THE DEVELOPMENT OF EFL LEARNERS' METACOGNITION IN A FLIPPED CLASSROOM

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Abstract

This study adopts a mixed method in comparing EFL students' development of metacognition in a university flipped classroom versus a regular classroom context. Quantitative survey data were retrieved in order to compare the changes in two groups (N=103) of students in their frequency of metacognitive strategy use. This is supported by qualitative data that revealed learners' metacognitive changes over the course of a semester. A total of 8 students joined two semi-structured interviews, at the beginning and end of the semester respectively. Findings show that while learners in the two contexts did not differ in the frequency of employing metacognitive strategies, qualitative changes in metacognition suggest the positive impact a flipped classroom may have on students' metacognitive development. Implications for teaching and further research are discussed.

1 Introduction

Students at the tertiary level are usually faced with a large quantity of course content in a relatively short period of time. While some students manage their learning well, other students struggle. It is, thus, not surprising to see education research seeking to understand what leads to different learning outcomes, and metacognition has been recognized as one factor that supports student learning. It is generally believed that the development of metacognition is essential to successful learning for it helps learners to manage their cognitive skills (e.g., Gourgey, 2001; Hartman, 2001). While it is task-specific at the initial stage, as students gain more metacognitive knowledge in different domains, they will gradually be able to use this knowledge flexibly and apply it to new areas of learning (Schraw, 1998). In other words, metacognitive ability is not fixed; rather, it is regarded as a construct of developing expertise (Sternberg, 1998) that is in a process of continuous development. How, then, could a classroom environment facilitate students' metacognitive development?

Flipped classroom (hereafter FC), defined as "the blend or mixture of any two instructional technologies" (Caner, 2012, p. 24), has one prominent feature distinct from traditional classrooms—students access teaching content outside of class and get involved in peer discussions, the application of knowledge, or hands-on activities in class. Previous research has demonstrated the impact a teaching model exerts on student's approach to learning (Trigwell, Prosser, & Waterhouse, 1999). Therefore, when students learn in the FC, where they are expected to actively participate in both in-class activities and pre- and/or post-class activities,

a different approach is likely to be adopted to facilitate their own learning. For example, when students are given more control over learning outside of class, they are also granted more opportunities to make use of metacognitive awareness and strategies in order to successfully engage in learning than their counterparts are given in the non-flipped classroom. While the majority of FC research reports educational benefits such as student satisfaction (e.g., Forsey, Low, & Glance, 2013) and increased student-teacher feedback and interactions (Bergman & Sams, 2012; Vaughan, 2014), studies investigating students learning outcome have yielded inconsistent results (Clark, 2015; Lai & Hwang, 2016; Kim, Kim, Khera, & Getman, 2014). Furthermore, a crucial component associated with students' learning—metacognition— deserves more attention in FC research. Therefore, the current study attempts to discover the differences between a flipped classroom and a non-flipped classroom in terms of students' (1) academic gains and (2) metacognitive development.

2 Review of literature

2.1 Flipped classroom

Popularized by two high school chemistry teachers (Bergman & Sams, 2012), the FC has received great attention across different educational levels and disciplines (Lo, Lie, & Hew, 2018). Reversing the traditional learning environment—students learning course content outside of class and teachers bringing activities including homework and discussion into the classroom—has shown to produce a positive effect on student learning. Not only do students perceive this approach as beneficial to their learning (Bishop & Verleger, 2013; Wilson, 2013), better academic performances are also demonstrated (Adnan, 2017; Hung, 2015). Additional benefits of the FC point to different aspects of student learning such as better control of the learning process (Bruff, Fisher, McEwen, & Smith, 2013), more active interactions among teachers and students (Adnan, 2017; Bergmann & Sams, 2012), more overall learning time (Chen Hsieh, Wu, & Marek, 2017), and increased class attendance (Prober & Khan, 2013).

However, the popularity of the FC has led Bergman and Sams (2012) to caution against seeing this approach as mere inversion of traditional instructional order. Specifically speaking, simply asking students to preview course content before class and to complete homework assignments in the classroom does not make it an FC. Rather, the essence lies in the fact that it is "a mindset that redefines teachers' and students' roles with the aim of optimizing student learning" (Tseng, Lin, & Chen, 2018, p.3). In a real FC context, instructors should create "a dynamic and interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter" (Flipped Learning Network, 2014, p. 1). In other words, class time is freed up for students to discuss, practice, and apply newly acquired knowledge through higher-order classroom activities such as group discussions, problem solving activities, and student presentations (Yilmaz & Baydas, 2017).

2.2 Metacognition

Defined as "knowledge and cognition about cognitive phenomena" (Flavell, 1979, p. 906), metacognition can be conceptualized as including three key components: (1) metacognitive knowledge, (2) metacognitive experience, and (3) metacognitive strategies (Lee & Mak, 2018). Metacognitive knowledge refers to one's awareness of cognitive processes, composed of three facets: knowledge of person, task, and strategy (Flavell & Wellman, 1977). An example of

person knowledge in a language learning context involves learners' self knowledge such as personal strengths and weaknesses. Task knowledge refers to knowledge of the purpose or demands of a learning task. Strategy knowledge is knowledge of the strategies learners can use to help them accomplish the task. Metacognitive experience is understood as learners' cognitive or affective experience before, during, or after a task. Examples include learners' judgement of or feelings about the learning task. The last component, metacognitive strategies, refers to skills learners use to regulate their cognitive processes, which consist of planning, monitoring, and evaluating strategies.

Metacognition has in general been found to positively correlate with academic performance, for example, in L1 writing (Harris, Santangelo, & Graham, 2009), L2 writing (Negretti, 2017); L2 reading (Zhang, 2010), and L2 listening (Cross, 2010; Goh, 1997). While the supportive role of metacognition to learning has urged researchers to explore possible ways to raise metacognition, as Lee and Mak (2018) point out, metacognitive instruction for L2 learners in educational settings is not well understood.

Narrowing our focus to the FC environment, we find that past research examining the effectiveness of the FC on learner's metacognition showed inconsistent results. Studies such as van Vliet, Winnips, and Brouwer's (2015) and Hsu and Hsieh's (2014) reveal positive results in terms of students' metacognitive development. However, Yong, Levy, and Lape (2015) reported an insignificant difference in the number of metacognitive strategies used between traditional and flipped classrooms. On the one hand, inconsistent results from previous research communicate the need to explore how students learn in the two contexts. On the other hand, a survey of the previous research shows that the quantitative method was the major tool of investigation even though the qualitative nature of learners' metacognition is less likely to be manifested through such data collection methods. It is hoped that by adopting both quantitative and qualitative methodology, a more comprehensive picture of learners' metacognitive development in the FC could be presented.

3 Research questions

1. What metacognitive development do students in a non-flipped classroom exhibit in the course of a semester?
2. What metacognitive development do students in a flipped classroom exhibit in the course of a semester?
3. What are the differences among students in the two learning contexts?

3.1 Methodology

3.1.1 Context

This research took place in two intact classes with the same course objective: helping students to prepare for the TOEIC® (Test of English for International Communication®) test, which is often regarded as an important language certification for job seekers in Taiwan. Therefore, students enrolled in these two elective courses were mostly those anticipating their imminent job search, juniors and seniors from a variety of majors. Course content included listening and reading skills, vocabulary building, and grammar knowledge. While all the course content taught in the two classes was the same, different approaches—the flipped and non-flipped

approach—were adopted in the two classes for the grammar lessons. The grammar lesson was selected for the FC approach for two reasons. For one thing, gaining grammatical knowledge (rules that are associated with grammatically correct language) takes time and developing grammatical ability (to use grammar for communicative purpose) requires practice (Ellis, 2003). Having students learn the rules outside of class would save precious class time for application and thus help advance students' ability in grammar. For another, the two groups were both comprised of students from various backgrounds differing in their language ability. Having them learn (or for some, review) grammar at home would give students the flexibility to adjust the intensity of their own study time according to their individual grammatical knowledge.

3.1.2 Participants

For the quantitative data, students from both classes ($N_{flip} = 54$, $N_{nonflip} = 49$) completed the same questionnaire on metacognitive strategies and participated in a simulated, short-version TOEIC® at the beginning and the end of the semester. Below is participant information from the two classes.

In order to gain insights into students' metacognitive development, semi-structured interviews were conducted at two points in time—one in week 3 and the other in week 17. A total of 8 students were invited to participate in the interviews, with 4 participants from each class. These students were selected for the diversity of academic disciplines and English levels the represented. Table 1 shows demographic information of the 8 participants.

Table 1. Interview participants' demographic information

Participants	Group	Pseudonyms	College	Pre-test score (%)	Year of study
1	FC	Matt	Construction	52	Senior
2	FC	Doris	Business	69	Senior
3	FC	Anny	Finance	79	Senior
4	FC	Lynn	Construction	80	Senior
5	Non-FC	Harris	Engineering	63	Junior
6	Non-FC	Ingrid	Business	65	Senior
7	Non-FC	Sharon	Business	66	Senior
8	Non-FC	Cody	Business	75	Senior

3.1.3 Instruments

In order to understand students' metacognitive development, both quantitative and qualitative methods were employed. A qualitative approach helped researchers understand students' metacognitive development while their metacognitive strategy use was further drawn from quantitative data elicited from questionnaires. A short version (half the number of official test items) of the TOEIC® was administered to understand students' learning performance after a semester. A detailed description of each data-collecting instrument is provided below:

(1) Metacognitive strategy questionnaire: nine items addressing metacognitive strategies were selected from the 50-item SILL (version 7.0) (Oxford, 1990), the reliability of which have been reported in the range of the .90s in various studies worldwide (Oxford & Ehrman, 1995). This study used the Chinese version translated by Yang (1992), and its high reliability has also been reported (Cronbach's Alpha = .94). A 5-point Likert scale was used, with 1 representing "Never

or almost never true of me" and 5 "Always or almost always true of me". See Appendix 1 for all of the items.

(2)   Short-version TOEIC® mock test: 50 items were selected from the TOEIC Official Test-Preparation Guide Vol.4. The number of questions in each part was reduced to half the official test due to time constraints. The same items were used for both the pre-test and post-test.

(3)   Semi-structured interviews: interview probes were designed to understand students' metacognitive development. All the interviews were conducted in participants' L1, Mandarin Chinese, and all were audio recorded. In the first interview, participants were invited to think about their English learning over the previous year (*Please describe your approach in general to English courses over the past year and how you learned English outside of class time*), their metacognitive awareness of themselves as an English learner (*How would you evaluate yourself as an English learner?*), their metacognitive planning, monitoring, and evaluation (e.g., *Have you found any differences in terms of your attitude or strategy use in learning English over the course of the past year?*), and any changes in attitude or strategy that they had experienced. In the second interview, while the probes were similar to those of the first interview, participants were restricted to talk about their learning in that semester. Other than these questions, they were also invited to reflect on the experience of peer discussion and group competitions (*Tell me how you usually engaged in peer discussion. What do you think of it?*).

3.1.4 Procedure
Figure 1 shows the research procedure of this study, and Figure 2 presents screenshots of sample video lecture content.
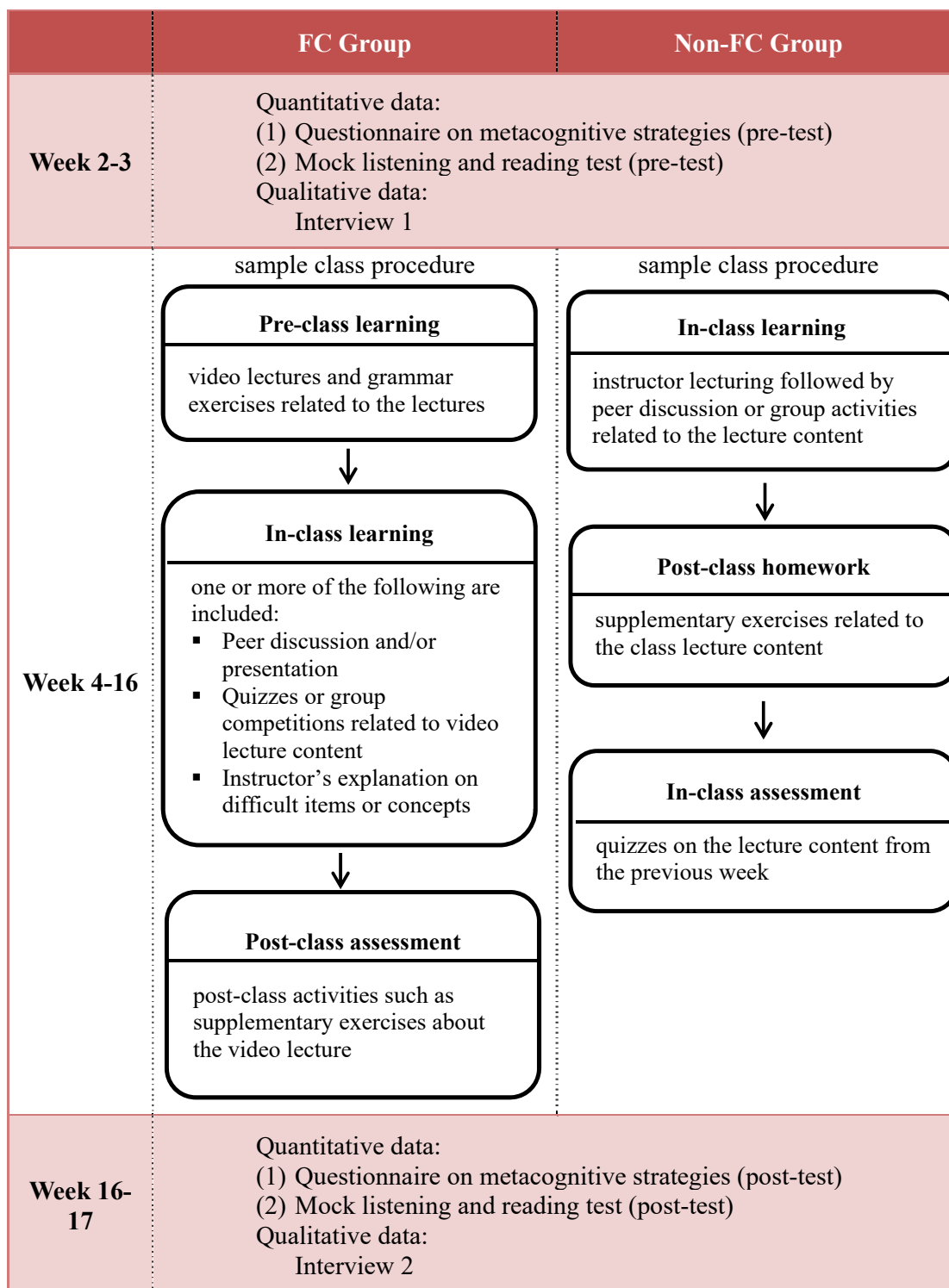
	FC Group	Non-FC Group
Week 2-3	Quantitative data: (1) Questionnaire on metacognitive strategies (pre-test) (2) Mock listening and reading test (pre-test) Qualitative data: Interview 1	
Week 4-16	sample class procedure **Pre-class learning** video lectures and grammar exercises related to the lectures ↓ **In-class learning** one or more of the following are included: ▪ Peer discussion and/or presentation ▪ Quizzes or group competitions related to video lecture content ▪ Instructor's explanation on difficult items or concepts ↓ **Post-class assessment** post-class activities such as supplementary exercises about the video lecture	sample class procedure **In-class learning** instructor lecturing followed by peer discussion or group activities related to the lecture content ↓ **Post-class homework** supplementary exercises related to the class lecture content ↓ **In-class assessment** quizzes on the lecture content from the previous week
Week 16-17	Quantitative data: (1) Questionnaire on metacognitive strategies (post-test) (2) Mock listening and reading test (post-test) Qualitative data: Interview 2	

Fig. 1. Research procedure

Fig. 2 Screenshots of sample video lectures

3.1.5 Data Analysis

Students' metacognitive strategy use and learning performance data of FC and non-FC classes (metacognitive strategies and mock TOEIC® test scores) were transferred to SPSS 20.0 statistical software for analysis. An independent-samples *t*-test examined the differences in metacognitive strategy use and the test scores between the two groups while a paired sample *t*-test showed whether there was a significant difference between pre- and post- tests.

Interview data were all transcribed verbatim for analysis. Data from different participants were compared for similarities and differences, which were then labeled to form categories. Repeated comparisons of the categories were made until themes emerged.

4 Findings

4.1 Quantitative results

The following tables present descriptive statistics of metacognitive strategies and the pre- and post- mock TOEIC® tests.

Table 2. Independent-samples *t*-tests for pre- and post-tests of metacognitive strategies

	Test time	Group	N	Mean	SD
metacognitive strategies	Pre-test	FC	49	3.68	.58
		Non-FC	54	3.30	.47
	Post-test	FC	49	3.71	.49
		Non-FC	54	3.43	.60

Table 3. Independent-samples *t*-tests for pre- and post- mock TOEIC® tests

	Test time	Group	N	Mean	SD
mock TOEIC® test	Pre-test	FC	49	62.70	11.01
		Non-FC	54	61.71	11.69
	Post-test	FC	49	69.96	10.87
		Non-FC	54	69.80	11.41

Before an independent-samples *t*-test was conducted, Levene's Test for Equality of Variances was carried out (see Appendix 2, Tables 4 and 5) on both pre-tests, and the values for both tests were found to be greater than .05, showing that the variability in the pre-test condition in the FC and in the non-FC were about the same.

A comparison of the post-test scores with pre-test scores using a paired sample *t*-test shows that there was a significant improvement in terms of students' mock TOEIC® test scores in both the FC, *t* (48) = -10.12, *p* = .000., and non-FC, *t* (53) = -6.5, *p* = .000. However, after one semester, their metacognitive strategies did not show a significant increase in either of the contexts (Tables 6 and 7). An independent-samples *t*-test conducted on the post-tests reveals that neither the mock TOEIC® test nor the metacognitive strategy results showed any significant difference between the FC and non-FC groups (see Appendix 2, Tables 8 and 9).

Table 6. Paired samples *t*-test for metacognitive strategies and mock TOEIC® test (FC group)

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Meta_pre – Meta_post	-.05669	.55884	.07983	-.21721	.10383	-.710	48	.481
Pair 2 TOEIC_pre – TOEIC_post	-9.735	6.729	.961	-11.668	-7.802	-10.126	48	.000

Table 7. Paired samples *t*-test for metacognitive strategies and mock TOEIC® test (non-FC group)

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Meta_pre – Meta_post	-.09259	.44484	.06053	-.21401	.02882	-1.530	53	.132
Pair 2 TOEIC_pre – TOEIC_post	-5.759	6.457	.879	-7.522	-3.997	-6.554	53	.000

Quantitative data shows that neither the FC nor the non-FC affected the frequency of metacognitive strategy use by the two cohorts of students. It may appear that students' development of metacognitive strategies remained the same after instruction, but the results have to be interpreted with caution. In language learning strategy literature, there has been a shift of focus from the quantity to the quality of strategy use by language learners. The long-held belief of the positive relationship between more strategy use and more successful learning has been questioned, and researchers have come to agree that the number and frequency of strategy use should not be the only indicators of successful learning (e.g., Cohen, 2011; Purpura, 1999; Yamamori, Isoda, Hiromori, & Oxford, 2003). As the mean scores from the pre-test in this study already indicated a medium to high use of metacognitive strategies (Oxford, 1990), it is possible that participants in this study experienced changes in terms of the manner rather than the frequency. For the further investigation of possible qualitative changes, interview results will be presented in the next section.

With regard to learning outcomes measured by the mock TOEIC® test, students gained significant progress in both learning contexts, and the FC did not contribute to a better learning outcome than a non-FC. The results, showing that both the FC and non-FC showed significant gains in academic performance, are consistent with a number of FC studies (e.g., Clark, 2015; Jensen, Kummer, & Godoy, 2015). Adopting a similar design as that of Jensen et al. (2015), in which active learning components (e.g., learners' application of new conceptual understanding) were incorporated in both conditions, this study may have reflected what Jensen and her colleagues asserted: the higher learning gains may be due to the active learning approach rather than the FC implementation. Taken together, at the surface level, student learning in the two conditions showed very similar patterns in terms of metacognitive strategies and academic performance. However, conceptualizing learning as an end-product would fail to tell us what has happened during the course of learning. Instead, understanding students' learning by seeing it as an ongoing process would help researchers examine their learning experience and changes,

which will also assist in the understanding of learners' metacognitive development. Now we turn to the qualitative results and findings of students' metacognitive development.

4.2 Qualitative results

The flipped classroom leads to a more active, deeper use of metacognitive strategies. According to the interview data, classroom activities such as peer discussion and language exercises promoted metacognitive strategy use in both conditions, but an investigation of the manner of strategy use reveals a different story. The self-evaluation strategy was utilized by both cohorts as students had to assess their understanding in order to participate in peer discussion, and it was through these discussions that problems they had been unaware of were often spotted. For example, the following excerpt from Harris (non-FC group) expresses his interest in being involved in peer discussion:

> the benefit (of peer discussion) is that I could learn how others see the main points of an article, which would help me look for what caused the differences between his/her main points and mine. Then I would know how to make modification. (Excerpt 1, Harris, non-FC group, interview 2)

While participants from both classrooms claimed to have benefited from classroom activities described above, only participants in the flipped context mentioned the pressure from classroom activities that led to their more active self-evaluation before class. Lynn (FC group), for instance, would try to memorize word usage and go through a self-assessment process because, she said, "I was worried that you (the instructor) might ask me something about this in class," and Matt (FC group) would manage to keep up with the instructor's pace of teaching in class by giving himself more time to digest the content when watching the video lectures before class. A deeper level of self-evaluation was found among participants in the FC group, showing that classroom activities had led to students' use of metacognitive strategies to make sure of their understanding of video lessons before they came to class.

Another example of the more active use of their metacognitive strategies can be found when comparing students' behavior in the face of knowledge acquisition. When asked about his learning situation in class, Harris (non-FC group) said that for most of the class time, he was there to "Jiēshòu hōngzhà" (literally, to accept bombing), or to accept the tons of new information being delivered by the instructor, and it wasn't until he got home that could he started to digest all the lecture content. Another student from the non-FC group also indicated that at times, the instructor's pace of delivery was too fast, and it was at those times, she said, "I would sometimes zone out a bit" (Sharon, non-FC group). This indicated the possible lack of metacognitive monitoring during the lecture. On the other hand, all the participants from the experimental group explicitly stated a major advantage of video lectures—the luxury of having time to think, compare and synthesize all the information. They used metacognitive strategies not only to monitor whether they were following the course content but also to evaluate existing learning strategy use and to make changes wherever necessary. Doris (FC group) described her use of monitoring strategies while watching video lectures as follows:

> When the teacher is lecturing in class, I can't really think because when the lecture is over, it's over. But I can engage in thinking when I am (watching videos) at home. When I encounter grammatical points that confuse me…I can hit the pause button and think about why. Or I could go back to an article I had read before and make some connections. (Excerpt 2, Doris, FC group, interview 2)

It is found that the FC offers learners conditions where they are more likely to make use of their metacognitive strategies to help them learn. One facilitating condition is the inclusion of classroom activities such as peer discussion. When learners are asked to engage in discussion about grammatical concepts they have learned, they are likely to involve themselves in a self-explanation process, which is regarded "an effective metacognitive strategy that can help learners develop deeper understanding of the material they study" (Ainsworth & Th Loizou, 2003, p 680). Another important feature of the FC is that learners are given the flexibility to process the learning materials at a time and place they find suitable. The luxury of being given time in the face of new knowledge has shown to provide nutrients for the development of metacognition. Indeed, as Hartman and Sternberg (1992) indicate in their model for improving thinking (BACEIS), instructional techniques and classroom environment are factors contributing to students' improvement in cognition and metacognition. Therefore, researchers have been striving to find out the effect of different instructional techniques to improve students' metacognitive awareness and skills, e.g., Palincsar and Brown's (1984) Reciprocal Teaching and Mazur's (1997) Peer Instruction.

5 Flipped classroom facilitates metacognitive awareness

Improvement in participants' metacognitive awareness was manifested in the changes they made to their strategies and how they understood themselves as learners. For instance, in order to deal with classroom activities such as quizzes successfully, Lynn (FC group) examined the suitability of her learning strategies and finally made changes to her grammar learning strategy:

> In the past, I would not take notes of the sample sentences, but now I will write them down because they are more likely to appear in a quiz, and by doing so I will have a deeper impression. (Excerpt 3, Lynn, FC group, interview 2)

Another learner from the FC group also expressed an unexpected change in how she went about learning grammar when asked about her video watching process:

> When I learned grammar before, I was kind of like memorizing rules…and now when I am learning grammar again…some of the rules can be deducted. I found that naturally, after two or three weeks of video lectures, I could discover the grammatical rules that normally I would not have noticed. (Excerpt 4, Anny, FC group, interview 2)

It can be seen that these changes were made to accommodate their learning to the FC environment, either for classroom activities or pre-class video lessons. Apart from strategy modification, the participant's self-awareness seemed to have undergone some modifications among those in the FC group. In the first interview, for example, when Anny recalled her English learning experience in the previous semester and assessed if she had found any difference in her English ability, she said:

> I don't have too much feeling about it because for the exercises (at the back of the textbook) I did, I did not check answers or receive correction, nor did I encounter them in any exams, so I have no idea whether I made any progress. (Excerpt 5, Anny, FC group, Interview 1)

In the second interview, however, she appeared to be clearer about her English learning situation after participating in a TOEIC® mock test held by the school:

> The scores I got were the same as (my scores on) the official test I took during the summer break. However, I thought to myself that I should have learned something from the English courses, so I started to think about why…maybe because I learned a lot about detecting my own problem and about how to improve English, but not other things. (Excerpt 6, Anny, FC group, Interview 2)

Participants from the non-FC group, on the other hand, remained unclear about their own English level, claiming that they wouldn't assess their strengths or weaknesses in English, nor were they able to evaluate their English clearly. For example, Sharon (non-FC group) said, "My classmates told me that, judging from my oral performance, my English was not too bad. But I just don't know why my test scores are not good. We all wonder why."

It should be noted that when comparing the two interviews, participants who had a clear perception of their English ability at the beginning of the semester remained clear throughout the semester, irrespective of the group. Changes in self-awareness were only found among participants who had initially been unsure about their English ability in the FC group, but no increase in self-awareness was found in the other group.

The results lend support to previous studies on the FC and learner awareness (Lai & Hwang, 2016; Strayer, 2012; Sun, Wu, & Lee, 2017) and confirm the facilitative role of the FC in helping students develop a higher awareness of strategy use and of themselves as learners. A quantitative study conducted by Lai and Hwang (2016) showed that when incorporating self-regulation instruction into the FC, learners' awareness of task strategies and self-evaluation outperformed that of their counterparts in the conventional non-FC class. They concluded that their self-regulated FC approach engaged their students in "empowering their self-observation, ascertaining the learning strategies they applied, and being personally aware of their effective learning" (p. 139). Sun and his colleagues (2017) reported FC students' were highly aware of the need to seek external help. A critical component in metacognition, metacognitive awareness, helps learners monitor their learning and performance so that they can adjust their learning time and strategies accordingly. Without such metacognitive awareness, learners are likely to have poor judgement of their own learning and remain "unskilled but unaware" (Kruger & Dunning, 1999). Raising metacognitive awareness gives learners more control over their thinking and learning process and thereby improves their performance (Hartman, 2001).

6. Conclusion

The objective of higher education is not just about producing employable graduates, but also equipping students with transferrable skills that are necessary for life-long learning. It is the concern of almost every teacher to find out what leads to more successful learning as innate abilities such as IQ are less likely to change. Metacognition seems a promising concept. Schraw (1998) posits that "metacognitive knowledge contributes to successful problem solving over and above the contribution of IQ and task-relevant strategies" (p. 117). This study therefore intends to find out whether the flipped classroom facilitates metacognitive development in a different way from a non-flipped classroom. The results show that the frequency of metacognitive strategy use did not increase after FC instruction and that both the FC and the non-FC course design led to academic gains with no significant difference between the two conditions. However, qualitative analysis of the interview data confirms the conducive role the FC plays in terms of metacognitive development. On the one hand, the FC encourages a more active use of metacognitive strategies to help learners monitor and evaluate their learning process and product. On the other hand, participants' awareness of themselves as learners and

their awareness of their strategy use were raised in the FC context.

Several limitations of this study should be reported here. First of all, past studies have addressed the importance of student readiness for e-learning for the successful implementation of the FC model and that helping students with more preparation on how to engage in FC instruction would help their learning (Hao, 2016; Yilmaz, 2017). However, constraints on time and manpower made it impossible for the researchers to monitor student engagement inside and outside class in the current study. Therefore, to what degree the participants were involved in FC remains unclear. Future studies, time permitting, will incorporate a learning log (Lai & Hwang, 2016) or asynchronous discussion using social media (Lin & Hwang, 2018) to ensure student participation. Another limitation of this study comes from the length of instruction. Being a one-semester course, the FC instruction lasted for only 18 weeks so whether the effect of the FC continues to facilitate learners' metacognitive development is unknown. As mentioned above, metacognitive knowledge, despite being task-specific initially, can be applied to other areas of learning (Schraw, 1998). It would provide more insight into flipped instruction if longitudinal research on the effect of the FC could be implemented.

In this study, flipped classroom instruction is reported to facilitate the development of metacognition through student empowerment and student-centered course design. However, more work is needed to provide evidence-based research on the relationship between the flipped classroom and metacognition.

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Appendix 1

Metacognitive strategy items from SILL, Chinese version

1. 當別人說英語時，我會特別留意聽。

2. 我試著找出如何學好英語的方法。

3. 我會考量自己學習英語的進展。

4. 我會留意自己的英語錯誤，並利用它來改進。

5. 我會找各種方式運用我所學的英文。

6. 我會尋覓時機多閱讀英文。

7. 我會留心尋訪可以用英語交談的對象。

8. 我會訂立作息表，好讓自己有足夠的時間研習英語。

Appendix 2

Independent sample t-test for pre- and post-test of metacognitive strategies and TOEIC® mock test

Table 4. Independent sample t-test for metacognitive strategy pre-test

		Levene's Test of equality of Variance		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Meta_pre	Equal variance assumed	2.402	.124	-3.629	101	.000	-.37885	.10440	-.58596	-.17175
	Equal variance not assumed			-3.595	93.238	.001	-.37885	.10539	-.58813	-.16958

Table 5. Independent sample t-test for TOEIC® mock test pre-test

		Levene's Test of equality of Variance		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
TOEIC _pre	Equal variance assumed	.026	.871	-.442	101	.659	-.989	2.238	-5.430	3.451
	Equal variance not assumed			-.441	98.547	.660	-.989	2.245	-5.444	3.466

Table 8. Independent sample t-test for metacognitive strategy post-test

		Levene's Test of equality of Variance		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Meta _post	Equal variance assumed	.686	.410	-2.525	101	.013	-.27202	.10773	-.48573	-.05832
	Equal variance not assumed			-2.501	92.899	.014	-.27202	.10878	-.48805	-.05600

Table 9. Independent sample t-test for TOEIC® mock test post-test

		Levene's Test of equality of Variance		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
TOEIC _post	Equal variance assumed	.053	.818	-.076	101	.940	-.167	2.197	-4.526	4.19
	Equal variance not assumed			-.076	98.885	.940	-.167	2.203	-4.537	4.20