14	− 0.14
Cognitive	0.54**	0.42*	0.48*	0.46*
Metacognitive	0.46*	0.20	0.15	0.19
Motivational	0.17	0.11	0.13	0.14

($**$ = significant at p = 0.001, $*$ = significant at p = 0.05)

Concerning the correlation between metacognitive strategies and the sub-categories of HOTS, it could be seen that except for evaluating (r = 46, p = 0.05), the correlation between this self-regulated strategy and HOTS and its components is not statistically significant ($p < 0.05$). It is also seen that while the correlation between planning and HOTS and its sub-categories is statistically significant (p = 0.05), the correlation between monitoring and organization and HOTS (evaluation, analyzing, and creating) is not statistically significant. Furthermore, it is seen that, except for orientation (p = 0.001), the correlation between the other motivational strategies (intrinsic values, self-efficacy, and text anxiety) and HOTS (creating, evaluating, and analyzing) is not statistically significant ($p > 0.05$).

Discussion and conclusion

Based on the findings of this study several conclusions can be made. First, with regard to the first question, it could be concluded that flipped classrooms significantly affect the learners' use of the subcategories of cognitive self-regulated learning strategies including summarizing, rehearsal, organization, and comprehension. It can also be concluded that three components of meta-cognitive strategies: planning, ordering, and monitoring, were significantly affected by flipped learning conditions. More specifically, it can be concluded that through attending flipped learning classes, students can summarize, rehearse, organize, and comprehend the assigned tasks before attending the classes. Through attending flipped learning classes, language learners learn to plan, order, and monitor the tasks before attending the EFL teachers' lectures and discussions.

It can also be postulated that the students exposed to flipped classes try to summarize, rehearse, organize, and comprehend the assigned tasks as pre-class activities. Students need to use self-regulated learning strategies because FC is thoroughly defined as a pedagogical strategy that leverages class time for active learning. FC deepens students` conceptual comprehension by giving them homework assignments to perform outside of class.

As Blau and Shamir-Inbal (2017) believe, it can be concluded that the students must constantly review, revise, and check their learning strategies as they advance through the curriculum according to the learning process. In general, flipped learning presents obstacles for students with low self-regulation (Ahmad Uzir, et al., 2020). According to claims made by the authors, students can be in charge of their education by using self-regulated learning (SRL) techniques (Wang & Zhan, 2020). This exposed the lack of a thorough examination of SRL in FC, which highlights the necessity of such a review given that FC needs SRL to flourish.

In line with the results of the study by Rasheed et al. (2020), it can be concluded that students are responsible for determining their own learning needs and applying micro-level task execution strategies to meet their learning goals. So, it can be inferred that for the students, the first step to learning how to manage to learn is to develop their SRL skills. Similarly, Schunk and Zimmerman (2007) concluded that self-regulatory strategies are essential for distance learning. This issue is significant since students have a high degree of autonomy due to the lack of physical presence during online instruction, as also suggested by Thomson et al. (2002). Self-regulation is the skill that students require o be successful in the electronic environment. Self-regulatory strategies are effective for learners in all learning situations but seem to be more important in e-learning settings.

With regard to the impact of FCIM on enhancing EFL learners' higher-order thinking skills, it could be inferred that DCIM significantly affects the EFL learners' use of evaluating, analyzing, and creating. In line with Rodrigues et al. (2019), it can also be inferred that flipped classrooms contribute to better learning outcomes and positively affect critical thinking, creativity, and student satisfaction. It is also inferred that the tasks which students do in the flipped classes help students to apply different higher order thinking skills to more effectively do the assigned tasks. Therefore, teachers and learners. Another reason for the effectiveness of flipped learning in enhancing the use of HOTS is Van Alten et al. (2019). Metanalysis has argued that implementing flipped classrooms requires careful attention to its design, maximizing face-to-face time, and appropriate assessments of the class learning. According to Amanisa and Maftuh (2021), flipped classrooms provide more learning opportunities to the students in both F2F and online mode, which helps enhance higher-order thinking skills. Liu and Zhang (2022) also reported that flipped classroom student achievements and higher order thinking skills were significantly better than their peers who had been taught in a traditional classroom environment. They also provided empirical evidence that higher education achievement and higher order thinking skills can be improved using a WeChat-based flipped classroom approach and is a valuable reference for both instructors and educators on the use of social software.

Concerning the findings of the third research question, which aimed at exploring the relationship between the participants' scores on HOTS and self-regulated learning strategies, it can be concluded that the correlation between cognitive SRLS and higher order thinking strategies is significant, suggesting that the learners who use cognitive strategies tend to more frequently evaluate, create, and analyze tasks. It is also seen that the correlation between summarizing strategy and HOTS and its components is statistically significant suggesting the higher scores on summarizing strategy, the higher use of HOTS. Findings also reveal that the relationship between rehearsal and analyzing is statistically

significant, but the other subcategories of HOTS are not correlated with rehearsal. However, the correlation between the other two subcategories of cognitive skills (organization & comprehension) and all subcategories of HOTS is statistically significant.

With regard to the correlation between metacognitive strategies and the subcategories of HOTS, it could be seen that, except for evaluating, the correlation between this self-regulated strategy and HOTS and its components is not statistically significant. It is also seen that while the correlation between planning and HOTS and its subcategories is statistically significant, the correlation between monitoring and organization and HOTS (evaluation, analyzing, and creating) is not statistically significant. Furthermore, it is seen that the correlation between the other motivational strategies (intrinsic values, self-efficacy, and text anxiety) and HOTS (creating, evaluating, and analyzing) is not statistically significant except for orientation.

Suggestions for Further Studies

In this study, because of the limitations, the researcher was not able to investigate some variables. Therefore, the researchers are recommended to undertake future studies and integrate FC effectively into learning using metrics that highlight key features of the flipped learning environment. The researchers are also required to focus on different models of flipped learning and see how each model might affect the learners' use of SRL strategies. In addition, future studies should consider validating other SRL models used in flipped learning environments. Further research needs to examine different aspects that can contribute to the success of flipped teaching in language learning. Examples that might require further investigation include student aptitudes, learning styles, and cognitive and metacognitive strategies.

Abbreviations

EFL	English as a foreign language
FC	Flipped classroom
FCIM	Flipped language instruction method
HOT	Higher order thinking
SRL	Self-regulated learning
SRQ	Self-regulation questionnaire
HOTS	Higher-order thinking skills test

Declarations

Ethical approval
The authors declare that all authors filled in the consent form and willingly participated in the study.

Competing interests
The authors declare no conflict of interest.

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